GOVERNMENT INCENTIVES AND INDUSTRIAL LOCATION: SOME CONSIDERATIONS FOR VENEZUELA

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ABSTRACT

This research attempts to evaluate the effectiveness of the Venezuelan industrial deconcentration policy. More specifically it attempts to answer the question: Have government instruments (both incentives and restrictions) contributed to the deconcentration of industry? To address this issue requires answering the following more specific questions: (1) Has deconcentration of industry indeed taken place? (2) Can any such deconcentration be attributed to the policy instruments applied? (3) What have been the other factors influencing industrial location and what has been their relative impact?

An advanced econometric method of analysis was used (that of discrete choice models) suplemented with conventional statistical analysis and interviews with Venezuelan entrepeneurs. All experimentation with the model of locational choice was done with the sub-sample of data for the period prior to the introduction of the financial incentives package, i.e., 1975-1976. This model fits the second sub-sample (for the year 1977-78) equally well, i.e., it seems to be structurally stable.

The results indicate that three of the six industries studied, leather, non-electric machinery, as well as electric machinery manufacturing groups, have deconcentrated their locations during the period 1977-78. The other industrial groups studied, textiles, plastics and transportation equipment, seem to have experienced no major change in their relative locations.

There seems to be little or no evidence that changes in the spatial pattern of industry, where such did occur, are related to the application of government instruments.

In order to explain why some industrial subgroups deconcentrated while others did not, a hypothesis was developed which proposes that during the study period, government protection for industrial promotion distorted the traditional factors of location supressing deconcentration. Evidence to support this hypothesis was obtained from several sources, including interviews with industrialists.

The results also show that entrepeneurs in Venezuela may be basing their industrial location decisions on a more careful consideration of relevant factors than is usually thought. Results for the sample studied indicate that (1) Wages, accessibility to both inputs and markets, presence of technical expertise and water availability seem to exert a large influence. (2) Potential labor unrest may also influence location to some extent, although its importance is relatively limited. (3) As expected, the relative importance of the variables changes according to the manufacturing sector considered. An unexpected finding is that government financial incentives do in fact seem to be an important locational factor for the plastics industry.

The policy utility of this research ranges from showing that a conflict may exist between industrial deconcentration and industrial promotion policies, to demostrating the potential usefulness of an econometric model for exploring alternative policy measures and their impact on the locational decision of firms.

Dissertation Committee:

Dr. Lloyd Rodwin (Chairman), Ford International Professor (M.I.T.)
Dr. Alan Strout, Lecturer (M.I.T.)
Dr. David Wheeler, Associate Professor (Boston University)

To my wife, Ilana, who had to spend
too much time without me and to our
children, Sandra and Roberto, who
had to spend too little time with me,
while pursuing my doctoral studies.

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PART I: INTRODUCTION

1 Background information

The traditional overall goal of a country is development. But the concept of development cannot be understood in isolation from the political ideology of the state. Thus, until recently, the Venezuelan government has considered development to be generally synonymous with economic growth. Only during recent years has some attention been given to the objectives of equity and environmental conservation.

The Venezuelan government understands that in order to work toward the overall goal of development, a society must make trade-offs among the objectives of efficiency, equity and environmental conservation. If the scale of achievement of each of these objectives is very high, then it may be concluded that there is no need for government intervention. But since in Venezuela this is not the case, the government has decided to give further consideration to the planning of development. In the past the Venezuelan government assumed that economic development would be maximized if it expanded the possibilities for exporting those products where it could achieve comparative advantages. Since the 1950's, the government has also tried to expand the national economy through the policy of import-substitution. More recently, in 1976, the policy of industrial deconcentration was added to the set of policy measures with the purpose of modifying the spatial pattern of development.

1.1 Regional characteristics

In order to set a proper framework for this study, a brief description will be presented of the main characteristics of Venezuela.

One of Venezuela's major characteristics is its rapid recent growth. The population has doubled in less than twenty-five years, and the percentage of population classified as urban has shifted from less than 48 percent to more than 74 percent in the same period. As a consequence, there has been an increasing difficulty for the administrative structure to deal effectively with problems arising as a result of these rapid and accelerating changes.

Economic growth has been equally remarkable. For example, the increase in Venezuela's import capacity during the last decade was greater than that in all the rest of Latin America combined, and its per-capita income is one of the highest in Latin America.

Sharp contrasts are particularly striking in Venezuela, for many aspects of Venezuelan life (economic, social, political, spatial) are skewed towards the extremes, with relatively little in the middle.

The maldistribution of income is severe. The biggest variation in income is between city and country; yet, the skyscrapers alternating with "ranchos" (informal and often makeshift dwellings) dramatize the point effectively in the big cities.

