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Science and Technology for Development

Technology Behaviour of Industrial Enterprises

STPI Module 11

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Science and Technology
for Development

STPI MODULE 11: TECHNOLOGY BEHAVIOUR OF
INDUSTRIAL ENTERPRISES

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FOREWORD

This module constitutes an integral part of the Main Comparative Report of the Science and Technology Policy Instruments (STPI) project, a large research effort that examines the design and implementation of science and technology policies in 10 developing countries (Appendixes 1 and 2).

The STPI project generated a large number of reports, essays, and monographs covering a great variety of themes in science and technology for development. More than 250 documents were produced by the country teams and the Field Coordinator's Office, and this proliferation posed rather difficult problems during the comparative phase of the project. It was decided that a Main Comparative Report, covering the substantive aspects of the research work of the country teams would be published, and that several monographs treating specific subjects would complement it.

The Main Comparative Report is organized in three parts. The first consists of a short essay covering the main policy and research issues identified through the research, and the second contains the most relevant results of a comparative nature that were obtained in the project. These first two parts have been published by the International Development Research Centre in a single volume in English, Spanish, and French (109e, 109s, and 109f).

The third part of the Main Comparative Report consists of 12 modules containing material selected from the many reports produced during the STPI project. They provide the supporting material for the findings described and the assertions made in the first two parts of the Main Comparative Report.

The modules were prepared by several consultants, and given the diversity of topics covered, the IDRC staff did not consider it desirable nor possible to impose a single format or structure for their preparation. The reader will find a diversity of styles and structures in the modules and will find that the selection of texts reflects the views of the consultant who compiled the module. However, the modules were prepared in close collaboration with the Field Coordinator and were also submitted to a STPI editorial committee who ensured that they provided a representative sample of STPI material. They should be read in conjunction with the first two parts of the Main Comparative Report.

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INTRODUCTION

The studies presented in this module focus on the technological behaviour of enterprises in selected industrial branches, analyzing the characteristics of change and assessing the relative importance of the various factors that affect them. They represent the intermediate level of aggregation in the STPI case studies on technical change, and in some cases they refer to specific, very large, state enterprises.

There is a great variety among the studies included in this module. The two Colombian studies refer to agricultural implements and fertilizers; the two Argentinian studies deal with state enterprises in the gas and electricity generation fields; the two Brazilian studies also deal with state enterprises, but in the electric power and flat steel products industries; the Venezuelan report covers the technological behaviour of mixed enterprises in the petrochemical industry; and the last study in the module refers to the contribution of transnational corporations to the technological development of Mexican industry.

COLOMBIA

AGRICULTURAL IMPLEMENTS

This study attempts to characterize the technological behaviour of enterprises in terms of four analytical dimensions:

- type of technology
- structural characteristics of the branch
- type and strategy of firms
- relative sensitivity to different policy instruments.

It is not intended to present an in-depth investigation of the agricultural implements branch. Rather, this branch will be dealt with as a suitable example of an industrial activity centred around product technology.

Type of Technology

The vital or core technological know-how is basically related to the know-how of product design and specifications. Thus, the technology is to a large extent embodied in the final product (agricultural implements). As a consequence of this, the technological know-how may be disaggregated by copying the characteristics and specifications of the product. This is the case when technology is either freely available or easily obtainable. It is difficult to appropriate and protect this type of technological knowledge.

Structural Characteristics of the Branch

The main structural characteristics of the branch are as follows:

Structure of Production: The structure of production of the branch is not highly concentrated. As a consequence, enterprises of all sizes may be found. Medium- and small-size enterprises may play an important role.

Obstacles to Entry into the Branch: There are no restrictions with respect to investment requirements: investment in plant and equipment is not large (small enterprises can be created).

There are no restrictions with respect to the availability of disembodied technology: it is freely available or may be copied.

There are no restrictions with respect to the availability of raw materials with special technological know-how incorporated. Nevertheless, the availability and adequate supply of raw materials in the branch may limit the development of the smaller firms.

Source of Capital and Investment in the Branch: Since investment requirements are not significant, practically any type of financing or investment may appear. But in general, foreign and public investment is not stimulated or required in this branch, because the investment amounts are not exceptionally high. There is a very important role for national, private investment.

Structure of the Suppliers' Market: The structure of the suppliers' market may vary widely, but this factor does not have a significant influence on this type of branch.

Structure of the Product Market: The product market is characterized by a high degree of competition.

The national markets are relatively small, but technological scaling-down has been accomplished successfully.

Customers (buyers) are dispersed and atomized, with a highly diversified demand.

As a consequence of the preceding characteristic, the marketing and distribution mechanisms and networks play an important role. In durable consumer goods (also characterized by product technologies), the availability of credit for this distribution is important. Marketing agents may play a significant role in technical assistance.

The product market is basically a national one, but export-oriented efforts try to expand the international market.

R&D Activities and Technical Assistance: Important roles are played by technical support activities: quality control, search for information, and technical assistance.

There are very good possibilities of integrating the branch as a system, through the support activities mentioned in the preceding point. R&D as such is not important in this type of branch.

Characteristics of the Enterprises

Enterprises of different sizes coexist. Enterprise size seems to be an important intervention variable, because it makes enterprises more sensitive to problems of cost-reduction and to policy instruments that are effective when the investment is high.

Although the ownership pattern may vary widely, there is a strong tendency for enterprises to be in the hands of national, private investors.

Firm Strategy and Technological Behaviour

Firm Strategy: Firm strategy consists of competition in the market through product diversification. This places great emphasis on product engineering and design. In larger enterprises, cost-reduction considerations may start to become important.

Technological Behaviour: The mechanisms related to technology transfer or commercialization (i.e., licences and patents) have very little or no importance, because technological know-how is freely available and cannot be easily appropriated. Thus, in the production of agricultural implements in Colombia, no licencing agreements have been signed recently. The few that were signed some years ago are being used only for commercial purposes (use of a trademark).

Engineering and design (with respect to product) seems to be the outstanding technological problem of this branch. A capacity for "reverse engineering" and for being able to copy foreign products successfully becomes crucial at the level of the enterprise.

Similarly, a strong "copy chain" is established among enterprises within the country. A technological innovation introduced by one enterprise is very rapidly copied or adopted by others.

R&D has very little or no importance in this type of branch (given the type of technology).

Normalization and quality control may play an outstanding role, especially to control the quality of the products that are copied.

Technological information is highly important, especially because of its nature of being freely available.

In this type of branch, contact with the clients becomes important. Through technical assistance to clients, information on the actual demands and requirements is collected. This contributes to either the design of new products or the modifications of old ones. Distributors can play an important role with respect to this activity.

N.B.: Many of these elements of the technological behaviour of enterprises in this branch are directly related to the type of technology that is dominant in it.

Relative Sensitivity to Different Policy Instruments

The influence of policy instruments is basically mediated through the structure of costs of the enterprise and the market in which it is located. In the case of product technology branches, the influence of the main policy instruments is as follows:

Credit Policy Instruments (Promotional Credit)

Credit for production: There is little sensitivity to these credit mechanisms (i.e., credit for the purchase of capital goods), because the enterprises in this category have relatively little investment in fixed assets (due to their structure of costs). For the larger enterprises these mechanisms could have somewhat more importance.

Credit for commercialization of products and working capital: Enterprises in this category are very sensitive to this policy instrument, because of their need to finance the commercialization and distribution of their products. In product technology branches this is an important requirement because of the complex nature of the distribution process (this is not the case in other types of branches).

Fiscal Policy Instruments: Fiscal policy instruments basically refer to tax holidays or tax exemptions for capital goods as well as depreciation rates of capital goods for tax purposes. In product technology branches, enterprises react very little to this type of policy instrument for two reasons: the low total level of investment that characterizes these branches; and the relatively low importance of fixed assets (equipment, etc.) in the structure of costs of these enterprises.

Foreign Trade Policy Instruments: There is great sensitivity to protectionist measures (i.e., tariffs), because they operate directly on the market (create a protected market). The possible negative technological effects of protectionism (i.e., inefficiencies and low productivity) are apparently avoided by the high degree of competition existing in this market.

There is great sensitivity to export-promotion instruments, because they open foreign markets (diminishing problems of small internal markets) and they frequently also have financial implications.

Policy Instruments with Respect to Control of Prices: These instruments are practically inapplicable, because the enterprise can easily diversify products to avoid price controls (this is very closely related to the type of technology dominant in the branch and to the firm's strategy).

COLOMBIA

THE FERTILIZER INDUSTRY

The approach and methodology of this study follows closely that adopted in the preceding study on agricultural implements.

Type of Technology

The vital or core technological know-how is incorporated into the plant (plant

lay-out) and the equipment (capital goods) that are used. This includes the basic engineering that is integrated into the plant lay-out, as well as the technology that is embodied in machinery and equipment. Because of the importance of the plant and the equipment in this type of technology, enterprises require large investments and have a structure of costs in which depreciation of fixed assets is very important.

In general, the type of product manufactured with plant and equipment technology often is very homogeneous, with very rigid specifications as well as norms and standards.

Structural Characteristics of the Branch

The main structural characteristics of the branch are as follows:

Structure of Production: The structure of production of the branch is highly concentrated. Large enterprises are found in these branches.

Obstacles to Entry into the Branch: There are important restrictions with respect to entry into the branch because of high investment requirements in plant and equipment (as a consequence of the type of technology).

There are no significant restrictions with respect to the availability of disembodied technology. Patents protect some basic processes or modifications, but these processes are often incorporated into the equipment, and payment is made for them when the equipment is purchased; no later payments are required.

Source of Capital and Investment in the Branch: Because of the high investment requirements in plant and equipment, both foreign and state investment or capital play an important role. Although foreign investment may be significant in this branch, it is not necessarily dominant.

Structure of the Suppliers' Market: There are normally very few and concentrated suppliers of equipment. These suppliers generally take care of the whole project in setting up a plant: they supply investment funds, engineering, equipment, plant construction and start-up, etc.

With respect to other production inputs, situations vary widely, but they do not appear to have a significant influence.

Structure of the Product Market: Enterprises in this type of branch are generally in an oligopolistic or monopolistic situation, with high concentration and little competition.

Sometimes the minimum scale of production of known technologies in these branches (in industrialized countries) goes beyond the size of the national markets. Some technological process innovations have been accomplished in the attempt to adapt technology to the size of the market.

Since the product manufactured in this type of branch generally has very rigid specifications as well as norms and standards, there is very little or no possibility of product diversification. There is rigidity with respect to the final product.

The commercialization or distribution network is very simple, and quite often it is in the hands of other organizations (the product is sold at the "factory gate").

R&D Activities and Technical Assistance in the Branch: There is an important initial demand for engineering and capital goods, but this is often more oriented toward the development of captive in-shop technological capacities that do not contribute to the functioning of the branch as a system.

Permanent high importance is given to activities related to maintenance, troubleshooting, and repair.

Characteristics of the Enterprises

Generally only large enterprises are found in plant and equipment technology branches.

Because of the magnitude of the investment required in plant and equipment, state or government investment generally plays a very important role. Foreign investment is

quite frequent.

Firm Strategy and Technological Behaviour

Firm Strategy: Competition in the market is basically sought through cost-reduction. Given the rigidities of the final product, product diversification is practically nonexistent.

Technological Behaviour: Technological innovations mainly take the form of modifications in the production process to reduce costs.

These enterprises generate an important initial demand for capital goods and for engineering.

Because of the importance of plant and equipment (fixed assets) in its structure of costs, maintenance and repair activities or functions become highly important for the enterprise.

Since the vital or core technological know-how is incorporated into the plant and the equipment, a learning process is possible by which the persons who operate the plant really come to master that technology (this has happened in the production of fertilizers in Colombia).

The mechanisms related to technology transfer and commercialization (i.e., licences and patents) have very little or no importance in this type of branch. Patents are already incorporated into the equipment.

Relative Sensitivity to Different Policy Instruments

Credit Policy Instruments: There is very high sensitivity to credit for production (promotional credit) because of substantial investments in fixed assets.

There is much less sensitivity to credit for commercialization of products because the commercialization of products is quite elementary or is under the responsibility of other organizations.

Fiscal Policy Instruments: There is great sensitivity to tax exemptions and depreciation rates, because of the high level of the investment and because of its concentration on fixed assets.

Foreign Trade Policy Instruments: Protectionist measures (i.e., tariffs) sometimes play an important role in the development of the markets, especially in those cases where the scale of production is larger than the national market. There is great sensitivity to export-promotion instruments, since this allows a greater utilization of the enterprise's installed capacity and gives a better margin for the absorption of fixed costs. In this type of branch, the process of dumping certain products in the international market can be observed.

Policy Instruments with Respect to Control of Prices: There is high sensitivity to this policy instrument because the rigidities with respect to the final product (specifications and norms) makes very difficult, or does not allow at all, product diversification to avoid control of prices.

ARGENTINA

REMARKS ON THE TECHNOLOGICAL BEHAVIOUR OF GAS DEL ESTADO

Gas del Estado has been growing constantly and regularly during the last few decades. This expansion, together with the fact that the installations are very simple, has meant that Gas del Estado has acquired considerable technical capabilities in laying networks and gas pipelines. The company is also technically capable of installing compressors and turbines, and it dominates all the basic processes involved in the exploitation, processing, and transportation of gas. This has allowed Gas del Estado to take the initiative, and to select and discriminate when dealing with suppliers.

There are certain factors that impose some constraints on the development of a technical capacity in the enterprise, which arise out of the nature of the technology it uses and of the priority assigned by the firm to technological matters. The nature of engineering needs, which include designing and locating the gas pipelines and designing the compression plants, puts an upper limit on the kind of technological activity to be performed. Other needs originate from the company's normal functioning and they include tasks that are extremely important from the commercial point of view, such as measuring and instrumentation, a laboratory specialized in analyzing gas, materials, testing quality control, and setting standards for approving gas-using appliances. All have very precise technological needs and can become focal points from which technological capacities can spread to suppliers and manufacturers.

However, the company does not have experience in laying underwater gas pipelines or in building ethane plants, and it has had to resort to foreign engineering for this. These new fields are technical challenges for Gas del Estado.

In Gas del Estado, macroeconomic and fiscal aspects carry most weight, and the emphasis is alternated between the demands of investments required to expand the supply of gas and the redistribution effect that is associated with keeping tariffs low.

Each of these alternatives involves a different concept of the functions of Gas del Estado; although for both of them technology is a secondary consideration. The problem to be resolved is how to reconcile a policy of expanding services based on regular and programmed investments with a tariff policy that will make the tariffs serve social and economic policies, at the same time using the enterprise as a vehicle for accumulating technology at the national level.

Gas del Estado presents an interesting case for analyzing these conflicts. The policies that attempted to minimize the impact of both residential and industrial tariffs by offering cheap fuel oil contributed to reducing the company's capacity to finance itself and delayed its investment plans. This policy had a double effect: the enterprise had to resort to more foreign financing, with the tied supply of equipment and technology, and at the same time it postponed laying new networks to take gas to new population areas.

When policies tend to increase the company's investment capacity, tariffs are usually raised so that the profits will be in line with what the international financing bodies consider acceptable. But doing this implies shortening the time taken to complete the project, paying more attention to the reliability of the project, and eliminating the burden resulting from eventual interference by the state. For these three reasons the enterprise will be inclined to resort to foreign engineering and turn-key contracts, and cannot use its accumulated technological capacity.

Furthermore, financial stabilizing policies put into effect by the government tend to lower the real value of salaries, to reduce deficits, and even to reduce personnel. Although it has not been possible to get precise statistics on the reasons why people leave the company, interviews indicate that the low salaries cause the younger employees, who are potential professionals, to leave and go into the private sector. As a result the training given by Gas del Estado is an investment that benefits other enterprises in the private sector.

In this light it is necessary to examine whether it is possible to use state enterprises as instruments of technology policy. The conventional approaches underline the possible - and desirable - link between state policies, demands of the productive sector, and the supply of know-how and technology. In this link the state enterprise can play the key role of joining the local supply of, and the demand for, technology. However, Gas del Estado does not play this role, because it has not been considered one of its objectives, management does not award importance to it, and probably the enterprise could not fulfill this role on a continuous basis.

Therefore, the conflict centres around the role assigned to Gas del Estado and around the way it fits in with the government's economic policies. The basic question to be answered refers the enterprise's contribution to these policies, for technology is subordinated to this contribution, even though it obeys both the enterprise's own dynamics - its growth pattern and its operational demands - and the conditions imposed by government policies at a higher level. The first point refers to the growth of internal technical capacities, while the second is related to the fact that Gas del Estado is a state enterprise that also has social functions.

ARGENTINA

REMARKS ON THE TECHNOLOGICAL BEHAVIOUR OF SERVICIOS ELECTRICOS DEL GRAN BUENOS AIRES (SEGBA)

This analysis will attempt to describe the relationships existing between the decisions taken outside SEGBA, the needs resulting from the increased demand for energy, the available alternatives for financing the company's expansion, and the technical training needed when the company becomes more complex and needed as a result of the stimulus given by legislation that aims to persuade the state to purchase from local suppliers.

These relationships mutually influence each other. The technological capacity develops with a certain logic, but in no way is it imposed upon the events and the decisions adopted. It is logical because as the company aims at certain goals, it will develop in a certain way because its function is to generate, transmit, and distribute electric energy and it must create planning and management-control mechanisms, technical services, and units to attend to the suppliers' market if it is to operate efficiently.

The way in which the company develops can differ depending on how it is subordinated to electricity development plans outside its control, on how its activities and the expansion are financed, on the decisions dealing with the participation of its technical groups in engineering, research, and development, and on the alternatives offered by the political and economic environment the company operates in.

Therefore, the analysis should begin by identifying the objectives SEGBA has had since it was founded. Some aspects incorporated into the concession documents have been discussed at length, especially those that might be relevant to implementing or not some recommendations made by the commission that participated in the discussion on whether the SEGBA shares in private hands should be purchased or whether the company should become totally private.

When SEGBA was created, the demand was dissatisfied, and there was the problem of occasionally dissatisfied demand because of low voltages, rationing, and frequent power cuts. But these problems in supply were not the only ones that existed. The debate revolved around what the national government's policy should be toward the concessionary companies. The Comisión Nacional de Energía Eléctrica recommended that the 1933 concession should not be renewed and that they should return to the terms of the original of 1907. To a certain extent the companies anticipated this decision, and this explains their policy of not investing during the period and the political process that occurred because of them.

In short, SEGBA became the focal point in solving the problem of electric power strangulation in Greater Buenos Aires. In 1961, the company became completely state owned and all the water and electric power installations in the northeast of the concessionary area and the Central Costanera works, which at that time were the largest industrial complexes of their kind in South America, were transferred to SEGBA. Thus, its basic objective is to increase its generating, transmission, and distribution capacity. The new state company is structured like the typical model of foreign companies providing public services. It had to tackle an enormous job that demanded very significant qualitative internal changes. The company, which had made no investments for decades, had to carry out an ambitious expansion plan. It went from being a mere branch of a gigantic international consortium to being an integral part of a public policy scheme that plans to integrate it later into an interconnected system. To do all this the company had to set up technical services, develop relations with suppliers, contract advisers, and search for financing. In other words it had to start doing the same functions all companies do. Because its strategies were previously decided abroad, its projects were worked out by technical units in the head office and the purchases followed SOFINA's worldwide policies.

This objective should be seen within the evolution of the Argentinian economy as a whole. This will help to explain many of the decisions that have determined the character of the public companies, and in particular, their policies and the problems they face. In Argentina in the 1950s a process that would be clearly seen in later years developed. It was then that the growing substitution process caused industrial promotion

policies to be adopted, which encouraged industries producing intermediate goods and consumer durables, especially in manufacturing means of transport, metal machines, and chemical and petrochemical products. These companies tended to be foreign owned and helped to create a new, more complex and concentrated industrial structure in which the productivity of these activities decreased depending on the technologies used.

With this situation an economic infrastructure was indispensable if the growth rate was to be maintained within an explicitly adopted model. Thus, public investment was crucial aspect of the policies of the period, and the state companies began to receive much more specific demands than during the previous periods. Reliable services, increased production, and a tariff policy that was an instrument used to promote certain activities and companies, became the number one concerns of the policymaking organizations.