The country's economy is also, to a considerable extent, dominated by extremes. At one extreme are a few advanced sectors, highly industrialized and comparable to the forward elements in the most advanced industrial economies. At the other end, half the farm families still live in primitive agricultural areas, practically outside of the monetary economy.

One of the most striking characteristics of the Venezuelan economy is the dominant position of the oil industry. While employing only 2 percent of the labor force, oil provides about 20 percent of the gross national product, nearly two-thirds of the total revenues of the national government, and most of the available foreign exchange. Under present circumstances it is, therefore, revenues from oil which provide most of Venezuela's capacity for public capital investment to stimulate economic growth.

In the cultural sphere, the cosmopolitan life of Caracas contrasts with the life of the backward rural farmers. Similarly, the centralization of power in the capital city has skewed the distribution of decision-making toward the center.

Geographically, Venezuela's land ranges from snowcapped peaks to torrid swamps and sabanna. About two-thirds of the population live in the mountain ranges extending northeast from the Andes; yet more than two-thirds of the country's area is less than 500 meters above sea-level. National growth and national life are increasingly concentrated in a few larger cities --above all, in the narrow and overcrowded valley of Caracas.

From the above description we can see that historically Venezuela has been characterized as presenting spatial duality. This duality is reflected in a high concentration of population and economic activities in the north-central area while the rest of the national territory has few urban centers with few significant economic activities.

The north-central area is known as the industrial axis of the country. This axis extends from the city of Caracas to Puerto Cabello, which is the second largest port and is located near the city of Valencia. See Fig. 1.1 and Fig. 1.2 .

In order to have an idea of the magnitude of the concentration problems in the north-central area, which only occupies 2.3 percent of the nation's territory, some indicators are presented below (Venezuela,[1]).

The north-central area:

- Contains 41 percent of the total population;
- Concentrates 48 percent of the total urban population;
- Is the location of 46 percent of the total working population;
- Contains about 67 percent of the Venezuelan manufacturing industry;
- Produces 74 percent of the value-added generated by industrial activity;
- Generates about 74 percent of the GNP (excluding that obtained by the extraction of oil and iron).

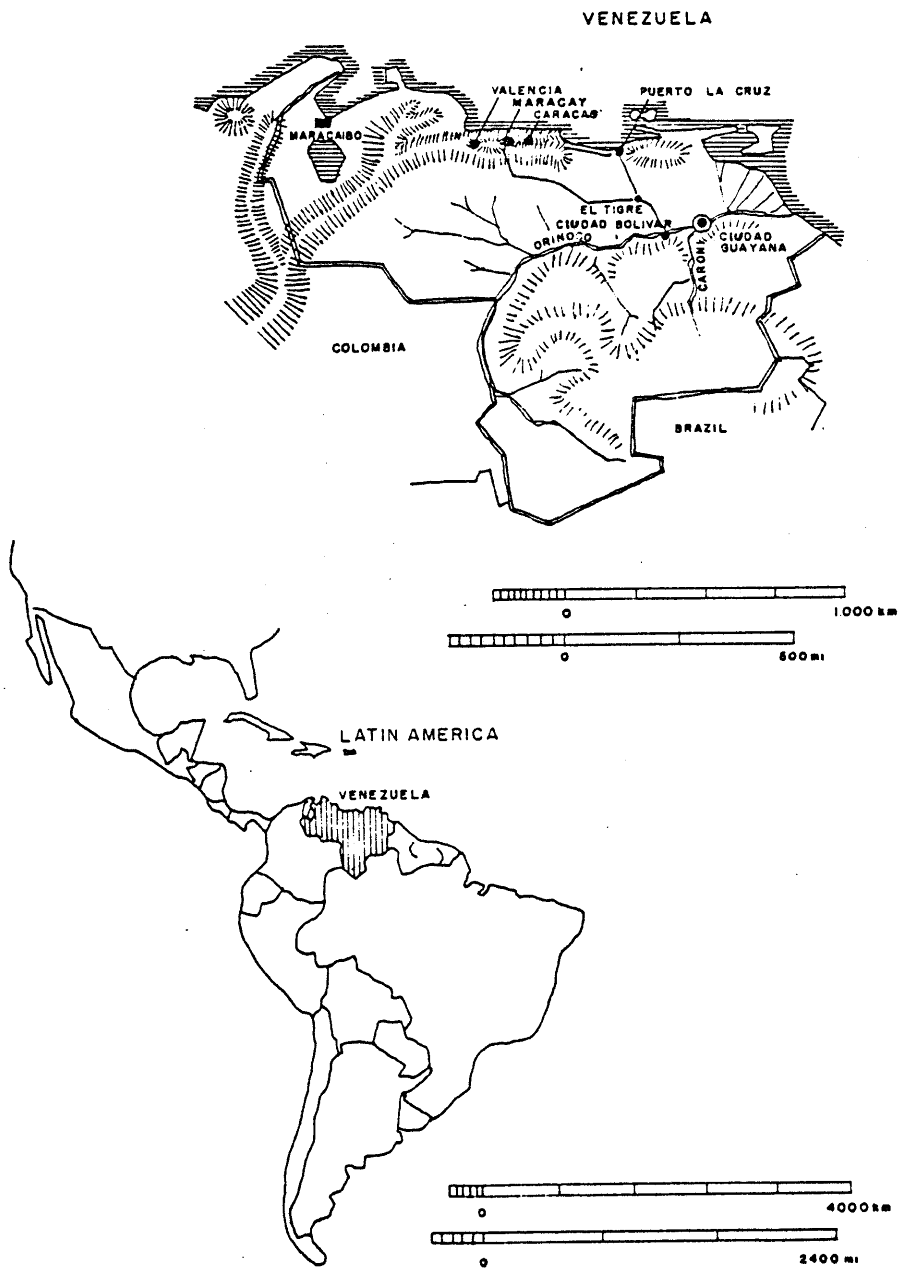


FIG. 1.1 LATIN AMERICA AND VENEZUELA

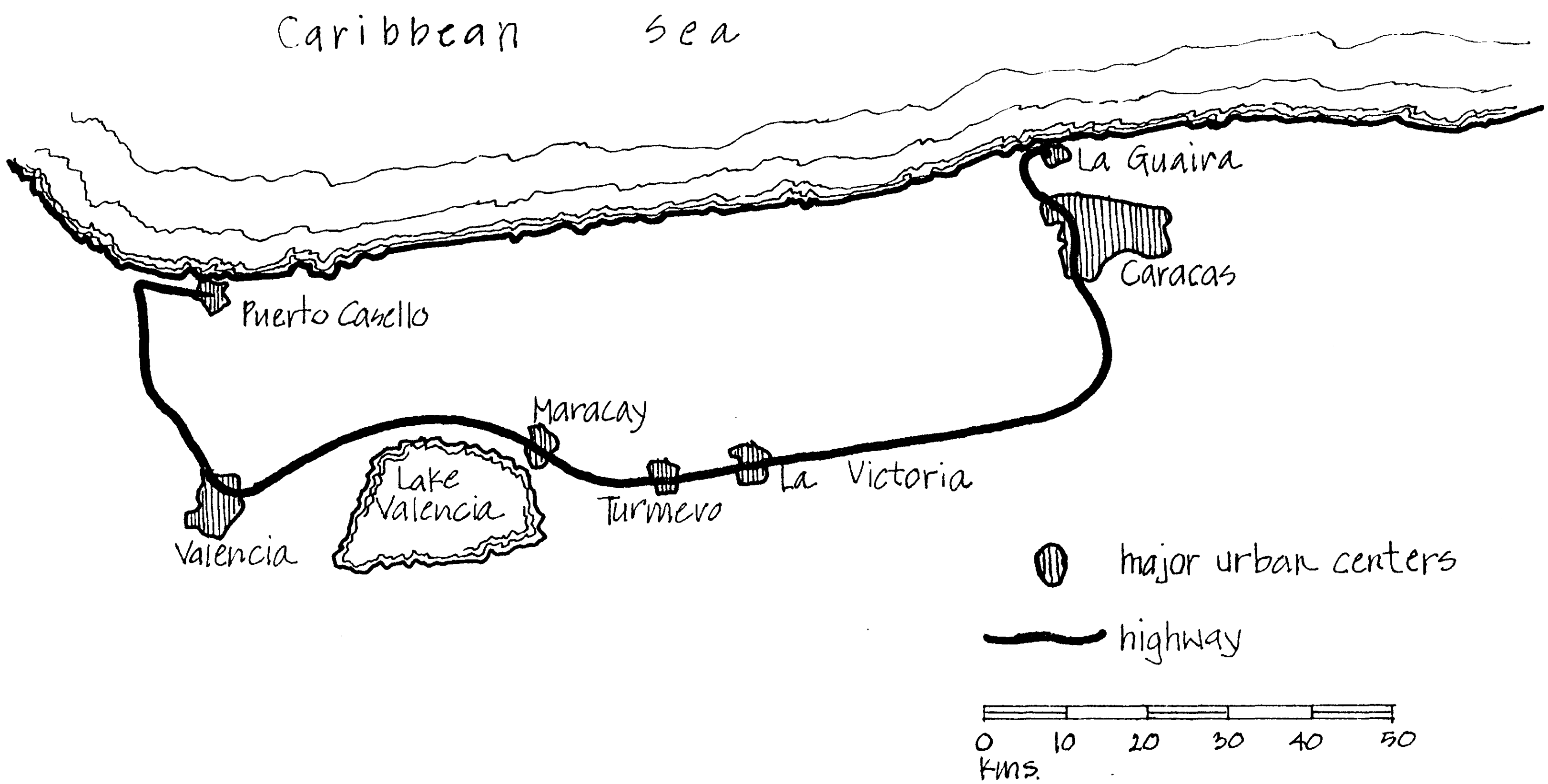


FIG. 1.2 THE INDUSTRIAL AXIS IN THE NORTH-CENTRAL AREA

1.1.a Problems

The regional imbalances imply the presence of backward regions which contribute little towards national economic development. The lack of development in most of the regions has generated problems in human and natural resources.

Human resources: The potential value of Venezuela's human resources is amply attested by national growth in the last three decades. Nevertheless (in view of the widespread lack of education and technical skills, and the shortcomings of social organization), a formidable task remains in making full use of these human resources.

Among the many problems that can be identified are those related to unemployment and subemployment. In relation to subemployment, it can be argued that this situation generates an under-utilization of human resources, which is reflected in the low working productivity in the peripheral regions of the country.

Regional imbalances and concentration of economic activities in the Metropolitan Region have also created a mobility of the population towards the growth regions. This migration process has reinforced the imbalances. The situation in the regions exporting population has worsened with the loss of their most dynamic people. At the same time, this phenomenon has created enormous problems for the receiving regions, specifically in the provision of jobs and services.

Natural resources: The lack of development of the productive capacity of the backward regions with high potential for economic development has created losses due to under-utilization and primitive methods of exploitation of the natural resources.

1.1.b Opportunities

As has been indicated above, a great many problems are due to imbalances between the industrial axis and the rest of the country. But at the same time, extraordinary opportunities remain for development. Venezuela is richly endowed with natural resources, of which so far only oil has been extensively developed, and iron and bauxite in a more limited way. The country has vast mineral deposits and an enormous potential for electric power, which is now beginning to be developed. Other resources include manganese, coal, lead and natural gas.

There are substantial opportunities in Venezuela for economic progress in other areas such as forestry, cattle-raising, commercial farming, and in the development of tourism. So far, only the Guayana Region has been expanding the productive capabilities of the nation by bringing new resources into play.

From the above description it can be seen that:

(1) In terms of efficiency, Venezuela is probably not working at its full capacity;

(2) In terms of equity, the sharp contrasts of the different aspects of Venezuelan life (economic, social, political, spatial) are skewed toward the extremes with relatively little in the middle;

(3) In the environmental dimension, the country faces the destruction of its natural resources, as well as the deteriorating conditions of its man-made habitat.

1.2 Historical context

The concentration of activities in the north-central area originated in colonial times when exports to Spain led to the concentration of activities along the coastline. Manufacturing activities in Venezuela in the nineteenth century, and well into the present century, were confined to various forms of artisan industries. Until World War II, the amount of industrialization achieved was very limited.

In the late 1890's and during the following decade, several small hydroelectric power plants were constructed along the rivers draining the Caracas valley. This improvement in infrastructure was a prerequisite for investment in manufacturing. Similarly, various thermoelectric plants were built at the begining of this century to supply energy to the cities of Valencia, Puerto Cabello and Maracaibo. When the development of this infrastructure was already under way, changes occurred in two important areas: the growth of a domestic market for manufacturers and the introduction of protection against imported products. The domestic market grew in the years before the First World War, as purchasing power increased due to the coffee export booms of the 1890's. Undoubtedly, much of this increase was channeled into importing consumer products. For many products, such as textiles and cigarettes, protective tariffs were introduced from the late 1890's onwards, and these were obviously of importance to domestic entrepreneurs.

The political take-over by Juan Vicente Gómez in 1908, with the political tranquility and financial order that accompanied it, seemed to provide an impetus to undertake new manufacturing. Gómez provided a favorable climate for foreign investors to develop the resources of the country. This was in contrast to his predecessor, Cipriano Castro, who antagonized foreign interests. The new conditions attracted petroleum companies in particular, whereas foreign investment in manufacturing remained on a rather small scale. By 1913 the city of Caracas and its port, La Guaira, accounted for over one-quarter of the manufacturing enterprises in the country. The city of Valencia and its port, Puerto Cabello, had the next largest concentration, with nearly as many enterprises as Caracas (Karlsson,[2]).