This model, which was applied during most of SEGBA's existence, needed some elements that had not existed. One basic element of this model is the capacity to foresee the risks or unexpected events that might arise as the company develops, because the size of the investment and its long maturity periods make it essential to have many guarantees. Thus, planning is a structural prerequisite of this model.

The fact that the companies did not have study and planning groups who worked in coordination with their counterparts in the central entities, and the weakness of these entities, contributed to the lack of energy planning.

After 1955 the installed capacity developed relatively independently of the cyclical variations in the economy and at a faster rate than the demand. Therefore, the service could be expanded even though consumer needs were not completely satisfied. At the same time, the makeup of the installed capacity was gradually changed and renewed. This serves to illustrate two mechanisms that were operating simultaneously: the policy's goals, which were coherent with the growing demands of an economy like Argentina's; and the absence of planning, which was strictly formulated and implemented. In other words, a line of development can be defined, even though it was under enormous short-term pressures and delays, and sometimes had to face reverses.

Within this national framework, the demand of the industrial sector for SEGBA's services has grown more rapidly. Whereas 37.1% of the consumption in 1958 was residential, this percentage dropped to 36.2% in 1974, although it should be pointed out that between 1962 and 1970 it was over 40% and reached a record figure of 48.2% in 1965. On the other hand, industrial consumption grew from 32.5% to 40%. After reaching a low point of 24.7% in 1963, it has been growing ever since.

The figures help to prove the hypothesis that there is a link between the growth of the electric power sector, SEGBA's role, and the main policies during the period, which favoured a certain type of growth model for the national productive structure.

Everything presented so far helps to illustrate the factors that determined SEGBA's growth. The energy situation was incompatible with the demands of the country's growing economic structure, which was based on import substitution and on the development of intermediate and finished consumer durables using capital-intensive technologies, with a high degree of concentration and predominantly transnational. This made the successive governments give high priority to regularizing the supply and increasing it so it could satisfy the future demand. Although the programs put more emphasis on hydroelectric plants, they are so costly to finance and the maturity periods are so long that thermic plants were still built. SEGBA played an important role in this scheme. Its generating capacity grew from 2.806 Gwh in 1958 to 6.924 Gwh, an increase of 147%, and the power billed grew from 3.135 Gwh to 8.003 Gwh, an increase of 155%.

SEGBA made very important investments during the period. They reached \$275 million between 1962 and 1964. The revenues SEGBA earned from the users were not enough to finance these investments, so the company had to resort to outside, either domestic or foreign, financing.

With these results, other conclusions can be reached. These conclusions are:

(1) The growth in the public company's technological capacity is associated with how its activities develop. In turn, these activities play the role they are assigned within the chosen development model. If the company does not grow, it is impossible to increase its technological capacity. Furthermore, the decision to expand, by itself, is not enough to increase this technological capacity even though the mechanisms that could be used to enlarge this capacity have to be created as the company becomes more complex.

If the company becomes more complex and these services and mechanisms are not created, it could endanger the future operation of the company or its capability of fulfilling the role it ought to play within the development model.

(2) An important element if the technological capacity is to be developed is that the company must be sure that it can face the fundamental variables for its expansion and functioning. This aspect is associated with the possibility of long-term planning and of implementing the goals; for this the characteristics of the political environment in which it develops and the national control over the most relevant economic transactions must be considered.

(3) When the public companies can count on continual planning to provide the guidelines for their action, they can program their expansion in accordance with the set goals and the available resources. These two aspects can change, with harmful results for this capacity, as it might cause delays in the execution of the projects or decisions might be taken to overcome the emergencies but which will subordinate technological considerations.

(4) For this planning the activities of the different companies in the sector must be compatible with and subordinated to the patterns laid down by the national policies. All the efforts made to make the planning systems more efficient will contribute toward technological development as long as this is one of the objectives.

(5) As long as foreign financing does not make conditions as to how the money should be used, it can help to reduce the company's financial uncertainty and give it more freedom in choosing technologies. Because this financing is very expensive, it may be advisable to create internal mechanisms with characteristics that are similar to the loans.

The World Bank loans play a fundamental role. A third of the investment mentioned above is financed with funds from the Bank. When a second loan was delayed, the plan of work was set back.

There was a shortage of funds during the 1965-67 period. To overcome this situation, the company reverted to contributions from the Ministry of Finance and other national bodies, and to increasing the tariffs. On account of the large devaluations, its debts increased in terms of pesos, so it became more indebted to official banking entities. As a consequence, investments decreased considerably and the company's plans had to be delayed.

The 1967-70 plan was again partially financed by the World Bank (40%). Guaranteed financing, the positive results of the tariff policy adopted, and relative stability in the prices of equipment and inputs all helped to make the company operate without sudden fluctuations. Nevertheless, decisions taken outside the company meant that the plans had to be modified, and this was repeated in the case of the 1970-72 plan. Important investments were made during both these periods, but the company also had heavy debts. Some conclusions can be reached from all this:

(1) The company is dependent on financing to carry out its plans. As a result, its operations have oscillated and it cannot finance itself. Therefore it had to resort to foreign credit or state contributions or internal indebtedness.

(2) Foreign credits depend on alternatives that are sometimes outside the company's control. The international credit organizations make certain conditions about tariff policies, which means that the company has to raise its tariffs above the level set by the national policy. Furthermore, it has to accept the conditions on how the executive vice-president is nominated and on certain operational methods.

(3) However, once the financing has been obtained from this source, it guarantees that the work can be carried out and within the stipulated period.

(4) Its own financing and domestic financing have provided an important source of funds for the expansion of SEGBA, although they are never reliable or stable; and this instability has obviously affected the planning, execution, and cost of the expansion.

(5) These problems caused by the lack of its own financing and domestic financing are not peculiar to SEGBA. They affect all the state-owned electric power companies, and this has indirect results for SEGBA. Because of the scarcity of funds, these companies finish their projects late so that SEGBA has to make investments that are not

compatible with the best possible generating expansion policy. This is why the gas turbines were installed.

(6) The alternative sources of financing influence which aspects of the plans will be speeded up and which will be put off. As there was a shortage of electric power in the concession area and the generation projects that should have fed SEGBA through the transmission interconnections were delayed, SEGBA had to give preference to its own generating projects over those for transmission and distribution whenever it had financial problems. This is why the World Bank loans play such an important role. They almost completely finance these projects and local industry can make significant contributions to them too.

(7) Generating capacity can be expanded regularly using suppliers' credit. Nevertheless, Argentina has had periods when the balance of payments was negative and there were consequent devaluations; as the debts increase in terms of pesos, this creates pressures when accompanied by increases in the cost of equipment, inputs, and labour. As these increases tend to occur before tariff increases, the company has to resort to additional credits. This cycle means that the projects get done more slowly.

(8) This situation regarding the funds has internal operative consequences. It has already been pointed out that SEGBA did not have long-term plans it regularly carried out. But this does not mean that SEGBA did not have specialized structures or no plans at all. On the contrary, SEGBA created these units and they reached a high technical level, but the plans are subject to the company's financial possibilities, to other companies completing their projects, to the national government's decisions, and to the unpredictable economic cycles. As far as the government's decisions are concerned, the Energy Secretary changed his position on certain projects, and as a result, SEGBA had to change the plans of one project and the growth of another. Finally, the unpredictable cyclical variations in the economy have indirect results. The financing problems and the changes in costs also plague SEGBA's suppliers, which often means that the delivery dates are extended and consequently the completion date of the project is also delayed.

(9) The tariff policy plays an influential role in financing and in the rate of expansion. If the average tariff values are deflated using the price index implied in the ratio of the gross domestic product to the cost of factors (this is an arbitrary index but useful for an approximation), it shows that the evolution follows a definite pattern. In the first place, an effort was made to raise tariffs up to 1964, when they dropped sharply. Later they recuperated, reaching the same value as before that year, then they stabilized in 1966, 1967, and 1968, and then dropped again. Undoubtedly, the larger equipment installed and the more extensive connections could have lowered the production and distribution costs, but the coincidence between these variations, the company's results, and the rate at which the work was done should be noted.

(10) There are other aspects of the tariff evolution, especially in the public company's role within the growth model based on expanding industries producing intermediate and durable consumer goods with strong government support for the private sector. Since 1958 the industrial tariffs had been increasing in relative terms compared with the residential tariffs, but this trend started to be reversed in 1964, and after 1967 the industrial tariffs were lower than the residential ones. After 1973, there was a return to the original relationship, with a relative decline in domestic consumption. So there is a type of interchange "subsidy" of the consumers, first favouring the industries and then favouring the families.

As a result of the policy decision to encourage electric power generating, transmission, and distribution projects and the possibility of resorting to financing, although this was sometimes not very sure, the rate of expansion was very fast and a technological capacity was developed in SEGBA, which was manifest in different ways. They are: the technical, economic, and financial planning and programming, the engineering, the setting up of a research and development service, and the increasing amount of equipment and inputs that were supplied locally.

Different mechanisms operate in each of these aspects. Nevertheless, there are certain links between the advances produced, and an attempt will be made to analyze them. Sometimes, with the growing complexity of the company, specialized units must be established to meet the demands of expansion and to administer the projects and loans. In other cases, national legislation will quicken the reorientation of the purchasing power. Finally, when the company has personnel capable of doing increasingly demanding tasks, the training received during the expansion and the stimulus given to innovating behaviour

means that it is more likely that a technological capacity will be developed. Some of these achievements demand great efforts if they are to last, and this will be analyzed too.

As SEGBA had to expand fast and it was beginning as a state company, it had to create the services that previously had been done in the head office in Belgium. Already in 1958, when CADE was enlarging the Central Puerto Nuevo, it had to create a special group to be in charge of the installation. In this way some Argentinian experts were trained by having to help make plans and solve problems that could not be made and solved in Belgium.

Later many of the members of this small group joined the unit created in 1962 and depended on the Technical Management. Very soon it was put in direct contact with the executive vice-president. Finally, in 1968, it was granted the rank of Management Group.

The activities of this group were increasingly complex. In the first place, it was in charge of the negotiations started with the World Bank a year and a half before, and it is also in charge of projecting future demand, working out the necessary expansions in the networks and preparing the projects for foreign financing. As the government sectoral planning units are not developed, they make 3- and 5-year plans.

In 1966-67, it began to do the economic and financial planning. There are various hypotheses that could be used to explain this new function. These include the giddy growth that occurred and that was foreseen, the administrative requirements of the World Bank loans (they had to be rigorously controlled and they needed very precise information), and the adoption of an internal financial policy that would bring benefits in later years and that set the tariffs according to the type of consumption.

In 1970, the Management Group took over the functions of management control and systems development. In both, it had to rationalize the procedures, provide information for the management level and the company operation, and increase efficiency in the operations and in implementing work projects. Management control is connected to the budget and it formed part of a system that they hoped to create at that time. This system would be made up of a board nominated by the President of the Republic, the National Development Council, and the respective sectoral office in the Energy Secretariat.

This gradual development goes hand in hand with the growing complexity of the company and it resulted in a continual training process. If the company continues to expand, even if only in the areas of transmitting and distributing (which is not the case at present as the No. 7 unit in the Central Costanera has begun to be installed), these planning, management control, and programming activities should remain at their present levels. If the opposite occurs, operations would be less efficient, there would be more problems in implementing projects, costs would increase, and there would be unforeseen problems that would affect the quality and continuity of the service.

As has already been said, the engineering was done in Belgium while the company belonged to SOFINA. Later, foreign advisers played a decreasing role in designing and installing the plants of unit No. 6, which was done completely by SEGBA personnel.

As the SEGBA personnel became more trained, the foreign advisers were needed less and less. Local experts made an important contribution to unit No. 9 at Puerto Nuevo, and the company has also shown its improved capacity in transmission and distribution. Already in 1962 there was an important discussion about the design for the transmission lines. SOFRELEC was asked to produce a technical report on the design and it suggested a solution that was similar to the one SEGBA proposed.

Nevertheless, some of the aspects related to designing technical training policies should be mentioned. To do this, SEGBA's participation in large projects, especially generating projects, must first be described.

When unit No. 6 was installed, a team that would be in charge of three aspects was created: installation engineering, equipment, coordination and services. The first includes designing installation plans: (1) civil service, which was all done by SEGBA except for some very specialized studies such as soils; (2) electric service; (3) mechanical service, which includes important studies such as the volume of water; and (4) measurement and control, including instrumental.

The equipment group was in charge of building the project and controlling it. Finally, the coordination and services unit inspected and received the materials. SEGBA

has already asked Bureau Verita to do part of this task. This direct inspection SEGBA was in charge of implied that its capacity to select better had improved, and it had developed the technology to write the bid requests and to adopt the standards laid down by the International Electrotechnical Commission. This team, which has so many diverse functions, is made up of technicians who were previously in charge of production activities, so they were all very highly trained in operating equipment. Thus, the real investment the company makes in personnel is extremely high. Therefore, bases should be created to perpetuate this team. To accomplish this, negotiations have been started to sell advisory services to companies abroad and there are plans to offer a service that would help other national companies with similar projects.

From all this it can be concluded that this engineering capacity was the result of a period of learning the company went through; it was used by company decisions that do not seem to have been influenced by superior levels.

These decisions do not seem to be part of a sequence that was foreseen and adopted as policy. Although clearly differentiated and integrated stages in the installation of the different units can be identified, the criteria used were not consistent. For example, the boilers and turbines are installed according to the terms of the purchase agreements, so as units No. 7 and No. 9 were acquired in port, SEGBA installed them, but unit No. 6 was installed by the supplier.

The role played by the national legislation passed to promote local suppliers should be emphasized. It first appeared in 1962 and was perfected in 1970.

SEGBA's enormous expansion, especially in transmission and distribution, created considerable demand for the country's electrical industry. The size of the repeated World Bank loans helped by guaranteeing the local suppliers a sustained demand. Furthermore, as the Bank laid down certain conditions as to purchases and international bids, this also encouraged the national industries to improve their quality and competitiveness.

A government policy to grant tax deductions and credits for imported inputs was another essential element in the development. This aspect underlines the combined influence of different factors. The loans made it possible to work out a program of purchases that could be incorporated into the local industry's planning. This shows how important guaranteed financing is in developing a technological capacity. Complementary government policies helped the local suppliers to meet the demand and they already had a high enough technological level to satisfy the company's needs. Lastly, the company had teams of experts and experience, so it was capable of choosing and it could be independent technologically.

As the local suppliers developed, a large proportion of the inputs for transmission and distribution expansions were national. In generating equipment there is a trend in the same direction, but many of the basic components such as turbines, boilers, etc., are supplied by only a few world manufacturers and the present and foreseeable market in Argentina does not justify local suppliers. Therefore SEGBA's engineering and negotiating capacity with the suppliers is what ought to be stimulated and consolidated.

As far as research and development are concerned, the establishment of this unit deserves some specific comments. On the one hand, it was a result of the initiative of one of the presidents, engineer Jorge A. Sabato, who had been concerned with the problem of the country's technological development for a long time before he arrived at the company. But it must be said that the company was already maturing technically and the establishment of this service was not only perfectly viable but also necessary.

This unit is still being consolidated within the company. However, it has already made substantial contributions. Its short history reflects many of the customary alternatives presented by these services. It must attend to the immediate demands and postpone the more ambitious projects.

By doing this it contributes toward its internal legitimacy, and makes it possible to have a more complete training in the operational requirements and to work out more realistic, relevant criteria.

This analysis confirms that the relationships established in this study are not linear or unidirectional. They are very complex, have different impacts, and are made up of a variety of forces operating simultaneously.

In the first place, it is clear that the decision to expand SEGBA's generating, transmission, and distribution capacity began a process that gradually enlarged the

company's possibility to discriminate, select, implement, and promote its correlative operation.

This decision posed the problem of how to finance the projects that would be undertaken. The funds came from the company's own sources, domestic credits, capital contributions from the government, suppliers' credits, and World Bank loans. However, the tariff policy produced variations, the cycles of the Argentinian economy caused the projects to be delayed, and the plans had to be continually modified.

So the plans could be completed in accordance with the company's obligations within the national program, it had to set up units in charge of technical planning, economy, financial planning, and executing the projects. In this way, the company acquired training and as a result the company experts played an increasingly large role in designing the projects until they were almost totally self-sufficient.

Local industry met the company's demands and during the last period, research and development services were created and they will be able to orientate the suppliers better and increase the company's technological independence. This process was facilitated by government policies and stimulated by the company's prompt decisions. Despite this, none of the decisions was based on an explicit and continual rationale.

The company's internal elements become centrally important if the former are present and work to eliminate completely all discretionary activities in the company. Among them the following should be pointed out:

(1) There should be enough good-quality technical schools that can offer continual technical training and help to design projects and contribute to their engineering.

(2) These schools must have attitudes that favour the company's and the country's technological development.

(3) There should be participation in decision-making mechanisms aimed at improving management, promoting innovations, and identifying the possibilities of substituting technology.

(4) Staff groups that can program, research, and develop technologies, as well as identify the possible national resources outside the company, should be maintained and developed.

BRAZIL

STATE ENTERPRISES IN THE ELECTRIC POWER INDUSTRY

In the electric power sector there are two major groups of enterprises actually generating power. The first one is state owned; it is made up of enterprises that are owned by the federal government and that are subsidiaries of ELETROBRAS, the holding enterprise, and of enterprises owned by the federated states, in whose capital ELETROBRAS is a minority shareholder. The second group is composed of private enterprises and can also be divided into two other groups: enterprises whose main activity is the generation and distribution of electric power, and enterprises whose main activity of industrial manufacturing consumes electric power at such a scale as to render more economical its production by the industrial enterprises themselves. In this last case the industrial enterprise might or might not have a concession to exploit commercially the surplus of its own production of electric power. This subgroup is placed in the group of private enterprises, with the qualification that some state industrial enterprises are also part of it, although in a small proportion.

Out of the eight subsidiaries of ELETROBRAS - FURNAS, CHESF, ELETROSUL, ELETRONORTE, CEM (Manaus; Amazonas State), CPFL, EXCELSA, and CBEE - the first four are responsible for carrying out and controlling regional planning concerning electric power: FURNAS is responsible for the Southeastern Region plus the south of Goiás State (below parallel 15°30') and the south of Mato Grosso State (below parallel 18°); CHESF for the Northeastern Region; ELETROSUL for the Southern Region; and ELETRONORTE for the Northern Region, including Mato Grosso State (above parallel 18°) and Goiás State (above parallel 15°30').

According to Law No. 5899 of 5 July 1973, ELETROBRAS, by means of those subsidiaries having a regional scope of action, will carry out its policy, which consists of "promoting the construction and corresponding operation..of electric power stations whose interest goes beyond the territory of any single federated state, and of systems of transmission in high and extra-high tensions, aiming at the inter-state integration of the electric power systems..."

Among the enterprises in which ELETROBRAS is a minority shareholder, the most important ones are those owned by the governments of the federated states and LIGHT, the largest private enterprise in the sector. A fact worth stressing is that the relative endowment of power resources known in Brazil led in the last decade to a pattern of growth exclusively based upon water-generated power (estimates for 1979 show that thermoelectric power will go down to 16% of the total).

Policy Objectives

On the basis of the set of measures defined for the sector, the overall policy orientation can be described as follows:

(1) It should aim to meet the needs of the growing demand for electric power and to eliminate the possibility of new crises in its supply.

(2) To reach its chief aim, it should render the sector capable of internally generating the resources needed for its expansion, which would at the same time give the enterprises the financial status suitable for obtaining complementary resources abroad, so as to liberate domestic resources, especially public funds, for other priority ends.

(3) On the other hand, there is a preoccupation with the costs of the industrial sector. The tariff should consider all the principles leading to the maximization of the "producer-consumer" ensemble. The tariff should have such a structure as to lead to a better utilization of the installed capacity, serving, at the same time, the policy of reducing the basic industrial costs.

No guidelines - besides the concept of "domestic similar product" ("similar national") - were set up as regards domestic equipment production, technician consultancy, or the possibility of integrated planning to solve technical problems at the enterprise level.

Research Generation

The authorities expected the sector to be able, on the one hand, to generate part of the resources needed for expansion and, on the other, to utilize tariffs as an investment for cost reduction in industry.

A tariff, in the same way as the price of any other product, should be enough to remunerate the investment needed for the production, transmission, and/or distribution of electric power, and to cover all the expenses of exploitation. The vast legislation concerning the subject has not prevented the tariff from being utilized as an instrument of economic policy - when submitted to readjustments within more general standards of anti-inflationary policy - and as a source of resources aimed at financing the sector's expansion. However, as there is a different tariff for each enterprise, its use in view of the various aims desired made the differences among the enterprises become more considerable than would be easily acceptable to the government bodies responsible for establishing the guidelines for the sector.

The difficulty of making the general policy of price control compatible with the readjustments of the electric power tariffs has had more effect on those enterprises that generate electric power than on those that distribute it. Among the former, the larger the size of their works, the more difficult it has been to repay the investments made.

The generating enterprises have actually been serving the objective of promoting development, supplying the industrial sector and the distributing firms with power in the quantity and quality required. Furthermore, the legislation itself establishes the priorities and, therefore, who should subsidize whom.

According to the law, the enterprise generating electric power is responsible for the investment necessary to raise the tension of the power produced and to build transmission lines, substations, and so on, up to the point where it is delivered either to the distributor or to the remaining consumers. The industrial consumer, however, is responsible for all the expenses needed to reduce the tension of the power received

according to the uses it is intended for, as well as for all the expenses involved in protecting equipment.

The industrial sector and the distributors of electric power have been having their tariff partly subsidized by the consumers (household and commercial) that receive power in low tension, and also by the producing enterprise itself, thanks to the tariff compression adopted in the years 1972 and 1973.

As a consequence of the tariff policy adopted, the operational resources of enterprises have had a declining participation in the investment programs, which have been demanding growing amounts of resources.

Public resources have been playing a declining role in the direct financing of the sector. Concerning foreign resources, although they show a declining participation, nearly the whole of the item "expected deficit" refers to operations of foreign financing still to be arranged. The sector's pattern of financing is quite different in this aspect from other state sectors such as steelmaking, petrochemicals, etc.

Taking into account the structure of the policy for the sector, the participation of the resources in foreign currency could only fall as those generated inside the sector grew.

In spite of the fact that the enterprises have theoretically assured their legal remuneration of 10% to 12% - plus 3% for depreciation - their rate of investment is very high, which reduces the participation of their own resources in total expenditure and sometimes reduces their remuneration itself. This leads them to depend increasingly upon resources from third parties.

As tariff adjustments can take into account variations in exchange, interest, and amortization rates beyond those originally agreed upon with foreign financial sources, the enterprises have an additional encouragement in favour of foreign financing operations.

If one takes into account that the financing operations with the Inter-American Development Bank (IDB) and the World Bank are applicable to purchases in the domestic market and that they generally give the enterprise greater bargaining power in negotiating complementary credits, this indicates the following tendencies:

(1) The availability of nontied foreign resources becomes smaller, and these resources become more expensive.

(2) The relationship between the equipment units to be bought and the origin of financing becomes closer.

Several aspects should be stressed. The structure of the tariff, the main instrument for the collection of resources (at the enterprise level, operational resources; at the sectoral level, the reversion quota and the surtaxes), indicates some of these:

(1) A problem characteristic of the enterprises basically responsible for the expansion of the generating capacity, which carry out large hydroelectric projects, is the total inclusion in the tariff of the costs and remuneration of such generating plants, once their operation has started. The problem arises on account of the fact that great tariff rises have been conflicting with the anti-inflation policy, which is especially rigid as regards the electric power sector.

(2) The transfer of the resources of the old amortization quota (now "reversion quota") to the control of ELETROBRAS meant a serious restriction to the enterprises' autonomy, at the same time as it strengthened the holding enterprise as the centralizing body of the policy for the sector.

(3) The subsidy to the consumers of power in high tension and the loss of the commercial and household consumers is, in some cases, one of the reasons why the enterprises do not always reach the largest remuneration the law allows.

As regards public resources, their participation is small, with the exception of tied resources. Concerning resources generated in the sector, financing operations with ELETROBRAS and the subscription of capital shares by this holding enterprise did represent an important contribution, although in the period under study these forms of raising capital were less attractive than resources in foreign money, which were cheaper and presented no risk in terms of exchange rate fluctuations as all variations in this rate are automatically absorbed by the tariff. A gradual withdrawal from the sector on the part of international development agencies can also be observed.

Demand for Equipment

The behaviour of state enterprises with respect to the demand for equipment is often presented as contradictory in view of the argument that because those enterprises are an instrument of economic policy, they should be totally geared toward the development of an internal equipment industry, instead of basing their expansion upon imported consultancy services and equipment units. However, there is no contradiction in this sense.

In the period under study the growth of the sector producing durable consumer goods was given priority. This being so, besides the stimuli and exemptions applying to the industrial sector as a whole, its priority segment could also benefit the tax-free importation of some inputs (chiefly steel). Moreover, it counted upon an efficient structure for financing its sales, the direct credit to the consumer. Only the housing sector could rely upon similar mechanisms in this period. In this way, the expansion of the state enterprises in this period was oriented toward those sectors, and only secondarily to the equipment-producing sector. Even in the last few years, in which this sector had a faster growth in production, the state enterprises have increased equipment imports.

A Note About Equipment: Several reasons have been given for the presence of foreign resources in the sector's financing. Besides those reasons, foreign financing has become important on account of the technical restrictions on the domestic production of equipment for the sector. An enlightening case is that of the transmission systems and substations, which is described below.

The longer the distances to be covered, the higher should be the tension of the system, to reduce power losses. It so happens that the higher the tension, the larger the proportion of imported equipment. In this way, the participation of imported equipment is nearly total in the systems with tension equal to or above 345 Kv, except for transformers.

Since long ago one could have foreseen that the need for power transmission would increase, on account of the location of the water resources in relation to the markets. In view of the substantial volume of resources already invested (and also what is planned to be invested) in the sector over the course of the whole period under study, the response to the demand on the part of the domestic sector producing equipment has been slow, either because of its apparent aversion to running risks or because of the restrictions the electric power enterprises put upon domestically produced equipment. Moreover, these enterprises have needed to complement the internally available resources with foreign resources.

Two points should be stressed concerning the connection between the origin of the financing and that of the equipment, which is generally applicable to the problem of consultancy as well:

(1) As was explained when the policy adopted for the sector was discussed, the resources complementary to those generated internally should predominantly come from foreign sources. This is so either because other resources in national currency should be reserved for the other priority fields or because at any given moment technical restrictions impose strict limits - in the short and medium term - on the domestic supply of equipment, the resources in foreign currency being thus needed for the purchase of imported equipment.

(2) Once this first aspect has been explained, the connection becomes clear between the origin of the equipment and of the financing, in the case of bilateral credits. In the case of resources financed by international development agencies, the connection occurs by means of the criteria such agencies establish for international licitations, not only in the purchase of equipment but also in the choice of the consultancy firms. There is also a close connection between consultancy firms and the origin of the equipment units. At the same time, the international agencies require that certain managerial standards be maintained. In this way, the international agency's interference is not restricted to the specific areas for which financing has been granted, but reaches the whole project.

Therefore, to expect from the state enterprises of electric power a greater commitment to the domestic sector producing equipment or to the national consultancy firms would be to contradict the sector's policy itself.

First of all, it would imply the breaking of, or significant alterations in, the pattern of financing proposed, as regards foreign resources. The strengthening of the ties with domestic equipment producers, national consultancy firms, and so on, becomes feasible to the extent that it is possible to replace those resources. Foreign financing can only be replaced by resources in national currency and, in the last analysis, given the amount of foreign resources and their destination, by public resources. Such resources, however, should be outside the control.

In the second place, a greater commitment of the state enterprises of electric power to the national equipment producers would be contradictory to the sector's objectives of maximizing efficiency, i.e., of faster response to the country's growing needs of electric power. The technical and financial difficulties inherent in this kind of behaviour - and capable of hampering the sector's desired performance - were solved with the definition of the policy for electric power, and especially of its financing scheme. The same applies to the problem of consultancy. One should also note that the problem of efficiency arises both at the sectoral and at the enterprise level.

These conclusions are applicable to state enterprises operating in other fields. Because in the course of time the dependence upon foreign consultancy and suppliers would imply serious restrictions on the state enterprises' autonomy and possibilities for expansion, it seems that the tendency to adopt a "statist" solution, in the shape of associations assuring the access to foreign technology, is irresistible. Such a tendency could only revert in the case of a change in the global economic policy, in which a different allocation of resources would modify the investment pattern of state enterprises, which is presently oriented toward the expansion of the so-called dynamic industrial segments.

From a microeconomic standpoint, it is obvious that the role ascribed to the state enterprise of electric power is the main conditioning factor of its restricted capacity for generating resources. If on the one hand a high investment rate is required from it, on the other hand the price of its product is strictly controlled, so as to assure it, at best, the legally allowed remuneration. What happens is that its high investment rate endangers even the possibility of reaching the legal ceiling of remuneration of the central government, which has already made explicit its policy for the sector, as well as set up an adequate structure to carry it out. This is an important aspect of the dichotomy between the state enterprise's autonomy and the growth of centralized control.

Summary and Conclusions

As from the 1900s the supply of electric power was becoming more and more a serious obstacle to Brazil's industrial development. One of the most important functions for the isolation of the problems of power supply was the existence of an adequate financing scheme, which might also allow the enterprises a better remuneration of the capital invested. Also to be solved was the problem of national property versus foreign property of the enterprises in the sector.

The latter problem was solved by the late 1950s, with LIGHT's decision to specialize in the distribution of electric power and with the dispossession of AMFORP (American and Foreign Power Corporation) in 1963. As these two companies were at the time the largest enterprises in the sector and the only ones with real importance controlled by (foreign) private enterprise, the spheres of responsibility were in principle defined: generation in the hands of state enterprises and distribution in the hands of private enterprises. Today, distribution is the responsibility of both private and state enterprises and, to a lesser extent, of the federal enterprises. In fact, it is LIGHT that gives weight to the participation of private enterprises in the distribution.

It is also interesting that LIGHT, with its strategic withdrawal from the sphere of generation and its specialization in distribution, has not only avoided more serious conflicts about the foreign ownership of its capital (it is true, however, that there are other explanatory variables in this question), but also has been able to maximize its gains. The remuneration of its investment in electric power is limited, but the maximization is made possible thanks to the relatively small reinvestment necessary in distribution, which allows LIGHT to invest its resources in other fields of activities.

The solution for the problem of financing the sector's expansion (including the criteria of remuneration of the capital for each enterprise) was outlined as from 1964, by means of guidelines that defined the consumer and foreign credits as the main sources

of resources, the latter being seen as a complementary source. The same set of guidelines also expressed the preoccupation with the repercussions of the cost of electric power upon industrial costs.

This pattern of financing is quite peculiar within the group of expanding state enterprises, with one of the lowest rates of financing in foreign currency. The sector of oil refining is probably the only one to present an equivalent rate.

It is clear that certain aspects of the solution adopted for the problem of financing are not totally defined. The most important one is probably that of the generation of resources inside the enterprises themselves. As was seen above, this problem exists for the enterprises that generate electric power, the distributors being free from it on account of the relatively small volume of investments they need to make to expand.

On account of the growing volume of expenditures earmarked for the generation and transmission of electric power, the enterprises' operational resources tend to represent a declining proportion of those expenditures, even in a situation in which all the enterprises obtain the legally allowed remuneration in full. Even so, the sector's financing scheme is not endangered if the direct forced savings (the Unified Tax, or IUÉE, and the Compulsory Loan) can manage to make up for the fall in the enterprises' operational resources; but this will not happen if the tariff is compressed in excess (both surtaxes are proportional to the basic tariff), which would obviously mean a break from the policy for the sector, i.e., the consumer as the main source of resources. Nevertheless, even this source is a restricted one, if it is considered that the most important consumer group - the industrial one - must have its contribution made relatively milder, according to the scheme of purposes the sector should sever (among them, to help avoid the rise in industrial costs).

In the sphere of the enterprises generating electric power, the relative compression of the tariffs has been restricting their capacity for generating resources for their expansion, a situation that becomes worse with the volume of investments that are required or that they propose to make. Such a problem cannot be seen in the enterprises specialized in distribution.

The decision made by the international development agencies to restrict their credits to the sector has reduced the availability of nontied foreign credits for the concessionaires, which has led them to resort to both bilateral and suppliers' credit.

The sector has fulfilled its role - the installed capacity of generation of electric power evolved from 6.356 Mw in 1963 to 16.156 Mw in 1973; moreover, to achieve that target, the sector has managed to mobilize national resources to a surprising proportion of total expenditures, complementing them with foreign resources. Nevertheless, despite the success mentioned above, the set of guidelines adopted has not reached aspects related to the import substitution of equipment and of consultancy services, nor has it given birth to integrated planning for the solution of technical problems at the enterprise level. An important determining factor of this behaviour was the explicit need to liberate already available domestic (public and private) resources for other areas the government also considered as having priority. Moreover, the requirement that the electric power supply should follow the fast growth of demand, at the same time as the service supplied should be of good quality, would have discouraged a greater commitment on the part of the generating enterprises to the domestic equipment industry or to the national consultancy services.

On account of the growing volume of investments planned for the next few years and the difficulties in obtaining foreign credits being confirmed, the growing weight of the value of equipment imports in the trade balance - together with the difficulties of generating resources inside the enterprises themselves on a sufficient scale - might lead to changes in the pattern of financing adopted: the enterprises would resort to the national development agencies more than they have been doing, and more would be required from the industrial consumer, by means of the basic price and of the surtaxes. There are some indications that, on account of the above-mentioned reasons and also of the government decision to enlarge the volume of resources available to the national development agencies, some state enterprises (including those in the electric power sector) would already have taken the initiative of resorting to those agencies. Whether this is merely occasional or not will depend upon the government's decision to alter the policy of industrial priorities in force so far.

BRAZIL

STATE ENTERPRISES IN THE FLAT STEEL INDUSTRY

The Brazilian steel sector is divided into two subsectors that are distinct on account of ownership, concentration, and kind of products.

The subsector of flat steel products consists of three large state enterprises that produce common flat steel products and one state enterprise, ACESITA (Itabira Special Steels), the only producer of special flat steel products. In the subsector of common flat rolled steel products, production was 3,253,000 tons of ingots in 1973: USIMINAS (Steelmills of Minas Gerais State) produced 41% of that total, CSN (National Steel Company) 40%, and COSIPA (Steel Company of Sao Paulo State) the remaining 19%. ACESITA's production was 56,000 tons of ingots in the same year.

In the subsector of nonflat steel products (of the producers of common nonflat rolled steel products), out of a total of 29 enterprises only three have state participation in their capital: CSN, with 10% of total production in 1973; COFAVI (Vitória Iron and Steel Company), with 3% of total production, and USIBA (Steelworks of Bahia State), with less than 1%. COSIM (Mogi das Cruzes Steel Company), with 6% of total production, is associated with CSN. The chief producer of common nonflat rolled steel products is Belgo-Mineira, with 23% of total production in 1973. CSN is the only producer of rail tracks and parts for railroads, as well as of some heavy structural shapes.

Out of the eight enterprises producing special nonflat rolled steel products, two are state-owned: ACESITA (24% of the production of special nonflat rolled steel products in 1973), and PIRATINI (1%). Mannesmann is the main producer, with 36% of total production; it also dominates the production of seamless tubes (90% of total production), COSIM being responsible for the remaining 10%.

The chief consumer of nonflat rolled steel products is the housebuilding sector (concrete bars, seamless tubes, structural shapes, and, in a small proportion, common steel bars), with approximately 50% of total consumption. Other important consuming sectors are the motorcar industry, machinery and equipment production, wires, the railroad sector, and so on.

Among the customers of the state steelmills, the distributors play an important role, as they have been buying approximately 30% of the production of flat steel products, thus supplying the market consuming flat steel products, which buys them in small amounts.

This subsector has gone through various phases:

(1) Up to 1964, the distributors should be accredited before CSN to be entitled to a quota as any consumer, and they later resold the product.

(2) In the 1964/1968 crisis the participation of the distributors in the subsector's sales fell considerably.

(3) Finally, after 1968, the participation of the distributors in the marketing of the production of the state steelmills rose again. As part of the activities of coordination that CONSIDER (originally Council of the Steel Industry, and later Council of the Steel Industry and Nonferrous Metals) was gradually taking up, it established, in Regulation No. 5 of 1970, the norms for the marketing of flat steel products. As a consequence of that, the distributors organized themselves and founded the National Institute of Steel Distributors (INDA).

The performance of these intermediaries in steel distribution has been much debated, as they have not been acting as "market regulators," which would be their main function as desired by policymakers. Price control at the level of the producing mills, in contrast with the formal control at the level of the small consumers, is another aspect of the question. Although the control over the producers was a very strict one, the same did not happen as regards the activities of the distributors. Thus, the target of controlling inflation was partly frustrated. The distributors resell those products to small consumers, who do not benefit from the price control, the advantages of which revert to the large consumers.

The great fluctuations observed from one product to the other originate from the dispersion of the consumer market. The greater the dispersion, the larger the

participation of the distributors' network in marketing the product. The more concentrated is the market for a certain product, the smaller the participation of the distributors in its marketing.

Economic Policy and Price Formation

In the course of the whole process of setting up and developing the steel sector in Brazil, there have been unending discussions about the prices of steel products. The problems might be due to the sector's characteristics themselves, as, in the case of Brazil, it is largely state-owned. The issue arises because, to the extent that the prices of steel products are compressed to subsidize sectors such as equipment, house-building, motorcar production, and so on, this policy restricts the steel enterprises' possibilities for self-financing. As a consequence, the sector's autonomy concerning its expansion plans is jeopardized at the first moment by the lack of resources; and later on, it becomes dependent upon the approval of the government's planning bodies, both as regards raising money in national currency and obtaining loans from the international agencies.

When the government's controlling and planning bodies establish a system of subsidies through the steel sector - to make competitive those sectors for which the price of steel is significant - the state's responsibility in supplying the resources for the sector's expansion also grows. It is an apparent vicious circle: the sector has its prices compressed to supply the other sectors with its products at competitive prices. As a consequence, the enterprises decapitalize themselves and their expansion plans are affected, which in turn leads to a shortage of their products. At this point, the following option presents itself: either to loosen the price controls or to provide the sector with government funds to cover the price insufficiency and to keep the expansion plans.

In the analysis of the formation and establishment of the prices of steel products, and especially of the flat steel products, it is not enough to decompose their cost and to consider that the steel companies resist both the prices of electric power and the maintenance of the subsidy represented by the extraction and use of national coal. Nor could there be sufficient arguments in the sense that, on account of the low cost of its labour and of the abundance of iron ore in its territory, Brazil might become a large producer and exporter of steel products. There are other aspects related to the direct control of those products, which has affected considerably the generation of resources by the enterprises themselves and their autonomous capacity for expanding their operations.

Performance of State Enterprises

In the early 1960s both COSIPA and USIMINAS were being set up (at that time USIMINAS was more advanced in this process). Both enterprises would have an initial installed capacity of 500,000 tons of ingot steel per year. Both originated from local interests; COSIPA (1952) was totally owned by private capital, whereas USIMINAS, already at the time of its foundation (1956), counted upon resources from the government of Minas Gerais State (GOMIG for short) and upon federal funds (from the National Treasury and the National Development Bank - BNDE). Already in the year USIMINAS was founded, agreements were begun with the group of Japanese suppliers to have their participation in the enterprise's capital. As regards COSIPA, the incapacity of the founders to take ahead the project soon became obvious, which led to BNDE's involvement in the project. In 1962 a task force was formed at BNDE, whose report was the basis for the resolution of the Council of Ministers, which not only determined that the initial project should be financed, but also recommended that COSIPA's installed capacity be expanded to 800,000 tons/year, as the minimum feasible economic scale. As is obvious, state participation meant the effective setting up of both steelmills.