During the interwar period, foreign oil investments and export earnings experienced a tremendous rise. As income increased for some segments of the population, particularly during the twenties, the markets grew for many domestic manufacturers. Nevertheless, the industrial development of the twenties was limited to a handful of industries, primary textiles, cigarettes and beverages, i.e., industries which enjoyed either high tariff protection (textiles and cigarettes) or strong natural protection by virtue of high transport costs (beverages) (Karlsson,[3]).

In the late 1930's, the government initiated a first but modest program to encourage industrial development in the country. The program however, was counteracted by the government's foreign trade policy. In 1939, a trade agreement was signed with the United States (revised and extended in 1952), which reduced import duties on a series of products. This agreement, it has been argued, came to substantially reduce the possibilities for further industrial progress (Karlsson,[4]).

By 1936, Caracas had expanded its share of manufacturing activity to half of that of the national territory. The city of Valencia continued to be number two. During the 1950's government service sectors expanded even further within the Metropolitan Region, having the effect of attracting many people to Caracas.

A marked shift in the growth structure occurred after 1958, when a comprehensive import-substitution program was adopted. As a result of this policy, the imports of semi-manufactured products and to some extent raw materials, increased sharply. Manufacturing industries were attracted to locations near the international ports and the largest market areas.

During the 1950's some well managed establishments in Caracas, as well as new manufacturing firms, realized that the Valley of Caracas offered very limited space for future expansion. Consequently, they looked for alternative cities in which to locate. The Municipal Council of the city of Valencia, composed of very dynamic people, realized that an opportunity existed to further develop the economy of the city. They decided to create a good industrial climate for entrepeneurs by offering the first organized, industrial park in Venezuela. This park had all the necessary physical infrastructure (water, electricity, roads, etc.), as well as municipal tax holidays and other special incentives. Also, industrialists found that Valencia had an acceptable labor force with some industrial tradition, a good infrastructure, inexpensive land, favorable municipal incentives, port facilities through Puerto Cabello and a location near Caracas. Furthermore, the construction of a high quality highway from Caracas to Valencia (completed in 1958) reduced travel time between the two cities to less than two hours. Hence, entrepeneurs decided to locate in Valencia, and later on, in other cities along the highway. As a consequence, the area between Caracas and Valencia grew at a very fast rate. Therefore, based on all the factors mentioned, it is not surprising that a high concentration of activities has occurred in the north-central area (see Fig. 1.2).

1.3 The case for intervention

The existing political ideology of the state, as a mixed economy, supports government intervention under the assumption that the undesirable situation described earlier is a product of market imperfections. Furthermore, it assumes that the government has the power and the political will to intervene.

If the various regional problems were self-righting over a short period of time, there would be little case for intervention. However, some scholars believe that regional growth may not be convergent (Myrdal,[5]), and some government intervention is needed (Hirschman,[6]). It must also be added that even if a laissez-faire approach is eventually self-righting, the inevitable distress of the intervening period would probably necessitate some form of intervention.

This suggests to the Venezuelan policy makers that there is a case for intervention, but intervention is costly, and there is a need for further evidence that such action is justified on economic and/or non-economic grounds (Glasson,[7]).

Economic arguments figure prominently in the case for intervention. It may be argued that the economic growth of the country could be substantially increased by utilizing more fully the wasted and potential resources of the depressed and underdeveloped regions.

From the social argument point of view, it may also be argued that the cumulative process of regional growth increases the gap between rich and poor regions. The latter are trapped in a "vicious circle", a downward stagnation spiral. The lack of economic opportunities and poor environmental conditions encourage selective out-migration, leaving a top-heavy population distribution, poorer services, and an overall reduction in the growth potential of the area. By intervening in these problems and reducing differences in per-capita regional income levels, a policy of industrial deconcentration can make a substantial contribution to the national goal of social equality.

Finally, political arguments, although often not explicit, are nonetheless of considerable importance. Their importance stems from the fact that they are explicitely voiced in the affected geographic areas. People feel very strongly about problems such as unemployment. It follows that in democratic countries such as Venezuela it is a sound policy to appease depressed areas, because these areas, if neglected for some time, will invariable vote against the government. If the neglect extends over a long period, separatist tendencies may develop.

1.4 Government measures

In 1974, the Venezuelan government, conscious of the socio-economic problems caused by the concentration of activities in the north-central area, decided to intervene in the spatial distribution of the manufacturing industry. A series of presidential decrees were issued to give a legal framework to the policy of industrial deconcentration.

There are three aims behind the Venezuelan industrial deconcentration policy. One is to prohibit the location of new manufacturing activity in the Metropolitan Region (Caracas and its surrounding area). A second is to induce industries considered hazardous to move their locations to safer places and to encourage non-hazardous firms, already located in the congested Metropolitan Region, to move to designated development areas. The third aim is to attract new manufacturing plants to the designated development areas.

Among the policy instruments for carrying out industrial deconcentration are straightforward financial and fiscal incentives, the provision of industrial parks and control over location.

From location theory and empirical observation, it is said that an incentive can only influence a firm to choose one location rather than another if the incentive sufficietly outweights the benefits the firm could obtain in the location of its first choice. As a corollary, it may be said that we cannot expect a firm to locate in a development area if it is not compensated in full.

Hence we may ask: Do the incentives given outweight the benefits of the preferred location? Does the policy of industrial deconcentration fullfil its objectives? What is the policy accomplishing?

One might argue that it is too early to answer these questions. Few years have elapsed since the policy was put into operation and, due to time lag considerations, no real effects can be perceived this soon. This implies waiting until more time has passed, when changes in the spatial distribution of industry can be better perceived. Nevertheless, a careful analysis of processes of industrial location and change indicates that the mechanics as well as the impacts of the Venezuelan policy measures may not be fully understood. It should be stressed that discrepancies between intended purposes and unintended effects may lead to serve misallocation of resources: for example, when incentives are given to firms that would have located in the designated areas anyway; or when subsidies to capital are given with the purpose of creating new employment opportunities but, in practical terms, these subsidies may lead to capital-intensive technology with limited effect on the desired objective. Therefore, it is extremely important to try to understand the consequences of the policy of industrial deconcentration as early as possible. Rodwin[8] stresses this point when he says that "It is debatable whether we know enough about urban growth strategies either to deal with them effectively or to secure the necessary understanding early enough to avoid doing more than good." Hence, we may argue that an "early understanding" is crucial, and efforts in this direction should be welcomed. The worst thing that may happen with this approach is to find no evidence of being off the path leading toward the desired goals. If this happens, we are in the same situation as if no monitoring activity had taken place, but with the advantage of having created a data bank for control purposes. Therefore, the "early understanding" approach is endorsed here.

1.5 Controversies

What do we know at present about the effects to date of the Venezuelan policy of industrial deconcentration? There seems to be little or no agreement in at least two of the studies currently available. A report prepared by the Ministry of the Environment (Ministerio del Ambiente[9]) is very optimistic about the policy, claiming that the pattern of behavior of the entrepeneur is changing. The report states that "All these indexes show without doubt a real tendency by the public as well as private sector to deconcentrate industrial investment toward the hinterland of the country." On the other hand, a document prepared the same year by the National

Planning Office (Cordiplan,[10]) indicates that the policy has merely accentuated existing tendencies towards concentrating manufacturing activity in the city of Caracas and its surroundings.

Hence, we may ask ourselves how two different research efforts directed at evaluating the same policy have reached opposite conclusions?

A closer look at the evidence presented in the two reports mentioned earlier shows that their conclusions are logical and well-argued outcomes of the data used. Hence, an answer to the above question may lie in the data. Because the pertinent data for a proper evaluation of the policy of industrial deconcentration are not available, the researchers of these two reports had to rely on less appropriate data. For example, Cordiplan used aggregate data for the number of establishments by administrative regions.