At the time they were set up both steelmills were totally specialized in noncoated flat steel products, although the possibility had been contemplated that at least COSIPA also produced some nonflat products (bars), as well as tin plates (which were CSN's monopoly). As regards USIMINAS, the hypothesis was apparently considered that it also supplied the market of coated flat steel products, but the National Steel Plan (PSN, of 1967) established the monopoly of this market for CSN.

The two enterprises were intended to meet the demand for flat steel products on the part of the growing industrial sector in Brazil, a demand that was mainly concentrated in the motorcar, shipbuilding, and equipment industries. They would enter the market

basically to replace imports: there was, however, a sphere of the market covered by imports. One enterprise replaced part of those imports at prices 35% above those of CSN, which at that time dictated the prices for the sector.

The situation of the enterprises in the steel sector had been relatively easy until 1963, because of the growing demand for steel in the course of the preceding 13 years, and chiefly because the prices were determined inside the sector itself. Even after COSIPA and USIMINAS entered the market of flat steel products, CSN went on dictating the prices, whereas in the subsector of nonflat steel products, CSBM (Belgo-Mineira Steel Company) was the leading enterprise for those products CSN did not make (CSN produces rails and heavy structural shapes). The slowdown of economic activity in general, already clear in 1963, would only affect the steel sector as from 1964, probably not only because of the small gap between the volume of sales and of orders, but also because in 1963 there was a considerable investment in stocks of flat rolled steel products on the part of the consuming enterprises. The crisis first reached the market of flat rolled steel products. The subsector of nonflat steel products was affected more seriously as from 1965.

In 1965, however, a new government attitude as regards the steel sector was defined: in February, Regulation GB-71, of CONEP, officially established the control of steel prices, which remained frozen until January 1966, when they got a raise of only 10%.

On the other hand, Decree-Law No. 63, of November 1966 reduced the import duties charged for steel products from 60% to 50%; Decree-Law No. 264, of February 1967, reduced those duties even further. In fact, not only enterprises making flat steel products felt threatened, but chiefly those producing nonflat and special steel products. The Brazilian entrepreneurs emphasized at the time that most imports of nonflat and special steel products (mainly bars and machine wire) merely replaced part of the national production.

The liberalization of imports would obviously be more harmful to the private enterprises, as most imports would consist of nonflat steel products. In terms of weight, the bars, concrete bars, and wires would on the average be responsible for 60% of the imports of nonflat steel products in the 1963-1967 period. In 1968, however, the participation of these three products fell to only 8% of the total imports of nonflat steel products, as a result of the adoption of a 15% import duty on steel wire, which had previously been imported duty-free. The participation of those products would reach its highest level - 92.4% of nonflat steel products - in 1970, when the sector's recovery was clearly visible. This fact is explained by the heavy imports of concrete bars - 160,000 tons - for the Rio-Niterói bridge (due to tied loans with British banks).

An extremely important aspect to examine in the performance of the three state enterprises producing flat steel products is the impact of the imports of flat rolled steel products upon those enterprises and their repercussions upon the sector as a whole in the years following the crisis.

As from 1970 the weight of the imports of rolled steel products grew rapidly. This is undoubtedly the reason why the coordination of steel imports has become one of the functions of CONSIDER since 1971.

Up to 1970, not only the producing and distributing enterprises, but also any consumer, could directly import rolled steel products; and exemptions from import taxes were granted according to the criteria of priority established by the global economic policy then in force. The state enterprises could automatically count upon exemptions, as their imports aimed at complementing domestic production, fulfilling the government guidelines of "full provisioning."

From 1971 to 1974 CONSIDER coordinated imports: the commitment to supply the internal market was delegated to the state steelmills; moreover, import exemptions were granted to some large consumers, such as the motorcar sector, PETROBRAS, and the steel distributors. It was only in 1974 that the tax exemption for direct imports was extended to the shipbuilding and railroad sectors.

In September 1974 the coordination of the imports of the state steel enterprises was transferred to SIDERBRAS. The distributors could no longer count upon exemptions. Other changes were also outlined: for example, the motorcar industry wanted SIDERBRAS to make imports for it as well; some of the enterprises in the sector had always imported, whereas others had always bought in the domestic market; when the international price is higher than the domestic one, the latter would finance the former's imports; concerning the distributors, they could go on importing, but now without tax exemptions.

In 1973 and 1974 the international prices of steel were higher than the domestic ones, because of the control the latter were subjected to. Furthermore, apart from this situation, which was seen merely as a result of a special conjuncture, the hypothesis was contemplated of gradually abolishing duty exemptions for the sectors that benefited from them. There had been a change in the attitude of the planners concerning steel imports.

The problem that was the target of the successive attempts at controlling imports and of the changes in the Customs Legislation was steel imports at prices of dumping. The international prices charged by the large steel producers of industrialized countries are lower than the internal prices in those countries. The justification would be that only production surpluses are exported, and therefore the price charged is equivalent to the marginal production cost in those countries.

The legislation now in force establishes higher ad valorem duties for special steel products and lower duties for common steel products. In 1974, according to preliminary data, approximately 65% of steel imports were represented by noncoated common steel sheets.

The problem of the imports by the state steel enterprises lies in the differential between prices in the domestic and foreign markets. Until late 1972 foreign prices were lower than or equal to the prices charged by the three state enterprises. After that, however, foreign prices became higher than the domestic ones, and several compensatory mechanisms were tried by the federal government to avoid a rise in the domestic prices of flat rolled steel products.

The solution adopted in 1973 consisted of financing the imports of the state steel enterprises, while the revenue from the sale of those products was invested in ORTN's (National Treasury's Readjustable (Indexed) Bonds), for such a time as would be sufficient for the interests to cover the differential between the domestic and the foreign prices (37 months on the average). This operation was called "zero profit operation." Nevertheless, at the time, it represented a loss, on account of the long term of the ORTN investment. This situation reduced quite considerably the profits of the three state enterprises in 1973.

In early 1974, once the "zero profit operation" had been abandoned, the state enterprises began to import steel with the help of ordinary financing operations by the Bank of Brazil, with a 180-day delay for payment. The three enterprises proposed to establish a domestic price according to the enterprise that had the higher unitary costs. The two others would revert the additional profitability to a fund aimed at financing imports, to be controlled by CONSIDER.

What in fact happened was that the National Treasury began to cover the losses stemming from the importation of steel, in what was called "1974 operation." Moreover, part of the last price rise granted in 1974 and the first rise granted in 1975 were aimed at covering the losses originating from imports.

The 1968-1974 period was characterized by the enterprises' economic recovery, at the same time as the fast growth of domestic demand raised steel imports, putting pressure upon the trade balance. Whereas in the 1963-1968 period the annual average of the CIF value of steel imports was \$78 million (highest value in 1963: \$100 million; lowest value in 1965: \$58 million), the value of imports rose from \$84 million in 1968 to \$440 million in 1973. (1974 was clearly atypical: the preliminary data show an expenditure of \$1,600 million on steel imports, with a tonnage that represents 65% of domestic production, in contrast with 35% for the previous year.)

In the 1968-1974 period the central government's control over the three state steel enterprises grew, in an attempt to speed up the expansion of their productive capacity to meet the growing domestic demand. The schemes of control, supervision, and integrated planning developed in this period were based upon the projects outlined for the sector during the period of crisis, that is, the years from 1964 to 1967.

The pressure on the part of the state for a faster expansion of production would also be exerted upon the private steel enterprises that specialized in the production of nonflat rolled steel products.

As was mentioned above, the sector's chief problems were the retraction of demand proper and the strict price control imposed by the state. As was also said above, the enterprises that specialized in flat steel products resorted strongly to exports during the crisis period.

The fall in exports in 1966 is explained by the retraction in the international market, which became highly competitive in that year. Also in 1966, an important incentive was granted to the enterprises: Regulation No. 26 of the Committee of the National Coal Plan, dated May 27th, liberated the use of imported coal in the making of steel to be exported, allowing the use of up to 100% of imported coal in this case; this represented a strong encouragement to exports in the following year. As from 1968, with the recovery of the domestic market, sales abroad fell considerably, although they remained present in the enterprises' revenue. This maintenance of revenue from foreign operations was due merely to the improvement of the prices obtained for rolled steel products (the same did not happen with unfinished products), as the amount exported is still marginal. The average export prices of rolled steel products show a marked improvement as from 1969. The jump in the average prices obtained for the exports of nonflat steel products in 1974 is explained by the fast rise in the price obtained for concrete bars; the exports of round concrete bars did not rise in quantitative terms in relation to 1973.

The effort to export was not enough to counterbalance the effects of the crisis in the internal market. Concerning the sales of rolled steel products, COSIPA and USIMINAS, although not having reached the full projected capacity (production equivalent to 500,000 tons of ingots per year) at the beginning of the crisis period, experienced rapidly growing total sales in quantitative terms, thanks chiefly to exports. In 1967, the most serious year of the crisis for the enterprises that specialized in flat steel products, COSIPA's domestic sales fell by 17%, whereas its total sales rose by 54% in relation to 1966; as far as USIMINAS was concerned, its domestic sales grew by only 5.2% and its total sales by 30% in the same period. Total sales by CSN fluctuated much more, although it resorted strongly to exports in the two most serious years of the crisis (1965 and 1967). One should note that when the crisis had been overcome as far as flat steel products are concerned, the level of CSN's domestic sales had not reached the 1963 level.

In the 1964-1968 period, only USIMINAS managed to have a real increase in its average revenue, CSN being the most seriously harmed of the three state enterprises. It should be noted that in that period the price rise for CSN was 244.7%. It is obvious that USIMINAS' positive result in relation to the real average revenue (2.3%) is not significant as such. Both USIMINAS and COSIPA went through this period in very difficult financial conditions and were often supported by the National Treasury and BNDE. The differences in the evolution of the real average revenue of the three enterprises should be ascribed mainly to the variations in the product mix sold and to the rapid expansion of COSIPA's and USIMINAS' markets, to the loss of CSN.

The sale of flat steel products by CSN fell by 11.7% of total sales from 1964 to 1968, the gap being filled by nonflat (heavy structural shapes and rails and tracks accessories) and unfinished steel products; the increase in the sales of tin plates and galvanized products was not enough to counterbalance the fall in the sales of noncoated flat steel products. At the same time, CSN's sales of noncoated flat steel products either declined or remained stagnant in absolute terms in the same period. It is true that the participation of the several items of noncoated flat products in COSIPA's and USIMINAS' sales presents a fast rise also on account of the fact that the years 1964-1965 still represent for both an early stage of production, when they had not yet reached their full projected installed capacity. Even so, the figures are significant because they represent the behaviour of their real sales.

It is important to stress that within each of the types of noncoated common flat steel products, there are large variations in terms of technical specifications (thickness, width, carbon content, and so on), the prices being determined by the degree of specification (starting from a basic price of each product, additional rates are added concerning the amount to be bought and the specifications of the product). In this sense, both COSIPA and USIMINAS - new enterprises utilizing modern technology - had great advantages in relation to CSN - utilizing obsolete equipment and techniques - with regard to meeting the more sophisticated demand from the motorcar, shipbuilding, and equipment industries. This was one of the reasons why CSN had been struggling fiercely for the implementation of its expansion and modernization plans. But these plans had their execution hampered by the crisis.

The optimization of the product mix became a constant preoccupation of the three state steel enterprises in their dispute for the markets, and the conciliation of the several interests in the search for a "rational specialization" for each of the enterprises would be one of the important aspects to be found in the government's steel plans.

In the same way, in the period after the crisis, the product mix sold is important in explaining the improvement of the enterprises' real average revenue. In the 1962-1968 period, USIMINAS presents the best results for this indicator, and COSIPA more than makes up for the loss in real average revenue that took place in the crisis period. The same, however, does not happen with CSN, despite the rapid growth of the sales - in both absolute and relative terms - of tin plates and other coated flat rolled products, CSN's most profitable products.

Although the average revenues of COSIPA and USIMINAS have grown faster than CSN's, the two new enterprises were in an extremely unfavourable financial situation.

Unfavourable results in 1973 in relation to 1972 were due, firstly, to an insufficient price rise (the average rise for the three enterprises in 1973 was around 15%, taking into account the effect of the rises granted in late 1972); and secondly, to the importation of flat steel products by the enterprises at a time when the prices in the international market were above those in force in the domestic market.

The crisis did not reach only the producers of flat steel products, but the steel sector as a whole. The retraction of housebuilding activities above all had deeply harmed the producers of nonflat steel products. At the same time, the producers of special steel products also felt the pressure represented by imports at lower prices, which would compete with their products in a market in crisis.

The first government attempt in the search for solutions was to contract the American consultancy firm Booz, Allen & Hamilton International (BAHINT) in 1965, to make a diagnosis and plan the sector's future expansion. The sector's reaction to the BAHINT plan was extremely unfavourable, and such a reaction was apparently reinforced by the lack of interest in financing the proposed expansion plan on the part of the international agencies.

In April 1967, when the crisis in the steel sector had reached its apex, the federal government created the Consultive Group of the Steel Industry (GCIS), in a new attempt at analyzing and finding solutions for the sector's problems. In December 1967, GCIS published its final report, which was approved by the federal government and constituted the National Steel Plan (PSN), the first effective planning instrument of the sector.

The Expansion Plans

In 1961 CSN had concluded its second Expansion Plan, Plan C, which established the enlargement of productive capacity to 1,000,000 tons of steel ingots per year until 1963; with changes and improvements of little import, CSN would raise its nominal productive capacity, still within the scope of Plan C, to 1,300,000 tons of steel ingots per year. As from 1961 care was also taken to set up the so-called Intermediate Plan, whose basic targets were to raise tin plate production with an additional 150,000 tons of steel ingots per year and, in its final stage, to reform and enlarge blast furnace No. 2, which would allow CSN to raise its nominal productive capacity to the equivalent of 1,400,000 tons of steel ingots per year.

It is important that the resources for CSN's growth in this period originated basically from the enterprises' own resources and from financing operations: more than 80% of the financing was granted by the EXIMBANK-USA, and the remaining portion by suppliers. Until the creation of CONSIDER, CSN had not resorted to BNDE for financing. Moreover, from 1959 to 1967 CSN received no resources from the National Treasury in the shape of capital contributions.

Already in 1962 CSN had begun to elaborate Plan D with technical assistance from Arthur G. McKee.

In 1963 the McKee consultancy company presented to CSN its project, divided into two stages: (a) 1963-1968 - expansion to 2,370,000 tons of steel ingots per year; and (b) 1968-1972 - expansion to 3,500,000 tons of steel ingots per year.

The project was budgeted at the equivalent of \$216.4 million in foreign currency and Cr\$633.5 million (at 1965 prices) in national currency. In the first stage, up to 1968, CSN would produce 1,650,000 tons of ingots per year of flat products (including coated products) and 367,000 tons of ingots per year of nonflat products; as from 1972, 2,500,000 tons of ingots per year of flat products and 1,000,000 tons of ingots per year of nonflat products.

It is undeniable that, in spite of CSN's good financial position in the 1950s, an ambitious expansion plan such as Plan D could hardly be carried out without the effective support of public resources via the National Treasury and even via BNDE.

It should be noted that this new expansion aimed at supplying basically the market of noncoated flat steel products, in the production of which CSN's two competitors, COSIPA and USIMINAS, would specialize.

As from 1964, besides the fall in the demand for its products and the official price control, CSN made large expenditures in setting up the Intermediate Plan. The financial difficulties typical of the crisis period forced the Intermediate Plan to be carried out at a slower pace, which in turn delayed the negotiations for setting up Plan D.

It would be going too far to state that, under other circumstances, CSN would have obtained the federal government's support to take ahead its Expansion Plan. The criteria of rationalization and optimization of the investments in the sector, already imposed by the BAHINT/BNDE/World Bank Plan, would have prevented CSN from fulfilling its intention of occupying a larger sphere of the market of noncoated flat steel products. At any rate, the weakening of the sector's leading enterprise would later make it easier to set up the scheme of centralized control over the sector.

The BAHINT Plan was based upon an estimated growth of steel consumption of 8.5% per year in the 1966-1972 period. At the same time an analysis was made of the expansion plans elaborated by the enterprises themselves.

According to the BAHINT Plan, CSN should expand its production from 1,400,000 to 2,500,000 tons of steel ingots per year in the 1966-1972 period. COSIPA would expand its production from 625,000 to 1,000,000 tons per year, a further expansion of 2,000,000 tons per year being already predicted (this enlargement of capacity was already foreseen in this steelmill's initial setting-up project). In the same way and during the same period, USIMINAS would also expand its production from 636,000 to 1,000,000 tons per year, a later expansion being predicted to 2,000,000 tons per year.

Concerning nonflat and special steel products, the BAHINT Plan recommended the expansion of seven enterprises - Belgo-Mineira Steel Company, Lanari, N.S. da Aparecida, Barra Mansa, Riograndense, and the state-owned ACESITA and COFAVI - in a total increase of installed capacity of 500,000 additional tons of ingots per year.

CSN then proposed a modified plan for a first stage of 2,500,000 tons per year, in which the main alteration was the abandonment of a third line of electrolytic tin-bathing (for tin plates). This plan was also refused for the same reasons as the previous one.

According to the National Steel Plan (which is henceforth called PSN-1, to distinguish it from the National Steel Program, PSN-2), the sector's fast expansion was indispensable, on account of its great importance in the chain of industrial products. The solution of supply problems via imports would in the long run (or in a medium-term range) be harmful to the economy because of the pressures it would put upon the balance of payments. To make the expansion feasible, it was necessary to make the short-run anti-inflationary policy compatible with the long-run development policy, to assure the internal generation of resources needed for the sector's expansion. At any rate, the state's participation was considered indispensable, even as regards the private segment of the steel industry, not only by means of incentives toward efficiency and specialization, but also directly in what relates to resources (granting low-cost financing, giving its surety bond to foreign financing operations) and to making compatible the short- and long-run policies, granting incentives and tax exemptions that would make such an adjustment easier.

The structure proposed for the sector was based upon the one existing in the Italian steel sector and included basically the following bodies:

(1) Council for the Development of the Steel Industry (CDS), which would formulate the policies and guidelines for the sector; it would be an interministerial body, but subordinated to the Ministry of Industry and Commerce (MIC).

(2) Brazilian Steel Enterprise Inc., which would be the holding company of the state steel enterprises.

(3) Committee for the Development of the Private Steel Enterprises, a consultive

body for the private enterprises, subordinated to the Brazilian Steel Institute (IBS).

The National Development Bank would work as the sector's financial agent and would participate in CDS.

The expansion of the three state enterprises of flat steel products was planned in block. The basic criterion would be that of the specialization of the steelmills.

There would be a new market division, in which CSN would supply the markets of coated flat steel products, of rails and heavy structural shapes, and of the traditional consumers of noncoated flat steel products, and COSIPA and USIMINAS would compete between themselves for the markets of more sophisticated noncoated flat steel products (the motor-car, shipbuilding, equipment industries, and so on). The financing scheme proposed in PSN-1 is shown in Table 1.

In this way, in the financing plan proposed for the expansion of the three state enterprises, nearly 53% would come from foreign sources, precisely because PSN-1 acknowledged the difficulties existing in the period of obtaining public resources on the necessary scale to complement the resources internally generated by the enterprises themselves (the hypothesis of resorting to the capital market applied to the private enterprises only). Even so, if the hypothesis materialized that the resources obtained abroad reached the amount proposed, there would remain a huge deficit to be covered.

The solution suggested for covering the deficit was based upon the model adopted for the electric power sector: resources obtained by means of a surtax to be managed by the holding enterprise of the state steel enterprises. In other words, the deficit should be covered with resources from compulsory savings of the steel consumers, i.e., precisely those industrial segments that had felt the economic recession of the 1963-1967 period most strongly and whose consumer markets were recovering slowly.

Out of the three enterprises, the only one that obtained foreign resources near the amount predicted in PSN-1 was USIMINAS, although in 1971 the cost of setting up Stage I of its expansion was already calculated at \$165 million, as against the \$89.6 million estimated in the National Steel Plan. Therefore, PSN-1 started to be revised from mid-1970, and is now under the responsibility of CONSIDER.