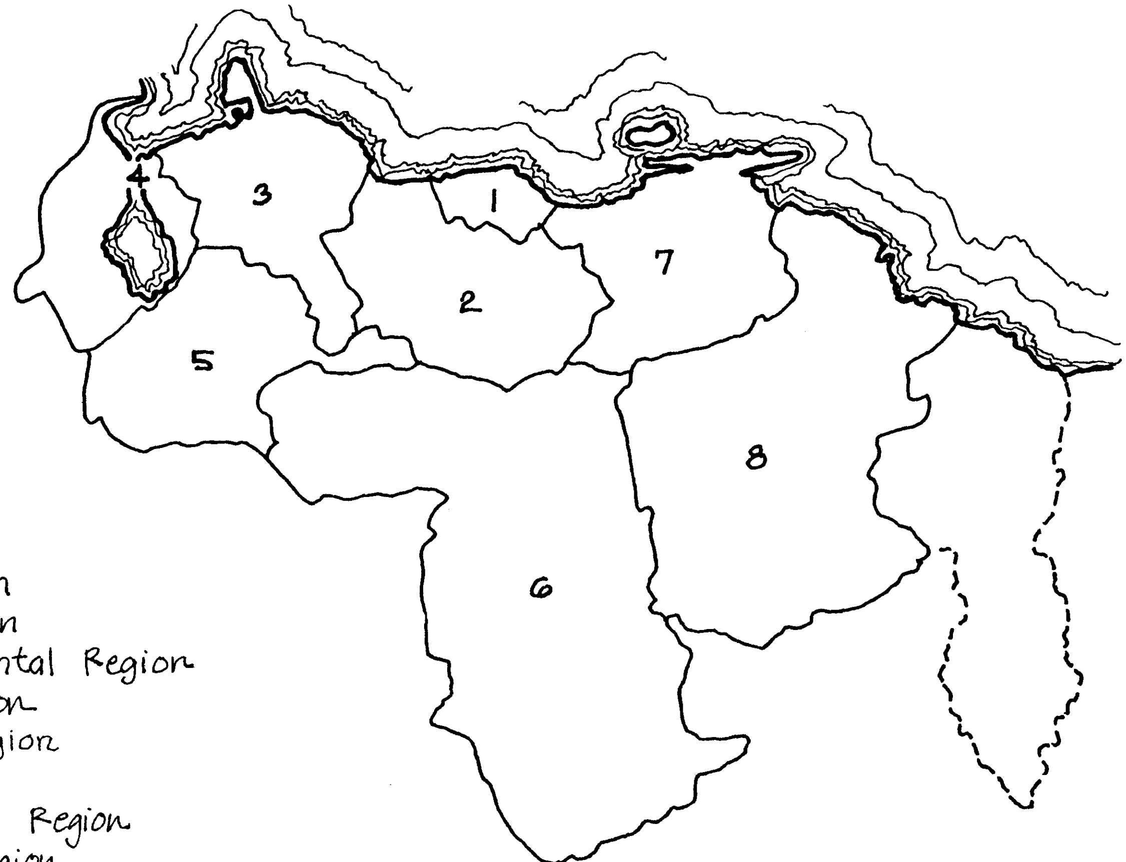
The use of aggregate data to describe the locational behavior of the manufacturing industry has many drawbacks. Among them are:

1.- Aggregate industrial data fail to capture the fact that each industrial subgroup may behave differently by reacting in a different way to the policy or other stimuli. For example, the plastic industry may behave differently from the textiles or leather products industry. Hence, there may be some industrial subgroups which are deconcentrating; others may be concentrating even more; while others may remain stationary.

2.- Aggregate spatial data do not reflect the degree of industrial activity in each of the five area subdivisions of the policy. The use of an administrative region (see Fig. 1.3) as the spatial unit may be misleading since the area subdivisions, according to the administrative regions, are different from the subdivisions as defined by the policy of industrial deconcentration. This divergence will be described in later chapters.

3.- Aggregate data may hide the dynamics of the manufacturing sector of the economy: For example, if one talks about the net change in the number of establishments in a particular administrative region over a two year period, this says nothing about the total number of establishments that are new, the number of firms that went out of business, or the plants that have changed location. This latter information is crucial for a proper evaluation of the policy.

On the other hand, the report prepared by the Ministry of the Environment uses indicators such as the number of industrial projects which entrepeneurs said they are planning to set up in the near future, or the number of new manufacturing firms that have registered with the Ministry of Development. The use of these sorts of data assumes for example that what the entrepeneur said will actually take place. Furthermore, it also assumes that if no new firms registered with the Ministry of Development have declared Caracas as a location, then this city has had in fact no new manufacturing activity.



1 Capital Region
2 Central Region
3 Centro-Occidental Region
4 Zuliana Region
5 Los Andes Region
6 Sur Region
7 Nor-Oriental Region
8 Guayana Region

FIG. 1.3 ADMINISTRATIVE REGIONALIZATION OF VENEZUELA 1958 - 1975

Clearly more reliable conclusions will be reached if proper data are used. But data collection is costly and time consuming. Are the data worth collecting? In general, the marginal benefits of using better data are unknown until the data are analyzed; Only then can we say if the exercise was worthwhile. The opposite conclusions reached by the two reports described earlier indicate that there is some justification for gathering appropriate data that will give us a more satisfying baseline to use for evaluating the policy of industrial deconcentration.

There are, no doubt, risks involved when gathering data; for example, that of collecting more data than is actually needed. There are two main possibilities for solving this issue: On the one hand, one may set up an ad-hoc operation of data collection where entrepeneurs for example, are asked for specific variables considered relevant to the hypotheses that are going to be tested, or where municipal councils, as another example, are asked about their local incentives. On the other hand, one may set up an operation to organize data already in existence, but which are dispersed or incomplete, i.e., an operation that will make accessible data more readily available.