PSN-2 takes into account the recent experience of PSN-1, when the failure of the financial program led to an enormous delay in the implementation of the expansion plans (Stage I would only be completed in 1974). In this way, it presents a complete and well-elaborated financing plan, in which foreign sources participate in 47% of total expenditure. The originality of the plan lies in the fact that the negotiations for collecting foreign resources would be led en bloc, thus breaking the traditional schemes of the three state enterprises and increasing their dependence vis-à-vis the sector's general coordination, then in the hands of CONSIDER. The success of the new financing scheme proposed allowed the present expansion (Stage II) to be according to the predicted schedules.

PSN-2 developed in more detail the idea of steelmills geared to the export of semifinished products, already suggested in PSN-1, and adopted in this case the model utilized for setting up USIMINAS: the association of state and foreign capital, the former being the majority shareholder.

The chief guidelines defining the new expansion program were the following:

- (1) Priority is given to the expansion of the production of flat rolled steel products.
- (2) The subsector of nonflat rolled steel products should remain in the hands of private enterprise; for its expansion the federal government would grant credit stimuli and/or participation in the enterprises' capital, the state being a minority shareholder (in larger-size projects).
- (3) BNDE is assigned the role of chief financial agent for the sector, and to fulfill this function it would count upon resources from the Union's budget and from the National Monetary Council.

The sources of financing were determined taking into account the following factors:

- (1) There is a need for international licitation in the purchase of equipment, in order that it be obtained under optimal conditions of technique, price, and time for delivery.

(2) There should be the possibility for foreign funds to finance domestic purchases.

(3) There should be the possibility for the largest possible volume of credits to be obtained.

The Purchase of Equipment

One of the most interesting aspects of the financing scheme for Stage II is the process of international licitation for the choice of equipment units. The total estimated cost of the equipment for the three expansion projects as a whole corresponded to 42.2% of the total cost of the investments, reaching the value of \$560 million.

As was mentioned above, the equipment was divided into two packages, one in which domestic producers had good chances of winning the licitation and the other in which they might at most have a participation in an order placed in the IDB/World Bank financing.

Both the financing scheme and the system of licitation worked well, which allowed Stage II to be set up within the predicted time schedules.

It was expected that, out of the three enterprises, COSIPA would be the one to absorb a smaller proportion of domestically produced equipment, as national producers would be overworked with the orders from the other two enterprises. CSN and USIMINAS were estimated to absorb in domestic equipment almost 25% of the total expenditures on equipment.

In this way, according to the criteria established by the program of Stage II (which would also be adopted for Stage III), the process suggested for the purchase of equipment - which was effectively and strictly followed - can be summarized in the steps below:

- (1) There is negotiation with IDB/World Bank.
- (2) There is negotiation of large credits in the main equipment-producing countries, with the precondition that they participate in the licitations.
- (3) The technical proposals of the producers are examined and, if necessary, modified to meet the requirements of the purchasing enterprises.
- (4) In this last stage, the commercial proposals (as to price, conditions of payment, etc.) are compared and assessed.

It was expected that domestic equipment producers would have a larger participation in Stage III than had been the case in previous stages. Decree-Law 1,335 granted domestically produced equipment the same incentives as those granted by the Industrial Development Council to equipment imported in a regime of priority. Moreover, there were new sources of resources: the funds of BNDE/TINAME (PIS/PASEP), which could be used for the purchase of equipment. These two reasons - the measures taken in Decree-Law 1,335 and the new sources of resources - were mentioned as the main causes for the expected larger participation of domestic equipment producers in supplying the steel sector. Furthermore, one of the three enterprises in particular expressed another kind of preoccupation: it was willing to create its own market, heavy industry being one of the largest consumers of steel products.

It was feared at the time that IDB/World Bank might not participate in the financial consortium for Stage III; this was a worry that did not materialize. The same scheme as for Stage II is apparently being repeated with some alterations: whereas in Stage II the participation of the expenditures on equipment reached 42.1% of total expenditures, in Stage III it will attain 50.1% of total expenditures. Although the participation of national resources has remained the same, it is important that the participation of IDB/World Bank, whose resources are largely used for domestic purchases, has fallen from 24.5% to 8.5% of total available resources. This necessarily reduces the volume of purchases of domestically produced equipment, even if possible alterations are not taken into account.

A New Development: The Export Steelmills

Another important aspect of the policy for the sector refers to the export steelmills. Since PSN-1, elaborated by the GCIS, the idea had been suggested of steelmills producing semifinished products for exportation. The two mills - one projected and the

other one already being built - are located in Itaqui (Maranhao State) and Tubarao (Espfrito Santo State) respectively.

At first it was intended that the whole production of those steelmills should be exported. This initial idea was abandoned and there was an evolution toward the present position, according to which at least one-third of the production will be directed to rerolling and consumption in the country, the remainder being exported. Rerolling could be carried out either by the producing mill itself or by another steelmill specifically set up for this task.

The same association model as the one used for USIMINAS would be adopted in this case, but with an important difference in terms of its objective: production mainly for export, in contrast with USIMINAS, whose production is basically directed toward the domestic market. The constitution of the export steelmills adopted, therefore, the association of state and foreign capital, provided that the majority of shares remain in the hands of Brazilian capital.

Summary and Conclusions

The first attempt at formulating a policy for the sector as a whole, and especially at planning and coordinating the group of state enterprise producers of flat rolled steel products, was made by the BAHINT Report, which was soon abandoned. An important event in this period was the change in CSN's expansion plans that the BAHINT Report suggested, toward an integrated growth of the three enterprises directed to the specialization of each one of them in the production of certain types of flat rolled steel products. Up to then, government control had been exerted only via prices, and even this was a recent situation. In this way, CSN, which was trying, with its Expansion Plan D, to minimize the impact of the entry of its two state competitors into the market, had its intentions postponed, at the same time as the market retraction and the strict price control weakened its formerly sound financial position, thus hamming even further its expectations about the possibility of expanding its capacity.

The continuation of the crisis and the exhaustion of the BAHINT Report would lead to the creation of GCIS, with objectives similar to those that had caused the BAHINT consultants to be contracted by the Brazilian government, but with a wider scope. GCIS should study a complete scheme to restructure the sector, to allow, above all, more effective control and planning of the state-owned subsector, leading to an adequate specialization by product of those enterprises, and thus avoiding the superimposition of investments that would inevitably occur if the enterprises could freely follow their own growth strategies. The subsector of flat steel products was considered strategic, as its consumers made up the leading segments of the industrial sector, according to the criteria chosen for economic development in Brazil.

The main achievements of GCIS, as regards the proposed Plan, were first, the creation and gradual strengthening of CONSIDER, a body that would be responsible for formulating, controlling, and carrying out the steel policy thereafter, and second, the definitive sharing of the market of flat steel products among the three state enterprises, the starting point for subsequent expansions.

Nevertheless, the implementation of the expansion recommended in the National Steel Plan was jeopardized by the absence of a sound financial scheme. The enterprises resorted to their traditional foreign financiers and equipment suppliers. Only COSIPA escaped the traditional pattern, giving emphasis to tied French financing, on account of a larger availability of credits; it was then forced to carry out modifications and adjustments in its plants, to adapt to the new equipment.

But the main difficulty for implementing PSN-1 lay in the resources in national currency, not only as regards operational ones - as the prices of steel products remained exceedingly compressed - but also as regards those originating from the National Treasury and BNDE, which were not enough to avoid delays in implementing the Plan.

In spite of all that, PSN-1 represented a step forward in the search for a definition of the financing programs for the sector, when it discarded once and for all the hypothesis that foreign private capital lead the sector's development, holding majority shares in steel enterprises in Brazil. Such a process - led by foreign capital - would only be possible with the abandonment of the objectives desired for the sector, i.e., that it should give rapid response, at low costs, to the country's needs for steel products.

The growing demand for rolled steel products, foreseen by the planners, led them to anticipate the enterprises' initiative and revise the Expansion Plan, proposing two subsequent additional stages that meant trebling the steelmills' installed capacity in a 10-year period, the subsector now being fully coordinated by CONSIDER. A careful financial scheme was drawn up and carried out, as it was essential for the expansion to be implemented within the established time schedules. The resources external to the enterprises were negotiated en bloc under CONSIDER's guidance, and this coordinating body also took steps to assure that the enterprises generate the volume of operational resources required according to the expansion plans, by directly negotiating with the authorities responsible for establishing the prices for the subsector.

Once the credits from IDB/World Bank and from the eight countries that are the largest suppliers of equipment for the steel industry had been negotiated, equipment units were purchased by means of international licitations, a margin of participation being assured to the domestic equipment industry, with CONSIDER's direct interference.

Therefore, in contrast with what happened with the electric power sector, a program was established as regards the purchases from domestic equipment producers, which involved detailed negotiations with the Brazilian Association for the Development of Basic Industries (ABDIB). Decree-Law 1,335 itself, which granted domestically produced equipment the same benefits and exemptions applicable to equipment imported on a priority basis, originated from suggestions by the three state steel enterprises and by CONSIDER (with the World Bank's approval). One of the reasons that contributed most toward this attitude was the fact that the equipment-producing sector is one of the large consumers of flat rolled steel products. There are, however, some signs that such a procedure will no longer be adopted, on account of the need for rapidly expanding the capacity of the three enterprises and the limited amount of resources in national currency available for the implementation of a program involving figures around \$1 million per year. Furthermore, certain important stages of the engineering of the projects and some equipment units would be under the responsibility of specialized subsidiaries of the state steel enterprises, COBRAP, Brazilian Company of Industrial Projects, a subsidiary of CSN, and USIMEC, a subsidiary of USIMINAS.

Stage III of the expansion was anticipated in 2 years, the necessary studies having begun, therefore, in the middle of the implementation of Stage II. Still with the aim of assuring a definitive financial scheme and of establishing direct control over the state enterprises' performance, the holding company, SIDERBRAS - already proposed in its general outlines by the GCIS document, PSN-1 - was created.

Nevertheless, in contrast with the electric power sector, the steel sector has not yet been able to adopt similarly favourable schemes for the internal generation of resources, and this is for an obvious reason: the degree of concentration of its chief consuming markets. As the steel enterprises face administered prices, their capacity for generating resources is restricted; and, what is also serious, the predictability concerning this restricted margin of resources is reduced not only because the enterprises do not exert any control over their prices, but also because their performance is very sensitive to fluctuations in the economic activity as a whole. Thus, it was only when the need for expanding the domestic supply of rolled steel products became pressing that it was possible to increase the enterprises' own capacity to generate resources, to render the needed expansion feasible. Even so, the contribution of public resources (in the shape of financing and capital inflows) - which varies in inverse proportion to the contribution of the enterprises' own resources (see the case of CSN, before and after the 1964-67 crisis, and the case of the power sector) - was substantial. The largest contribution, however, came from foreign financing operations.

Since PSN-1, many mechanisms have been contemplated to assure sound resources to the steel sector, but so far with no success. These mechanisms have ranged from the establishment of a margin of profitability for the sector's enterprises to the creation of mechanisms of forced savings similar to the Unified Tax on Electric Power (IUEE) or the Compulsory Loan (these two surtaxes are applied in the electric power sector). Thus, SIDERBRAS can today count upon the budgetary resources allocated to it for the absorption of the enterprises that should become its subsidiaries and for effecting its participation in its associates (as a matter of fact, the mechanisms to be utilized in this process have not yet been defined), and upon the corresponding dividends in the future. As SIDERBRAS will only have those sources of resources, no special funds being created to support it, it is difficult to foresee to what extent the sector will become independent of foreign resources.

The Plan proposed by CONSIDER established a division of spheres of action between state and private enterprises, the production of nonflat rolled products being defined as an exclusive function of private capital. However, as the expansion of the enterprises producing nonflat products did not materialize or their projects went beneath what was considered adequate by the planners, government authorities and technicians began to denounce the "agreement."

The importation of rolled steel products rose substantially in the last 3 years, reaching in 1974 - according to the latest estimates - more than 60% of domestic production, and thus becoming the heaviest item in the Brazilian import roll after crude oil. The 1974 imports would have corresponded to 7% of the total of steel products marketed internationally in that year.

Debates were than encouraged about the entry of state capital in the subsector of nonflat steel products, and it seems that a somewhat original solution is being contemplated: the association of SIDERBRAS or of its subsidiaries with other state enterprises (in this case, CVRD) in the setting up of new projects. This scheme is already being used for one of the export steelmills (Itaqui, in Maranhao State), in which SIDERBRAS and CVRD jointly own 51% of the capital shares, and Kawasaki (Japan) and Finsider (Italy) 24.5% each. There is now the possibility that CVRD might associate with USIMINAS for setting up steelmills producing nonflat products. Although the immediate reason for the association of the state enterprises in question is quite prosaic (CVRD would have a sufficient volume of resources available), the reaction of the private sector, in view of the implications of the project, might endanger this kind of solution. Parallel to that, a more concrete possibility is the association between SIDERBRAS or its subsidiaries and private enterprises in the steel sector for the purpose of carrying out new projects.

Lastly, an important change that is beginning to take place in the sector should be mentioned. The new projects of steelmills producing nonflat products establish the utilization of the process of direct reduction instead of that of oxygen conversion. Direct reduction has been applied so far in Brazil in small-size projects and in the production of nonflat and special steel products only. The new projects referred to above are of medium-size steelmills (production of 1 million of ingot equivalent per year). Among those new projects there would be one of a mill that would produce nonflat steel products and would be formed by the association of USIMINAS, SIDERBRAS, and CVRD. It would be the first experience of a state enterprise that would produce nonflat steel products utilizing the process of direct reduction.

The great advantage of the process is that it eliminates the difficulties related to the use of metallurgical coal, although with a high consumption of electric power and of natural gas.

Given the diffusion of information about the process of direct reduction, and, moreover, the fact that, out of three state enterprises, COSIPA and CSN will have exhausted the physical possibilities of expanding their plants after the setting up of Stage III of the Steel Plan on account of a shortage of utilizable space, those two enterprises should begin to contemplate now the adoption of the new process in their new plants. The new process would imply the construction of several small- and medium-size steelmill units instead of each large-size blast furnace. In other words, it would imply reexamining the question of the greater productivity and profitability of large-size plants (the blast furnace) over a series of medium-size plants.

VENEZUELA

TECHNOLOGICAL BEHAVIOUR OF MIXED ENTERPRISES IN THE PETROCHEMICAL INDUSTRY

Introduction

This section analyzes the technological conduct of the mixed enterprises in charge of the production of intermediate products in Venezuela's petrochemical industry.

A technical report by the Venezuelan Petrochemical Institute (IVP), referring to the initial phase of this industry (1957-68), points out that the plans in effect at that

moment and the selection of the localization of the enterprises had no real vision of the future development of the industry. The omission of the necessary preinvestment expenses for an undertaking of this nature, among other factors, explains in large part the evolution of the Institute, as a certain volume of its losses in later operations was due to omitted preinvestment investments or to those added in later as ordinary operational expenses.

A negative aspect that can be pointed out in this early stage is the delay in the times allotted for the development of the projects - produced in part by inexperience on the part of the country itself and the span of the projects and in part by national political changes - and the stoppage of the flow of funds needed for the investment. At any rate, from the point of view of technological aspects, a national capacity for taking steps was created.

In an analysis of the transfer of technology during this period (1), it was shown that in all the accomplishments, including the complex industrial infrastructure for providing the necessary services for plant operation and urban development, there was a disintegration of technology within the possible limits for the period. Acquisition of equipment was carried out directly by IVP through innumerable bids; public works not undertaken by the Institute's personnel were contracted to Venezuelan firms working under its supervision. Almost all of the setting up was done by the Institute's personnel, part of which had received training for 1 or 2 years in similar plants outside the country, and finally the IVP personnel, aided by experts and operators from other countries, proceeded to put the plants into operation successfully. It must also be pointed out that the national and international marketing was done directly by IVP, using very few intermediaries; in the case of fertilizers, IVP installed its own distribution, sales, and technical-consulting system, which covered all the national territory.

Even though, in this initial phase of development, petrochemistry presented a series of problems from the point of view of efficiency, it led to the formation of a national technical capacity, which, with more experience, has now been incorporated in later stages.

Since 1966 a new orientation in national petrochemical development has been seen. It is believed that IVP cannot confront all the petrochemical development processes by itself, and the necessity has been established for private enterprises as well as national and international interests to participate and contribute to the efficient and rapid development of the sector.

Related to the substitution of imports, the concept of the structure of the integrated complexes of IVP, and the resulting development of mixed enterprises, the main idea is vertical integration, which permits the substitution of one series of imported goods, thus diminishing the quantity of revenues that leave the country.

The constituting of mixed enterprises would be done so that the participation of national capital is preferentially that of a majority; that the fundamental decisions could never be made without the affirmative vote of the state or government representative; and that there would be necessary guarantees for obtaining the financial resources required for carrying out its projects, given in proportion to the capital invested.

The real beginning of petrochemical development in Venezuela is the execution of the El Tablazo Petrochemical Complex. In this new stage of development of the national petrochemical industry, significant changes in the modes of technological transfer occur. In this respect and in relation to the basic products industries, as of 1964 the turn-key contracts become dominant, a result of the negative balance of earlier activities.

However, based on the examples of the Explosives Complex and of fertilizers, the idea was to overcome the delays in the execution of projects, but the idea failed and the capacity for national applications even diminished. That is, the new method of contracting, apart from the disadvantages it presented from the point of view of national technological development, did not fulfill the goals of production, the diminishing of national capacity for projecting being one of the gravest problems in the sector, now that the development of petrochemistry is even more demanding in this sense.

In conclusion, it was observed that in spite of the comparative advantages of Venezuela for the development of a strong petrochemical industry, this has been characterized until now by a lack of adequate planning; by delays and lack of coordination in carrying out projects; by the absence of development of national capacities in diverse areas; and finally, and partly as a result of the above, by its being a permanently

deficit-prone industry where - in addition - the policy of the government has been to subsidize, through the petrochemical production, other sectors in the economy.

Regulatory Instruments

As seen above, mixed enterprises within the national petrochemical industry arise from a new orientation given to the development of the sector in 1966. The objectives of the program of mixed enterprises, within the framework of the objectives for national development, were the following:

(1) To diversify the sources of the country's revenues to compensate for the slow growth of petroleum exports.

(2) To increase as much as practically possible the aggregate value, which, by processing, maximizes the value of Venezuela's renewable natural resources.

(3) To increase the number of employees, although this is not an important characteristic of this industry.

According to a pamphlet published by IVP, interest in the creation of mixed enterprises with private capital was based on the contribution of the private partner in the following:

(1) A capacity for international marketing, which permits a large volume of production, as is required by modern technology, thus being able to overcome the disadvantage of the lack of an internal market of the necessary scope.

(2) Modern production technology, not only in what relates to accumulated development but also in what permits a continuous and opportune flow of future developments.

(3) A capacity for proposing projects, which reinforces the management and technical potential currently existing and which can be available in the future for IVP.

(4) Contributions of capital, which make possible a more rapid and extensive development of the petrochemical industry, and alleviate the financial burden of IVP in the case that it has to take over the development of this industry alone, requiring the use of large amounts of capital.

If these are the reasons and new arguments for the association with private capital in general, it is evident that this type of aid cannot be given, with the exception of the last point, except by a foreign private partner.

As an initial observation in relation to these reasons, it can be shown that a primary reduction of alternative sources of technology is implied when the foreign partner, whose basic contribution is carried out through technology, has to be able to speculate and enter the international market. That is, in this case the foreign partners must be only producers, being the only ones able to meet all the requirements.

On the other hand, this type of reasoning tends to strengthen the purchase of package technology, the type tied to elements of a nontechnical nature, such as financial aspects and the position in the international market.

The minimal conditions of negotiation established by the Subdirectional Office of Mixed Enterprises were as follows:

(1) The foreign participation would be to a maximum of 49%, depending on the volume of production dedicated to export.

(2) The Statutes of the enterprise must insist that basic decisions be made only with the favourable vote of the IVP representative.

(3) IVP representatives must participate in the administration of the enterprise, and to this effect mechanisms are established for cooperative decision-making and the rotation of responsibilities.

(4) Sales on the national market will be carried out by the mixed company or by IVP.

(5) Sales on the international market will be carried out by the mixed company, using the international partner as agent, plus IVP and/or any other agent selected by mutual agreement of the parties involved, IVP reserving the right to act as sales agent in negotiations with national and foreign governments.

(6) Agreements must foresee, on the part of the enterprise, a policy of

Venezuelan personnel training, with the goal of preparing these persons for the majority of the jobs available on all levels.

(7) Possible partners cannot be directly or indirectly associated with engineering firms or equipment factories, with the goal of avoiding conflicts of interest.

(8) Agreements must foresee that the carrying out of projects be through bidding by competitive firms, with the enterprise establishing the method of contracting.

(9) Each enterprise duly constituted must dedicate at least 1% of its sales to scientific and technological research to be done in Venezuela.

It is clear that the mixed enterprises of the national petrochemical industry do not possess at this time sufficient criteria, legal and explicit, for their regulation, the only instrument being, for the Venezuelan government, the minimal conditions for negotiating established agreements with no legal backing by the negotiating group of IVP. The effectiveness of these, as well as the validity of the criteria assumed by the association of foreign capital, will be analyzed, now that their efficiency is reflected in the functioning and practice of the said enterprises.

Formal Government Decision-Making Powers

The analysis is based on three basic indicators: the composition of capital and of boards of directors and the role of the foreign partner.

With reference to the composition of capital, and in accordance with the minimal conditions for negotiation established by IVP whereby the maximum participation by foreign investors would be 49%, national capital is in the majority position, although exceptions were made for two enterprises: Monomeros Colombo-Venezolanos and Produven.

It is immediately obvious that government capital has an important specific influence on the other eight enterprises in the study, of which only VENOCO and OXIDOR show, because of the specific period in which they were constituted, a majority participation in national private capital. Apparently, IVP maintains a high decision-making power in terms of its partners.

The financing of the total estimated investment, of which social capital represents only 31.7%, is carried out mainly through credit tied to the providers of technology and equipment. This type of relationship of businesses with the financial agents undoubtedly diminishes the effective decision-making power of the government, at least in what refers to a real technological transfer.

One might think that this diminishing of the decision-making power of the government is a logical result of the bases upon which the Program of Mixed Enterprises is built; that is, the fact that private capital, basically foreign in source, is incorporated into the function of its aid to technology, financing, international marketing, and decision-making powers.

It can be supposed that in practice the partners who dominate technological aspects and, in some cases, financial dealings are the ones who really carry most weight at the moment of decisions because they are the ones most knowledgeable or sometimes the proponents of alternatives upon which decisions are to be made.

One-fourth of the stock underwritten by foreign capital does not come from the contributions of revenues but from the price paid for the technology as evaluated by its owner. This is technology that has been sold, generally, in other countries and surely has also been funded. In these cases, with a minimal or nonexistent investment, the foreign partner earns a significant percentage from the utilities. To this should be added that when foreign partners capitalize on their technology, they generally charge an additional royalty, with which are made a total of royalty earnings plus those for utilities.

It has been observed that foreign partners have been selected on the basis of the technologies they offer, which means that dominating the central technology gives advantages and greater influence in decision-making relative to the rest of the technological components. Also, in the technical agreements signed between themselves and the companies, the information and technical assistance for the commercialization of the product are generally included, the latter being related to the fact that some of them are directly in charge and, in any case, have voice and vote for the selection of the agents to commercialize. This gives a clearer idea of their real power within the

enterprises.

Apparent decision-making power is really reduced. The actual capacity of decision-making in any one of the partners finally depends on the domination each one exercises in the production and distribution of the products. In the case of mixed enterprises, the domination over fundamental areas is exercised by the foreign partner. This is the more or less logical result of the type of argument put forth for the creation of mixed enterprises in the petrochemical sector.

The Process of Technological Negotiation

IVP, besides being the organization responsible for the development of the petrochemical industry, is also a centre for proposing projects that determine the elaboration of a given product, carrying out promotion of it based on a feasibility study, and initiating the process of buying technology.

With the features established in the minimal negotiation conditions for technology, in spite of not setting up any legal framework, a team of negotiators was organized in 1969 for the area of mixed enterprises.

The steps to be followed in the process of evaluation and initiation of negotiations are as follows:

(1) A study of technical-economic information is performed, on the basis of which the plant capacity is determined and a selection of possible dealers is made.

(2) Contacts with dealers are made to solicit information such as: experience in the production of the product selected and the technological advances achieved; the situation as to patent ownership and licences, and an indication of the costs and conditions of their transfer; capacity of the international market for the product considered; description of the process, diagrams of flow with indications of the major equipment and balance of materials and heat; indications of the existing plants that use the process, their dominion, affiliates, or third parties. For the level of production indicated, the following are required:

- Estimates of the total investment, including services.
- Specifications for raw materials and finished products.
- Unit consumption of raw materials, auxiliary materials, and services.
- Technical, administrative, and operational personnel required.
- Area required for the plant.
- Any other information that contributes to a better evaluation of the process and permits a greater understanding of the company's position in regard to the project.

(3) There is an evaluation of the information received and the associated criteria. This evaluation is complemented with meetings of the parties, visits to the plant, and, at times, tests of the product. Based on the results of these, an order of priorities is established among the different firms. The first two or three are taken and a preliminary Technical Agreement is requested. A preliminary Investment Agreement is turned over to the possible partners. The Investment Agreements contain a series of previous commitments to the constitution of the mixed capital company, which are agreed on by both parties. These agreements are of vital importance because they must reflect the minimal conditions for negotiation established by IVP. The major points they contemplate are as follows:

- A study of the market, which must be carried out to the satisfaction of both parties.
- A study of economic feasibility.
- Confirmation of the availability and prices of raw materials.
- Location of the plant.
- Confirmation of the availability of financing.
- Conditions for patent licences, technical knowledge, and factory brands.
- Conditions for the contracting of process engineering.
- Methods of bidding for the plant's construction.
- Constitutional document and Statutes for the mixed capital company.
- Sale of products, which must be undertaken, and their prices.
- Possible bonuses to IVP in contributions to the national market in the form of a captive market.
- Reinvestment obligations.

- Amplification policies to maintain the export market as the national market expands.
- Policy for scientific and technological research to be carried out in Venezuela.

The Technical Agreements contain conditions by which the acquisition of a licence for a determined process is possible, by this means separating other components of the technological package.

These Agreements are revised, taking out those clauses on which agreement exists, those in which flexibility is possible, and those that require more discussion, reinitiating talks until a solution is agreed on by both parties.

Below is a revision of both types of Agreements made by the varying mixed enterprises:

Technical Agreements and Engineering Contracts: The acquisition of technology by mixed enterprises is carried out, at least theoretically, in two ways. The first is based on the selection of the process of production by the IVP technicians, who obtain information on some preselected processes and then choose from these; the result of this is a Technical Agreement. Generally this leads to the acquisition of a licence, process information, basic engineering, technical assistance, supervision of other stages, training of Venezuelan personnel, and aid to commercialization. These contracts will be referred to as Type A contracts.

After selecting and contracting the above, one or more bids are heard from the contracting of detail engineering, purchases of machinery and equipment outside the country, the supervision of construction, and setting up the plant. These contracts will be referred to as Type B contracts.

Finally, it is supposed that the company will contract the installation, setting up, placing in operation, and acquisition of equipment directly with Venezuelan firms. Actually this does not always occur, and there is little uniformity in the form of technological negotiation.

TYPE A Contracts: The contractor is usually an international firm, one that has bought a licence or is a subsidiary of another firm that has developed the process and is also a producer of the same product whose technology is under negotiation. Ordinarily this firm has installed similar plants in other developing countries. In Venezuela, the majority are American or French firms and the contracts made with them include the obtaining of export or exporters' credit; that is, most of the negotiations imply financing tied to the contract.

On the other hand, the contractor is usually a foreign partner of the mixed enterprises (whenever they have such), and the partner's contribution of capital is generally made through the capitalization of the technology.

In those firms with no foreign partner (OXIDOR and FERRALCA), the contracts for technology are turn-key with the providing firm; in other words, they include all the services of the Type A contracts plus those of Type B and even some of the phases that should be contracted for separately within the country.

The object of this type of contract, as shown above, is the licence, the processing of information, the basic engineering, technical assistance on all levels, commercialization assistance, and continuing information, generally unilateral or that of the provider toward the enterprise. There are no great variations among the various enterprises, although it can be pointed out that in some are included, as objects of the contract, technical aid to administration and organization manuals. It is also the case to include overseeing of research activities done by the mixed enterprises, with 1% withheld based on the Investment Agreement. In all areas considered objects of this type of contract, local intervention is nonexistent.

Types of contracts vary between "lump sum" contracts and "lump sum plus royalties" contracts. The latter are either for net sales or the produced TMA. In addition there are the turn-key type of contracts with the restrictions this implies.

The duration of contracts is generally for 10 years, in some cases renewable, and there are some for 12 years renewable also.

In these Type A contracts there are restrictive aspects, expressed in clause form or not. These include the following: prohibitions on exporting to certain areas,

prohibition on ceding technology to others, restrictions on the volume of production - taxing the surplus with a royalty, imposition of products (a catalyst, for example), the obligation to report on all improvements or developments introduced in the processing, prohibition on modification of the original design of the plant, restrictions on the application of the continuing information, fixing a minimum royalty - whether the plant produces what is sufficient or not, overseeing of research and development plans, and monopoly rights through the mixed enterprises in the Andean subregion.

Finally, it can be pointed out that the contractor obtains a series of facilities on the part of the Venezuelan government, normally relative to obtaining import permits, clearing away red tape, etc. Among the protective clauses, it should be noted that sometimes the foreign firm, at the same time a producer, obtains a monopoly on sales for its product in the country, at a time when the Venezuelan market can be covered by the mixed enterprises; this has caused a delay in time for installation in at least one plant. This means that although this measure was presented with the idea of creating or widening the market for a determined product, it has been converted into a weapon that hits both ways, allowing the foreign firm to obtain many additional benefits.

TYPE B Contracts: As was shown above, type B contracts generally have the purpose of detail engineering and the purchase of equipment and machinery. The diversity of contracting methods obliges their presentation as cases, as a generalization would impede the correct illustration of what happens in reality.

Costs of Technology: The costs of Type A contracts - those for processing, basic engineering, and technical assistance - are around 10% of the total expenses for the enterprise. It should be remembered that it is for these elements that the company's foreign partner is selected and from its contribution is where it capitalizes. This means that the market conditions for technology and the lack of local infrastructure permit that for a contribution of 10% of the total investment of a company a foreign firm can control an important percentage of the shares in that company, earning corresponding benefits. Besides, Venezuela's weak negotiating powers lead it to turn-key contracts with this partner or to contracts that, though not turn-key, imply a series of purchases of services, machinery, and equipment from the same country of the firm that provides the process.

In this situation it is clear that the financing aspects play a fundamental role, the normal obtaining of which is connected to the partner in question. In most cases the financing is tied to the purchase of services, machinery, and equipment in the country providing it; however, the countries that provide the technology give favourable financing conditions - interest, commissions, terms - from the point of view of economic benefits for the national investor. As this financing in other countries responds to government policy of protection for industry, it will be very difficult to overcome the situation in Venezuela without local financing mechanisms. Another very important aspect is that of guarantees. On agreeing to a turn-key contract or acquiring different elements with interrelated firms or firms powerful in their field, guarantees for normal and adequate functioning of a plant are obtained. The introduction of national components within the package makes such guarantees difficult to obtain. Because of this it is logical, up to a certain point, that there is a tendency toward the type of negotiations that have been carried out so far.

The Type B contracts (nonpatentable elements), usually made with a firm that also acts as contractor and subcontracts others, carry the highest percentage of the total investment. From this value, Venezuela takes nearly one-half, devoting this part to the machinery and equipment, which represent approximately 25% or 30% of the total investment. The reasons for and the type of credit accompanying such contracts have been seen, but even within the actual financial framework the conditions of this type of negotiation can be improved; some cases of it have already been seen.

In conclusion, the cost of the patentable aspects of technology does not justify the association conditions with foreign firms, nor the negotiations with other firms that are not partners; but these conditions are fully reinforced by the characteristics of the technology market and the market for financial capital.

Training of Venezuelan Personnel: In the mixed enterprises analyzed, agreements on personnel training are generally included in the negotiations for processing information and basic engineering, i.e., the Technical Agreements. In some cases it is not stated concretely what the training refers to; in others it only covers operational

aspects of production, and in those that go further in theory, this is neither qualitatively nor quantitatively sufficient.

As a result, the form in which training has been carried out up to the present by the provider firms, has given hardly any results, and the degree of schooling obtained has been quite low as it is not based on real training but rather on instruction dedicated to covering a given formula.

MEXICO

THE CONTRIBUTION OF TRANSNATIONAL CORPORATIONS TO NATIONAL TECHNOLOGICAL DEVELOPMENT

The following discussion presents data from the Mexican survey for the purpose of analyzing to what degree research and experimental development are contributing to the process whereby a transnational corporation could aid in local technological development (2).

In the sample of 67 firms visited, 34 companies had foreign participation higher than 20%: 12 in capital goods, 11 in petrochemicals, and 11 in foods (3). (At least 27 firms had foreign participation equal to or higher than 40%, and the general average of foreign participation for the 34 companies was 51.2%. It is correct to assume that foreign control of the strategic decisions of these firms exists.) In accordance with the hypothesis of numerous authors, this study examines the position of these firms in relation to their possible contribution to technological development. The first point concerns the contribution of technology to the industrial apparatus of the recipient country.

At the time of the interview, 27 of the 34 transnational corporations were licensees in contracts for technology, and 31 declared that the head firm was the source of the technology that they were using. Still, within this group of subsidiaries, 10 declared that they themselves had developed at least part of the technology used, but in two cases the transnational firm had acquired companies previously in operation; moreover, five of these cases were located in the foods branch, where the technology is basically in the public domain. The average level of exports is lower in firms that figure as licensees in contracts for technology. Consequently, if these companies are indeed more efficient as a result of their modern technology, this efficiency is not benefiting the country in terms of increasing its exports. On an average, the transnational corporations (TC) of the sample maintained a level of utilized capacity of more than 77% (logically, this level came out higher in the petrochemical branch), in contrast with a level of 66% for national firms. However, the TC exported only 15% of their production against 17.6% in the national companies. In fact, the advantages of the TC enable their subsidiaries to reach dominant positions in national industry, a situation that is not necessarily translated into a net gain for the host country (4). Finally, the contribution of modern technology cannot be considered as desirable in all cases: in a country like Mexico where no guidelines on regional development or reclamation of natural resources exist, where no clear policy on environmental conservation is available, modern technology can have disastrous effects.

In the second place, it has been asserted that the TC can contribute to local technological development by conducting research and technical activities in the host country. This discussion will examine the problem of decentralization of technological research within the transnational corporation, especially from the point of view of the host country.

The question is closely linked to the model of organization and planning within the TC. To what degree do the TC carry on these activities in a decentralized fashion? In a now classic study, Rubenstein (5) analyzed three basic models of organization of R&D in a transnational enterprise: first, the centralized model, in which all R&D efforts are conducted in a central laboratory (while other departments perform some minor research on adaptations); second, the decentralized model, in which research activities are distributed throughout various sections and departments of the TC; and third, the mixed model, in which a central laboratory conducts basic research that might be of an exploratory nature or have long-range implications, while departmental laboratories are

responsible for applied research and experimental development. The following important factors favour the adoption of the first and third models:

- (1) The coordination of research performed in a decentralized manner is more difficult and represents additional costs.
- (2) Normally, there are restrictions in terms of the critical masses of human resources, external economic factors (such as the support services for R&D: documentation, computers, etc.), and economies of scale that work against decentralization.
- (3) There is the chance to distribute certain fixed costs among the subsidiaries, even though (as Vaitos has demonstrated) a particular subsidiary might not benefit directly from investment in R&D at the level of the head firm.
- (4) In the case of joint investment, there are fears of losing control of the technology.

Numerous recent studies confirm the existence of this tendency toward centralization. For example, Baranson notes that the majority of transnational companies do not consider it necessary to change their R&D activities in face of the needs of developing countries. Other than indicating that their programs for training human resources constitute an "adequate contribution" to the scientific development of the host countries, the TC do not find a reduction in the technological dependency of those countries either "possible or desirable" (6). Without resorting to simplistic explanations, it is important to recall that in their planning strategy many TC take into account their experience in Japan, which contributed to the creation of competition, which has seriously affected their interests.

Furthermore, even though a subsidiary may conduct R&D activities in some cases, it is not very likely that it would participate in the decision-making process at the strategic (or global) level of the TC, and its involvement in planning the activities of the corporation would probably be limited to the sending of information. It is not surprising, then, that the most common organization schemes for TC do not incorporate the subsidiaries at the various levels of strategic planning. For example, the outline offered by Eric Jantsch establishes the following levels: (1) board of directors; (2) horizontal groups at the level of the entire enterprise (including R&D laboratories); (3) divisions or departments (7). The subsidiary of the transnational enterprise does not participate at any of these levels. The subsidiaries may serve for transmitting information on local conditions or on investment and commercialization opportunities (valuable inputs in planning), but the direction of the TC will be determined on the basis of a vision that incorporates the fragmented point of view of the subsidiaries (8).

For the subsidiaries included in the sample, the picture is similar. Table 2 shows the various degrees or levels of participation of the subsidiaries in planning the R&D activities of the TC. Out of 34 subsidiaries, 18 indicated that they did not take part in the process; four reported that they participated in determining new lines of research; and in 12 cases, participation took place in a variety of ways (exchanging information, putting into practice experimental development programs designed by the head firm, or adapting certain aspects of the technology, etc.).

The more intensive participation in the foods branch stands out. This is an industry where products must be carefully adapted to local patterns of consumption, and for this reason the adaptation of product technology is indispensable. Moreover, the channel of competition that predominates is the diversification and differentiation of products, which also requires the performance of research and experimental development. In petrochemicals, adaptation to local inputs becomes a critical problem, but does not necessarily imply active participation in determining the directions of R&D in the global enterprise.

In summary, the participation that the subsidiaries indicated is in fact a manifestation of the division or decentralization of certain assignments, but apparently only very few cases involve decentralization of the decision-making process itself. Some subsidiaries that did not participate in determining the research program at the head office were nonetheless executing parts of that program at their installations in Mexico. Thus, of the 20 subsidiaries that indicated they were performing R&D activities (9), five were not participating in the process of planning the research activities of the TC. And in 11 cases, the subsidiary was trying to develop knowledge that had been generated in the head firm or another affiliated company. Finally, the wish that the TC would decentralize toward the developing countries the performance of activities concerning the

first phases of the product cycle appears to be an illusion rather than a feasible project, at least with the existing policy instruments.

The third point involves the links of the subsidiaries with the scientific and technological system of the host country. As a group, the companies in the sample had few relations with R&D centres: 44 of the 67 had never had working relations with the research centres in the country. And among the 23 who maintained some form of link with these centres, there is a very high incidence of foreign subsidiaries: 15 fall into this category. It would seem that the TC contribute to tightening the bonds between the scientific system and the industrial apparatus.

However, the same conclusion cannot be reached when the type of relations that the TC maintain are examined. The performance of technical activities through the use of the R&D centres predominates. The data on these activities are presented in Table 3. The only enterprise that used a research centre for experimental development maintains close relations with the Mexican Petroleum Institute and needed to develop a process to make use of a subproduct. Only with difficulty could one consider the cases of quality control and training of human resources as contributions to national technological development. The only benefit for the local scientific system derived from such activities as solutions of technical problems, advice, and adaptation of technology would be the acquisition of greater experience. But the cost of all the services mentioned above is less for the TC than if it were to contract for them in its home country (10).

The fourth point is also another reason for which the TC have hired national engineering firms for the execution of their projects. In contrast with other Latin American countries, various firms that specialize in offering industrial engineering services have been formed in Mexico (11). An analysis of 255 projects in which the three principal engineering firms participated reveals that 154 (60%) were projects with subsidiaries of TC. But this fact does not imply that the origin of the technology was determined by the engineering firms or that the national component of capital goods increased. Nor does it imply that national engineering firms have acquired the capacity for developing basic or process engineering. The first national firm emerged 25 years ago, and to date the services that it offers (basic and detail engineering, supervision of projects, and construction) are closer to technical activities of production support than to technological research and development of processes. Clearly, the use of these firms by the TC has contributed to their growth and diversification, but if there is any desire to attain a capacity for basic engineering, other modalities will have to be put into effect in the operation of the engineering firms.

The fifth point concerns the sensitive question of the adaptation of technologies to local conditions. The survey data on adaptations in the technology of production, products, and materials show that the subsidiaries use essentially the same technology employed by the head firm. Adaptation of production technology has been conducted basically in terms of local inputs: 27 of the 34 TC indicated that they had had to adapt technology to the characteristics of local inputs. Yet only four companies in capital goods and five in petrochemicals had completed adaptations to the scale of the market. And in terms of modifying technology in accordance with the proportion of factors, only six subsidiaries (three in capital goods and three in foods) declared that possibilities existed for using more labour in their processes, but none had realized changes in technology to substitute between factors.

In product technology, few adaptations to local conditions are found. Even in the food industry, these modifications are minimal because diversification and artificial differentiation of products (consumption technology) predominate. In the petrochemical industry, the adaptation of the product is restricted because it would normally imply a different process. And in the capital goods industry, this type of adaptation is linked to the forms that competition takes in each branch. For example, three subsidiaries in the agricultural machinery industry had modified parts of tractors and implements because of a need to furnish them with greater resistance and to facilitate maintenance of their equipment (since the network of distributors and repair shops are an important variable in this branch). These are adaptations of the product according to the preferences of the consumers. As can be observed, in Mexico the transnational corporations are not modifying the basic designs of their products to adapt them to a set of conditions that may be quite different from those that the same firms might find in other countries. In the uniformity of their lines of production and methods of commercialization rests one of the greatest advantages of the transnational companies, and the attempt to have them give it up implies the existence of powerful policy instruments.

Slight participation of the national capital goods industry appeared in the TC visited during the study. Table 4 shows that the purchase of capital goods of national origin varies in each branch. The higher participation of national equipment in the petrochemicals area seems uncommon and is fundamentally due to five firms producing resins (whose preparation does not require very sophisticated capital goods). In the preparation of other petrochemical products, the use of national equipment is much lower. In transnational firms in the foods branch, the participation of local equipment increased due to three TC that process fruits and vegetables who had acquired in Mexico machinery that had a cheaper price but the same efficiency as that available abroad. However, in the same branch three other TC indicated that their capital goods were almost 100% foreign. The assertion that transnational firms encourage local producers of machinery and equipment cannot be considered valid for all industrial branches. Indeed, as the strategy of industrialization did not favour the production of these goods and as strong incentives to import capital goods exist, the TC have not found themselves having to acquire such goods in Mexico.

Finally, the transnational firms may contribute to technological development through the training of human resources. It is difficult to measure this contribution, because increases in productivity are distributed via different channels. Certainly, the host country can derive some gains from this point of view, but the fruits of an increase in productivity can also be absorbed by the TC. Of course, the trained personnel can leave the subsidiary and offer their services to another firm, but this contribution is difficult to evaluate.

Lastly, the nationality of the directors of the subsidiaries, their size, and the national origin of the head firm did not turn out to be pertinent variables for the analysis of the technological behaviour of these corporations.

A large portion of the studies of the emergence and importance of the transnational corporations reveal a perspective limited by formal and ahistorical considerations. The TC is viewed (a) as a response to the necessity of protecting access to sources of raw materials or positions in a fixed market (12); (b) as the creation of modern techniques of commercialization (marketing) and corporate planning (13); and (c) as a result of the linking of national financial capitals (14). As conclusions, the analyses derived from such approaches offer various means through which developing countries can benefit by the presence of the TC.

However, the central defect of these studies is that they ignore that the transnational corporations are the consequence of a complex process of the internationalization of capital. This process is something more extensive than Robin Murray or Stephen Hymer propose when they use this terminology (15), and implies the internationalization of the diverse fractions of capital (financial, industrial, commercial) and the growing oligopolization of the principal branches of industry at the world level (16). Without a clear awareness of the nature of this process and without relying on a precise strategy for industrial development, it is absurd to suggest that the TC can be used in one way or another. Indeed, the historical approach to the presence of the TC at the world level does not conceive of the existence of alternative strategies for industrial development in which severe restrictions have been imposed upon these corporations (17). In this context, it becomes difficult to define in the abstract just how the TC can contribute to technological development in Mexico if a selective strategy for industrial development has not been concretely defined. Nevertheless, the following discussion points out some measures that should be implemented, independent of that concrete definition.

The Law on Foreign Investments of 1973 aims to regulate the amount and the orientation of direct foreign investment (DFI) in Mexico. This goal arose out of the growing preoccupation with the impact that DFI has had and will have on the process of economic development, and in particular on the process of industrialization. The way in which the instrument seeks to reach this objective is through the definition of sectors in which the participation of foreign capital is not acceptable (perhaps because they are reserved for public or national investment); of sectors in which such participation is acceptable up to 40%; and through fixing a participation of no greater than 49% for all those cases in which Mexican legislation does not specify a percentage. Moreover, the criteria that the Commission can use also serve as guidelines for orienting DFI.

However, whether the objective indicated can be reached depends on various factors. In the first place, this policy instrument does not attempt to rectify the course of the strategy of industrial development that has been followed to date. That strategy

had ingeniously postulated a merely complementary part for DFI, but in practice it has led to a situation in which foreign investment not only competes with national investment (in the search for sources of financing, in the struggle for new and larger markets), but displaces it and puts itself in a position from which it has the capacity to direct the process of industrialization. On the other hand, the strategy for development imposed no limit on the types of techniques that could be used; it established a captive market to which foreign capital had (and has) access; it fixed no sort of restriction with respect to the possibility of remitting capital abroad; and finally, DFI has been able to benefit from the instruments of industrial promotion via fiscal incentives (offered by the Law on New and Necessary Industries, and by the Decree on Decentralization and Industrial Development, Certificates for Rebate of Indirect Taxes for promotion of exports, etc.), credit lines (FOMEX, FOMIN, etc.), subsidies through low prices on agricultural products (which in turn permits low salaries) and raw materials, as well as on energy. Consequently, direct foreign investment has had complete liberty to enter the branches that seem most attractive, to produce the goods that suit it and to produce them as it wants, to locate itself anywhere, and to repatriate its profits at whatever speed it finds convenient (including the short-term recuperation of its capital). In sum, industrial policy has not concerned itself with complementing the ties of the interindustrial structure, but with maintaining high rates of earnings for the national or foreign capitalist.

The result is that the amount and orientation of foreign investment are determined by the characteristics of the existing market in Mexico (urban, intense concentration of income, with a preference for consumer goods of greater income elasticity, etc.), the guidelines for financing, and all the elements that form what can be called the style of recent development of the Mexican economy.

In this context, the Law on Foreign Investments is little more than an instrument that struggles against the current and that finds itself in the bad company of a policy of industrial promotion that is scarcely selective or not selective at all. Furthermore, this is a very weak instrument, badly designed, through which it cannot be seriously hoped to regulate the amount and the direction of DFI. On the one hand, a company whose equity is 49% foreign can hold 100% of the stock of another firm without this being considered a foreign investment. On the other hand, the most serious omission consists of the failure to define clearly that foreign investments made after the Law came into effect must be approved by the Commission on Foreign Investments. The interpretation of Article 5 is not easy and has given rise to failure to require approval of the Commission for foreign participation up to 49% (although registration with the Registry is indeed demanded). Given the text of Article 5, this interpretation cannot be upheld, because if the Commission can decide on the increase or decrease of that percentage (49%), all new foreign investment is necessarily subject to the approval of that organism.

Consequently, beyond the discussion of alternative approaches to the study of the TC and of the context in which the Law on Foreign Investments operates, it is undeniable that its possible use as an instrument of technological policy depends upon two elements: (a) the potential contribution of the transnational corporations to local technological development; and (b) the management of the technological criteria that have been set in the Law itself (article 13).

In the first place, it has already been suggested that since the transnational corporations have been established in Mexico, they can in some way be used to strengthen the country's development. Those who support this position insist that the way to obtain this objective is through the definition of a series of instruments that would control and direct the activities of these entities. Whether these instruments exist or can be designed is a very debatable question. What is certain is that by accepting this position, one also accepts the principle that the potential contribution of the TC is greater than the cost (in economic and social terms) associated with their activities.

Furthermore, if one begins from the assumption that the operations for the transfer of technology within the TC constitute one of the most important mechanisms for preservation of the monopolistic or quasi-monopolistic advantages derived from the process of technical innovation in the first phases of the vital cycle of a product, these organizations would scarcely be interested in promoting a technical development contrary to their interests. In the words of Vaitos, the product cycle is converted into a monopoly cycle in which the transfer of technology plays a central part in the sequential adjustments (in the life of the product) that permit lengthening the duration of monopolistic positions in the first phases (18). Thus, it is no surprise that 80% of the payments for technology coming from the industrial sector involve the payments of the TC. In sum,

the transnational corporations do not need the countries receiving DFI to reach a certain level of technological development.

Therefore, since the technology controlled by the TC is an important source of monopolistic advantages, no desire to decentralize the activities that generate this technology can exist. Numerous studies confirm the tendency toward greater centralization of research and development activities within the TC. The desire to keep the plans of the firm secret is not the only influence, for the global strategy of the transnational firm involves subsequently distributing the costs of research performed in the main firm among the subsidiaries (whether they have benefited directly or not from these investments). Also involved are economies of scale, the need to have adequate support services available, and the fact that in some areas a minimum level of investment is required for the research to be worthwhile.

The results of this study demonstrate that the subsidiaries of the TC use national research centres to carry out projects that could not, strictly speaking, be classified as research and experimental development (instead, analyses and tests, quality control, and solution of specific technical problems). Moreover, the great majority of the affiliates of TC that were visited did not participate in corporate strategic planning activities conducted in the head office. In some cases they are consulted, but this does not mean that the affiliate intervenes in the planning (in the same way that the activities that the affiliate must realize to adapt a process or a design to the traits of local raw materials or inputs do not imply altering the design of the product). In fact, the subsidiaries visited seem to have a vision quite partial to the global activities of the corporation.

In the second place, it must be recognized that the criteria that the National Commission on Foreign Investment can manage and that can be classified as technological are interpreted only with difficulty. In principle, any new foreign investment project can generate jobs and contribute new and more efficient technology to the already existing industrial plant. But as a comparison with alternative projects is never made, its opportunity cost is never known. Moreover, "the contribution to research and development of technology in the country" is a criterion that can turn out to be deceptive. Indeed, in a case where a subsidiary directly conducted research projects, it would be difficult to decide who was the beneficiary: the country or the corporation? The same question would be valid if a subsidiary of a TC happened to develop a new technology. Moreover, another case might present a subsidiary that uses its own personnel, installations, and human resources of the national scientific and technological system, as well as support services, to generate a new technology. The knowledge thus generated can be sent to the head firm to be used by other affiliates or to be licenced to other firms: national scientific and technological development will not have received any contribution other than the experience for the human resources who participated in the process. However, even this contribution also has its negative aspect in terms of directing part of the resources of the national scientific system toward the solution of problems that are not necessarily the most relevant ones for the country.

Table 1: Proposed PSN-1 Financing Scheme.

Resources for Expansion	\$millions
Enterprises' own resources and capital	131
Capital market	30
Financing operations	250
Deficit	244
Total investment (1)	655

(1) - Includes increases in the enterprises' circulating capital and additional investments in mining.

Source: National Steel Plan, Vol. 1, pp. 6-9.

Table 2: Foreign Subsidiaries in Mexico and Centralized R&D.

Number of Firms by Industrial Branch	Type of Participation in the R&D of the Transnational Corporation
Capital Goods	
10	Do not participate
2	Research on adaptations, exchange of information
Petrochemicals	
5	Do not participate
1	Determination of lines of R&D, research on adaptations
3	Experimental development and adaptations
2	Research on adaptations
Foods	
3	Do not participate
3	Determination of lines of R&D, research on adaptations
5	Experimental development
Total	
34	18 firms do not participate 4 help to define lines of R&D 12 participate in various ways

Source: Direct research

Table 3: Type of Relations that the TC Maintain.

Activities with R&D Centres	Subsidiaries (by industrial branch) that Used R&D Centres		
	Capital goods	Petrochemicals	Foods
R&D projects	-	1	-
Adaptation of technology	-	1	3
Advice on choice of technology	1	-	-
Solution of specific technical problems	1	2	3
Quality control tests	2	2	3
Preparation of human resources	-	1	3

Table 4: Origin of Machinery and Equipment Used by 34 Transnational Corporations in Mexico (Averages by industrial branch).

Sector	Imported	National
Capital goods (12 firms)	84%	16%
Petrochemicals (11 firms)	34%	66%
Foods (11 firms)	49%	51%

Source: Direct research.

NOTES

- (1) Luciano Reni, Transference of technology in the basic national petrochemical industry.
- (2) Part of the material presented comes from the study, Transfer of technology and multinational corporations in Mexico, presented by Alejandro Nadal in the meeting of researchers on Transfer of technology and transnational corporations, organized by the OECD, Paris, November 1975.
- (3) These 34 firms are also found in the sample of transnational corporations as defined by the research of Fernando Fajnzylber and Trinidad Martínez Tarragó, Las Empresas Transnacionales: expansión a nivel mundial y proyección en la industria Mexicana, Centro de Investigación y Docencia Económica (CIDE), Mexico, mimeo, 1975.
- (4) Fiscal methods do not seem to capture a substantial portion of the surplus, and the share of salaries in the value added to the TC is diminishing.
- (5) A.H. Rubenstein, Organization and research and development decision-making within the decentralized firm, in The rate and direction of inventive activity, Princeton University Press, 1962.
- (6) J. Baranson, Transfer of technology and the developing world: conflict and accommodation, presented at the International Conference on Asia and the Western Pacific, Canberra, Australia, April 1973. Another study that points in the same direction is Jack N. Behrman, Some patterns in the rise of multinational enterprise, Chapel Hill, N.C., Graduate School of Business Administration, 1971.
- (7) E. Jantsh, Technological forecasting in corporate planning, in Economics of information and knowledge, ed. D.M. Jamberton, Penguin Books, 1971.
- (8) For A.J. Cordell, the subsidiary merely plays the role of "lookout" in the planning process. Consult his study, The multinational firm, foreign direct investment, and Canadian science policy, Background study for the Science Council of Canada, Special study No. 22, December 1971.
- (9) These included at least one of the following activities: applied research or experimental development. Not one firm indicated that it was conducting basic research.
- (10) These data confirm the results of a survey of 13 R&D centres in Mexico conducted during the first phase of the research on the STPI project.
- (11) This investigation includes a special study on the emergence and modalities of operation of these firms. Consult A. Nadal (in collaboration with Mariano González), Las firmas de ingeniería en México, El Colegio de México, mimeo, 1976.
- (12) The analyses of Vernon point basically in this direction. See Soberanía en peligro, Fondo de Cultura Económica, Mexico, 1973. Also, L.G. Franken, Patterns in multinational spread of continental European enterprise, Journal of International Business Studies, Fall 1975.
- (13) Examples of this approach are numerous: W. Dymzsa, Multinational business strategy, New York, McGraw-Hill Books, 1972; Igor Ansoff (ed.), Business strategy, Penguin Books, 1972; H.B. Thorelly (ed.), International marketing strategy, Penguin Books, 1973; and, of course, numerous articles published in the Harvard Business Review and Long Range Planning.

- (14) S. Hymer and R. Rowthorn, Multinational corporations and international oligopoly: the non-American challenge, in *The international corporation*, ed. Charles P. Kindleberger, MIT Press, 1970.
- (15) R. Murray, The internationalization of capital and the nation state, in *The multinational enterprise*, ed. John H. Dunning, New York, Praeger, 1971; S. Hymer, *Empresas multinacionales: la internacionalización del capital*, Buenos Aires, Ediciones Periferia, 1972.
- (16) See the development of this thesis in Christian Palloix, *Las firmas multinacionales y el proceso de internacionalización*, Buenos Aires, Siglo XXI, 1975.
- (17) As Christopher Freeman points out, two of the countries that have had the greatest success in their industrialization policies are distinguished by the restrictions and controls they impose on the TC: Japan and the U.S.S.R. Consult Comment to the chapter by Mr. Pavitt, in *The multinational enterprise*, op.cit., pp. 86-88.
- (18) Constantine Vaitzos, *Income generation and income distribution in the foreign direct investment model*, Cambridge, Harvard Business School, unpublished doctoral thesis, 1970.

Appendix 1
INSTITUTES AND COUNTRIES PARTICIPATING
IN THE STPI PROJECT

Argentina	Secretaria Ejecutiva del Consejo Latinoamericano de Ciencias Sociales (CLACSO) Country Coordinator: Eduardo Amadeo
Brazil	Financiadora de Estudos e Projetos (FINEP) Country Coordinator: Fabio Erber (until September 1974) and José Tavares
Colombia	Fondo Colombiano de Investigaciones Cientificas y Proyectos Especiales "Francisco José de Caldas" (COLCIENCIAS) Country Coordinator: Fernando Chaparro
Egypt	Academy of Scientific Research and Technology Country Coordinator: Adel Sabet (until July 1975) and Ahmed Gamal Abdel Samie
India	National Committee on Science and Technology Country Coordinator: Anil Malhotra (until June 1975) and S.K. Subramanian (until March 1976)
South Korea	The Korea Advanced Institute of Science (KAIS) Country Coordinator: KunMo Chung
Mexico	El Colegio de Mexico Country Coordinator: Alejandro Nadal
Peru	Instituto Nacional de Planificacion (INP) Country Coordinator: Enrique Estremadoyro (until February 1975) and Fernando Otero Technical Directors: Fernando Gonzales Vigil (until February 1975) and Roberto Wangeman
Venezuela	Consejo Nacional de Investigaciones Cientificas y Tecnologicas (CONICIT) Country Coordinator: Dulce de Uzcategui (until July 1974) and Ignacio Avalos
Yugoslavia (Macedonia)	Faculty of Economics, University of Skopje Country Coordinator: Nikola Kljusev

Appendix 2
SURVEY OF THE COUNTRY TEAM'S WORK

The organization, composition, and orientation of each of the country teams reflected the own interests and those of the institutions that hosted them, always within the framework of the STPI project concerns. A brief review of the approach and the work of each team may help to place the STPI project and the comparative reports in perspective. To complete the survey, a description of the field coordinator's office work is given.

ARGENTINA: The initial location for the Argentine team was the Department of Economics of the Catholic University. However, after some months, the university decided to withdraw its application and the country coordinator moved to the Argentine branch of the executive secretariat of the Latin American Social Science Council (CLACSO). The team was headed by Eduardo Amadeo, an economist, and two other members were appointed to work full time on the project. An advisory committee of several researchers and policymakers active in science and technology policy was formed. To carry out the research, the team relied on consultants who wrote reports on specific subjects that were integrated into a final report.

A significant change took place when the country coordinator was named president of the Instituto Nacional de Tecnologia Industrial (INTI), the national industrial technology institute, which is the largest and most important industrial research organization in Argentina. Mr Amadeo never relinquished his formal role as coordinator; after 6 months, he left his new post and resumed his position as country coordinator. Because most of the work was well under way, his absence did not substantially alter the team's pace, although the preparation of the Argentine synthesis report was postponed. Part of the team's work was reoriented to be most useful to the coordinator in his new position.

The Argentines focused on two branches of industry - machine tools and petrochemicals - but studied many broader issues. For instance, the reports include a document on the technological content of the 3-year development plan (1974-77), a study of the Argentine industrial structure, a description and brief analysis of technology policy instruments in Argentina, a study of the system for regulating technology imports, and several short reports on international technical assistance as an instrument of technology policy.

The structure of the Argentine scientific and technological system was studied in detail, as were the conditions under which it could be made more responsive to industry's needs. The Argentines covered the public sector, examining the possible role of the public sector as promoter of scientific and technological development. Detailed studies were carried out at two enterprises: one in charge of generating electricity in Buenos Aires (SEGBA) and the other in charge of generating and distributing gas for household and industrial consumption. Other contributions of the Argentine team were a study of the emergence and development of engineering and consulting firms in the chemical process industries, a detailed analysis of two research centres within the national industrial technology institute (INTI), and two short papers on capital accumulation and on the crisis of capitalism.

The Argentine team followed the methods guidelines; however, they produced a series of thematic reports on issues of actual and potential interest to policymakers in the country, coinciding with the themes selected for study in STPI.

BRAZIL: The Brazilian team was hosted at the research group of the Financiadora de Estudos e Projetos (FINEP), the state agency in charge of financing studies for investment projects and also the executive arm of the national fund for scientific and technological development. The first coordinator was the director of the research group,

Fabio Erber. When he took a leave of absence from FINEP in September 1974, he was replaced by José Tavares, the new head of the research group. The group at FINEP had been carrying out research on science and technology policy for some time, and the STPI assignment was one of its tasks for 1973-76. Practically all of the work was done by members of the FINEP research group, although two or three reports were contracted to professionals outside FINEP.

From the beginning, the Brazilians decided to concentrate on the role of state enterprises in technology policy. They chose branches of industry that were dominated by state enterprises (oil and petrochemicals, steel, and electricity), conducting detailed interviews, analyzing existing data, and testing hypotheses systematically to cover issues such as the selection of equipment and processes, the purchase of engineering services, the performance of research and development, and the planning activities at these state enterprises.

In addition to the new material generated by the Brazilian team during STPI, several reports based on past research carried out by FINEP were made available to the STPI network. These included background reports on the organization and structure of the Brazilian science and technology system, a study on the machine tool industry, a report on the demand for services of 12 research institutes, and a background report on industrial policies in Brazil during the last 2 decades.

In parallel with the work for STPI, the FINEP team was also engaged in a research project on the diffusion of technical innovations in three industrial branches (pulp and paper, cement, and textiles) and they agreed to put their results at the disposal of the STPI network as an additional contribution.

The Brazilian team used the guidelines only as a general reference, given that most of their work went along different lines from those originally envisaged for the project. Nevertheless, the richness and variety of their material effectively upgraded the comparative reports.

COLOMBIA: No Colombian participant was present at the initial organizing meeting, and the Colombian application to join the STPI network was received later and formally accepted at the Rio meeting of the coordinating committee. The team was hosted by the Colombian Council for Science and Technology, COLCIENCIAS, and was headed by a sociologist, Fernando Chaparro. In spite of joining the STPI network late, the Colombian team caught up with the pace of work and finished all its work by the deadline.

COLCIENCIAS organized a special team with five members who devoted practically all their time to research in STPI. Several other consultants were also asked to prepare reports on issues of specific interest such as selected policy instruments. For example, a study was commissioned on the impact of tariff mechanisms; a report was prepared on the influence of price controls; and a preliminary analysis of the possible use of the state's purchasing power as an instrument of technology policy was also prepared. The branches chosen for study were all linked to agriculture: fertilizers and pesticides, agricultural machinery, and food processing, taking into consideration the interests of Colombian policymakers as perceived by the team. In these branch studies, the methods guidelines were closely followed.

Other reports prepared by the Colombian team include a study of science and technology planning, an analysis of implicit industrial technology policies, a conceptual framework for the study of consulting and engineering organizations, a series of reports on industrial branches based on discussions with panels of experts, a study of science and technology policies in the agricultural sector (to complement the analysis done for industry), and two essays on the process of industrialization in Colombia and its technological implications.

Five groups of policy instruments were studied in detail, and their impact on each branch was examined through interviews at various enterprises. All of the findings were integrated into the final report of the Colombian team.

EGYPT: Although an Egyptian representative participated in the initial deliberations leading to the STPI project, it was not possible to organize the team to carry out

research and prepare inputs for the international comparison. There were several administrative difficulties and staffing problems that prevented the organization of a working team. The host institution was the Academy of Scientific Research and Technology and the first coordinator was Adel Sabet, who was replaced by Gamal A. Samie in July 1975. The Egyptian team presented papers that were personal contributions based on past experience rather than the result of research carried out by a team; and research was not begun at the academy until the second half of 1976.

INDIA: The host organization in India was the National Committee on Science and Technology, and the first coordinator was Anil Malhotra, who was replaced in June 1975 by S.K. Subramanian. Mr Subramanian resigned in March 1976, and no one replaced him. No funds were requested to set up a country team in India, and the Indians provided background material that had already been collected as background for a new science and technology plan.

Three background documents were distributed along with the final S & T plan to all the teams in STPI. In addition, a report on foreign collaboration, a note on science and technology planning in India, a survey of engineering consultancy services, a report on the development of the electronics industry, and two papers on small-scale industries and technology transfer were distributed by the Indian coordinator. No empirical research was done following the methods guidelines, and the Indian contribution to the comparative reports reflects this.

SOUTH KOREA: The South Korean team was one of the first to be organized and was established at the Korean Advanced Institute of Science, KAIS, as part of the activities of its science, technology, and society program. KunMo Chung was named country coordinator and the team consisted of five other members. All but one of them had other academic duties and could allocate only a portion of their time to STPI research. Then, Graham Jones was hired to advise in the preparation of the report for phase 1.

The South Korean team advanced rapidly and completed its work in time for the Sussex workshop, following the methods guidelines and introducing modifications only where necessary. Two reports were produced corresponding to the requirements for phases 1 and 2 of the project.

The branches chosen for study were electronics, petrochemicals, and powder metallurgy, and a report was prepared for each one. In addition, the team prepared documents on engineering services and industrialization in South Korea, on the Korean Institute of Science and Technology, on transfer of technology in the electronics industry, on the interface between the science and technology plan and the economic development plan, and on state enterprises in technical development.

Although most of the work was done by the team located at KAIS, consultants were asked to deal with specifics. The team predominantly represented engineering and physical sciences, but an economist who was a senior government official, helped to relate the results to South Korean policymakers and to balance the other team members' biases.

MEXICO: The Mexican team was among the first to start working in STPI and was located at El Colegio de Mexico, an academic and social research and graduate training organization. Alejandro Nadal was country coordinator and there were four other members of the team who worked full time on STPI. The Mexican team initially followed the guidelines rather closely and was one of the first in suggesting modifications and changes as a result of contrasting concepts with preliminary research findings. In particular, the team found it difficult to interpret the results of interviews in enterprises using the schema proposed to study technological behaviour. The branches chosen for detailed study were capital goods, food processing, and petrochemicals.

A background report on the structure and evolution of the Mexican scientific and technological system was prepared, together with a description of the industrialization process and of agricultural development. Documents on particular subjects included a report on engineering firms, a study of the technology policy of PEMEX (the state oil monopoly), and progress reports dealing with hypotheses on the impact of policy instruments on technical behaviour at the enterprise level, a description of policy instruments in Mexico, etc.

Most of the findings of the Mexican team were integrated into the main final report, part of which was delivered at the coordinating committee in New Delhi (January 1976) and the rest at the Sussex workshop (June 1976). The work of the Mexican team covered practically all the research topics considered in STPI, and its contribution to the comparative report reflects this. The Mexican report was published in Spanish in 1977 and was awarded second prize in a contest for the best works in economics.

For various reasons, the Mexican team chose to limit its direct interaction with policymakers and followed its own research program. Results were made available to policymakers in the form of draft reports, and through the participation of the coordinator in one of the committees established to prepare the Mexican plan for science and technology.

PERU: The Peruvian team was established within the research group of the National Planning Institute. A series of administrative difficulties affected the progress of the team, including a change of technical director, when Fernando Gonzales Vigil was replaced by Roberto Wangeman in February 1975. Approximately two-thirds of the research was completed in time for the Sussex workshop.

From the beginning, the team decided to adopt a sectorial approach to the research. Efforts were focused on the study of industrial branches connected with the extraction and processing of minerals and with the provision of machinery for the mining industry. The steel industry was also studied, with emphasis on the state enterprise in charge of the largest steelworks. This meant that the guidelines were used primarily in sectorial studies and in the analysis of policy instruments.

Background reports on the situation of the scientific and technological system and on the evolution of Peruvian industry were prepared following the general framework put forward in the guidelines. In addition to these and the sectorial reports, the team prepared other documents, dealing with issues such as explicit and implicit science and technology policies, consulting and engineering capabilities, the possible use of state enterprises as instruments of technology, and the government administrative machinery for science and technology policy.

The Peruvian team was located within an official government organization, but its direct impact on policymaking is difficult to assess because it took the form of daily contact with government officials. On the basis of the sectorial reports on mining, a committee has been set up to review the findings of the STPI team.

VENEZUELA: The Venezuelan team was hosted by the national council of science and technology (CONICIT) and was among the first to start working. The team was initially dominated by sociologists, although economists increased their participation at later stages. The first coordinator, Dulce de Uzategui, was replaced by Luis Matos, who was soon followed by Ignacio Avalos. Three other members worked full time, and the team was biased toward sociology and economics.

They progressed through two stages punctuated by a change in government. In the first stage, most of the background reports corresponding to phases 1 and 2 of the STPI methods were prepared, covering the science and technology, the political, the educational, and the economic systems. These reports were made obsolete by the change in government. In the second stage, the team tried to adjust to the new situation, repeating some of the earlier studies and continuing the research. However, the organization of a national congress on science and technology, which mobilized all the staff working at CONICIT, affected the team's progress.

The branches chosen for study were capital goods, electronics, and petrochemicals. In addition, reports were written on specific issues such as the government organizational structure for science and technology policy, instruments for industrial science and technology policy, economic and financial policy instruments and their impact on technology, the purchase of capital goods in two industrial branches, and the relations between the financial system and technology policy. The Venezuelan team concluded its research shortly after the Sussex workshop.

The fact that the Venezuelan team was located in a government agency that took

a very active role in science and technology policy after the change in government created both opportunities and problems. As a result of the new tasks undertaken by CONICIT, the pace and continuity of the STPI work was frequently altered. On the other hand, there was more possibility for actively contributing to policymaking. The Venezuelan contribution to the comparative reports reflects this situation.

YUGOSLAVIA (MACEDONIA): The Macedonian team was organized at the faculty of economics of the University of Skopje. A senior faculty member, Nikola Kljusev, was appointed coordinator. The team was composed of a very large number of faculty members and researchers who devoted part of their time to STPI. The tasks were subdivided and individual reports requested from various members of the team, although at a later stage two team members were asked to work full time on STPI.

The Macedonian team did not follow the guidelines, except in the preparation of a background report for phase 1. Individual reports were submitted on issues of interest to the STPI network, covering topics such as the problems of research and development in industrial enterprises, aspects of science and technology policy in Yugoslavia, the metallurgical industry in Macedonia, and the growth of engineering firms in Yugoslavia.

The Macedonian team's specificity is reflected in their relatively limited contribution to the comparative reports. At any rate, given the high degree of participation of professionals at all levels in policymaking in the Yugoslav self-managed economy, it is rather difficult to assess their contribution toward policymaking in conventional terms.

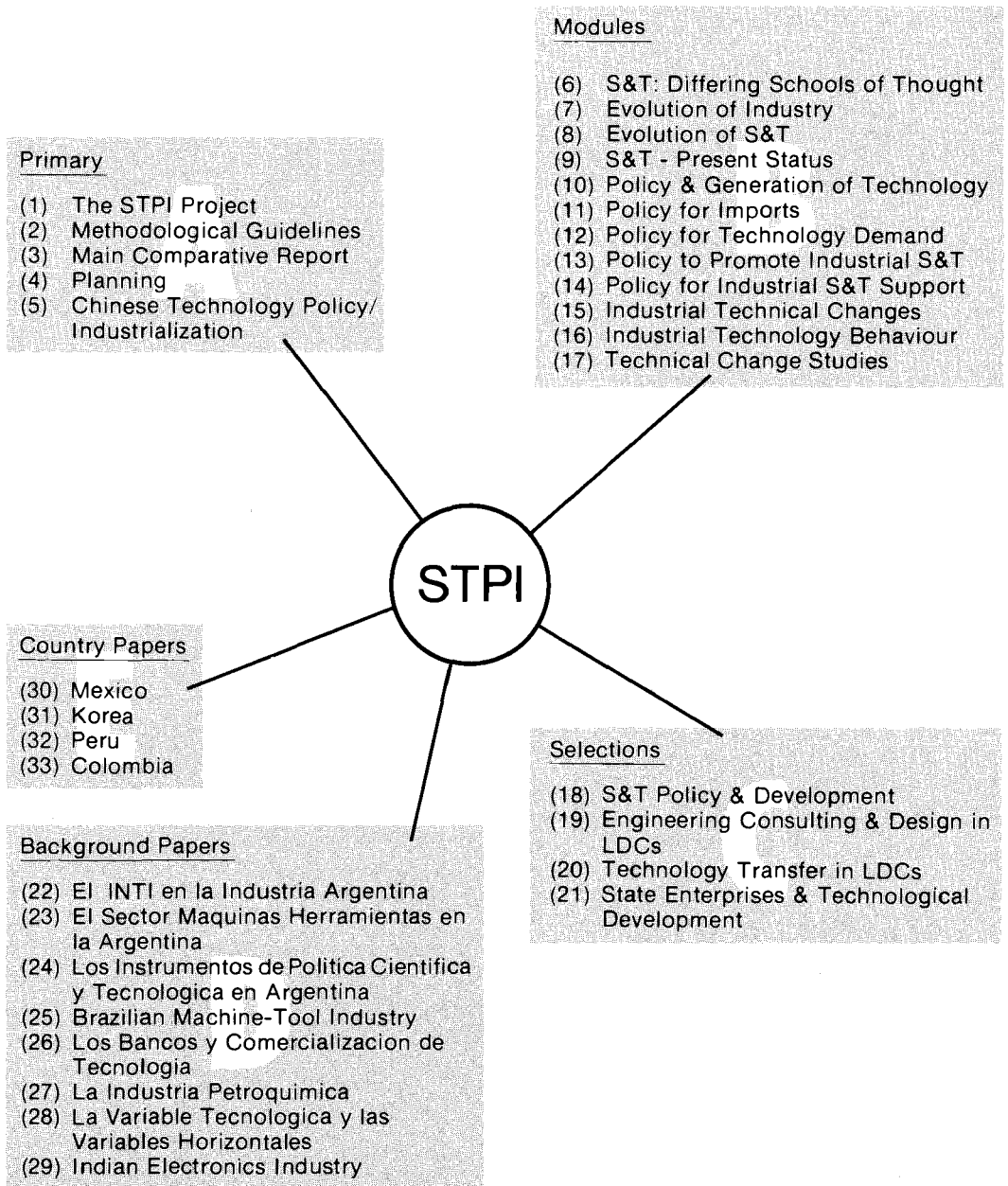
THE FIELD COORDINATOR'S OFFICE: In August 1973, at the first meeting of the coordinating committee, Francisco Sagasti was appointed field coordinator of the project and his office was established shortly thereafter and began operating in a limited way. Staffing was completed in April 1974 with the addition of two members.

The field coordinator's office was independent from the teams and was not engaged directly in empirical research. It offered organizational and technical support and contracted consultants to prepare reports on topics defined by the coordinating committee.

The field coordinator, first, drew up methods guidelines for phases 1 and 2 of the project. Background reports on technology policy in China, on technological dependence/self-reliance, on science and technology planning, on technology policies in Japan, and on technology transfer were also prepared, either by staff members of the field coordinator's office or by consultants. The guidelines for phases 3 and 4 of the project were prepared jointly by the field coordinator and a consultant. The office also organized the Sussex workshop and drafted the comparative reports. The field coordinator was also active in the board of the Peruvian Industrial Technology Institute (ITINTEC).

With the exception of the teams that were engaged in science and technology policy research as part of the activities of their institutions (the Brazilian and South Korean teams, for example), the teams were dismantled after the STPI project was completed. The field coordinator's office was closed in December 1976, and the comparative reports were prepared during 1977-1978, although some teams had not finished their work by April 1978. Even though most teams had concluded their STPI activities by the end of 1977, this does not mean that the team members left the field of S & T policy research and that their effort in STPI was not followed up. What was dismantled, as planned from the beginning, was the formal structure of the STPI project. The network of personal contacts remains in operation and most of the former team members are active in the field of science and technology policy, carrying the experience accumulated in STPI to their new positions.

Key to STPI Publications



**A GUIDE TO THE
SCIENCE AND TECHNOLOGY POLICY INSTRUMENTS
(STPI) PUBLICATIONS**

A. Primary Publications

- (1) The Science and Technology Policy Instruments (STPI) Project (IDRC-050e) (out of print)
- (2) Science and Technology Policy Implementation in Less-Developed Countries: Methodological Guidelines for the STPI Project (IDRC-067e) (out of print)
- (3) Science and Technology for Development: Main Comparative Report of the STPI Project (IDRC-109e). (Also available in French (IDRC-109f) and Spanish (IDRC-109s).)
- (4) Science and Technology for Development: Planning in STPI Countries (IDRC-133e)
- (5) Science and Technology for Development: Technology Policy and Industrialization in the People's Republic of China (IDRC-130e)

B. Modules

These constitute the third part of (3) above and provide supporting material for the findings described and the assertions made in (3).

- (6) STPI Module 1: A Review of Schools of Thought on Science, Technology, Development, and Technical Change (IDRC-TS18e)
- (7) STPI Module 2: The Evolution of Industry in STPI Countries (IDRC-TS19e)
- (8) STPI Module 3: The Evolution of Science and Technology in STPI Countries (IDRC-TS20e)
- (9) STPI Module 4: The Present Situation of Science and Technology in the STPI Countries (IDRC-TS22e)
- (10) STPI Module 5: Policy Instruments to Build up an Infrastructure for the Generation of Technology (IDRC-TS26e)
- (11) STPI Module 6: Policy Instruments for the Regulation of Technology Imports (IDRC-TS33e)
- (12) STPI Module 7: Policy Instruments to Define the Pattern of Demand for Technology (IDRC-TS27e)
- (13) STPI Module 8: Policy Instruments to Promote the Performance of S and T Activities in Industrial Enterprises (IDRC-TS28e)
- (14) STPI Module 9: Policy Instruments for the Support of Industrial Science and Technology Activities (IDRC-TS29e)
- (15) STPI Module 10: Technical Changes in Industrial Branches (IDRC-TS31e)
- (16) STPI Module 11: Technology Behaviour of Industrial Enterprises (IDRC-TS32e)
- (17) STPI Module 12: Case Studies on Technical Change (IDRC-TS34e)

C. Selections

These are a selection of the numerous reports prepared for the STPI Project chosen as a representative sample of the various topics covered by the STPI Project in the course of the main research effort on policy design and implementation.

Science and Technology for Development: A Selection of Background Papers for the Main Comparative Report.

- (18) Part A: Science and Technology Policy and Development (IDRC-MR21)
- (19) Part B: Consulting and Design Engineering Capabilities in Developing Countries (IDRC-MR22)
- (20) Part C: Technology Transfer in Developing Countries (IDRC-MR23)
- (21) Part D: State Enterprises and Technological Development (IDRC-MR24)

D. Background Papers

- (22) El INTI y el Desarrollo Tecnológico en la Industria Argentina (In press)
- (23) El Sector Maquinas Herramientas en la Argentina (In press)
- (24) Los Instrumentos de Política Científica y Tecnológica en Argentina (In press)
- (25) The Brazilian Machine-Tool Industry: Patterns of Technological Transfer and the Role of the Government (In press)
- (26) Rol de los Bancos en la Comercialización de Tecnología (In press)
- (27) Comportamiento Tecnológico de las Empresas Mixtas en la Industria Petroquímica (In press)
- (28) Interrelación Entre la Variable Tecnológica y las Variables Horizontales: Comercio Exterior, Financiamiento e Inversión (In press)
- (29) A Planned Approach for the Growth of the Electronics Industry — A Case Study for India (In press)

E. Country Reports

- (30) Instruments of Science and Technology Policy in Mexico (In press)
- (31) Technology and Industrial Development in Korea (In press)
- (32) Los Instrumentos de Política Científica y Tecnológica en el Perú: Síntesis Final (In press)
- (33) STPI Country Report for Colombia (In press)