The first approach is costly and time consuming. It is difficult to define in advance the level of detail of the information needed. Furthermore, it is expensive to return to the surveyed entity for additional information if more is needed. The advantage of the first approach, however, is that more relevant and consistent data can be obtained.

Since in our case a considerable amount of previously unexploited data in fact exist --although with some gaps-- and seem to be of acceptable quality, the second approach looks appropriate, i.e., to dig out from different sources the required data, fill as many gaps as necessary, and then organize the data in an appropriate way. This approach allows for collecting the minimum necessary data that will do the "job", allowing one to go deeper into the data gathering organization as the need arises. This is the approach followed in this research.

2 REGIONAL POLICIES AND THE RESEARCH

2.1 Regional goals and objectives

The inequalities in regional levels of income, unemployment, migration and economic growth rates in Venezuela have stimulated government intervention with the overall goal of reducing inter-regional disparities.

Among the objectives of the Venezuelan regional policy (Venezuela,[1]), the main ones have been to:

- Increase employment in lagging areas;
- Restrain expansion of employment in the congested metropolitan region;
- Create a more diversified industrial structure;
- Reduce net outward migration from previously neglected regions;
- Utilize more fully the resources and comparative advantages of the neglected regions;
- Maintain and strengthen provincial cultures and identity;
- Equalize access to a good environment --including housing, education and health services.

From an economic viewpoint, the ultimate objective of regional policy may be to reverse or reduce the cumulative decline of lagging regions designated for new development by creating a rate of economic growth sufficient to secure full employment in those regions.

The employment-generation strategy should be sustainable in the longer run without special incentives and in the medium run should avoid excessive demand inflation. Ideally, the accompanying self-sustained economic growth should preferably be obtained without impairing the growth rate in other regions, thereby securing a net increase in the economy as a whole. This latter goal, of course, may pose a major task as long as capital is scarce.

Some of the objectives listed above may be in conflict with one another and with wider economic objectives. For example, there may be a conflict between the objective of full employment in <u>all</u> regions and the general demand-management objectives of the government, i.e., the avoidance of excessive demand inflation and a satisfactory balance of payments.

The transition to self-sustained growth for particular regions is likely to be a long and gradual process. Each contribution to the objective of reaching full employment with the aid of subsidies (i.e., medium-term objective) can be expected to make a contribution to the longer-term objective of self-sustained economic growth, only insofar as the manufacturing sector becomes more competitive than it would otherwise be.

2.2 Regional policies

In a mixed economy, an area with high unemployment can reduce its unemployment rate in two main ways:

1) Through a <u>migration policy</u>, i.e., assisting the movement of labor to places where people are more likely to find a job.

2) Through a policy of industrial deconcentration, i.e., assisting the movement and creation of industries in places where an excess of labor is located. This alternative includes the promotion of industrial growth in lagging areas.

In Venezuela, the stated policy to be used for the achievement of regional development objectives is industrial promotion in lagging areas, i.e., taking "jobs to the people." This has been interpreted to mean a policy of industrial deconcentration (Ministerio de Fomento,[2]), coupled with the strategy of spatial concentration of investment and service activities in growth centers. Hence, a policy of industrial dispersal, combined with a "concentrated decentralization" strategy (Rodwin,[3]), is perceived by the Venezuelan government as the cornerstone for the development of the national territory.

The basic assumption underlying the policy of industrial deconcentration is that most of the unemployment in lagging or development areas, rather than from structural or frictional causes, results from demand deficiency, i.e., the assisted areas suffer excessive unemployment, not because they are inferior locations for the growth of modern industries, but because there is no industrial tradition and appropriate agglomeration economies to encourage industrial growth. It is expected that the introduction of new industries in designated areas will reinforce the indirect impact of new activities until a point is reached where, in a group of industries linked by the interchange of goods and services, the multiplier effects become significantly stronger, signalling a qualitative as well as a quantitative change.

This regional policy may be in conflict with sectoral policies. Taking full advantage of modern industrial technology, as favored by the sectoral approach, may give rise to locational decisions recognized as non-optimal from the point of view of long-term regional development policies.

2.3 Policy instruments

A crucial factor in these locational manipulations is the use of incentives and restrictions, intended to channel investment into specific areas and induce firms to perform and behave in accordance with certain social goals and objectives.

In Venezuela, there is an array of policy instruments for carrying out industrial decentralization. Among these instruments are:

a) Direct incentives, i.e., straightforward financial and fiscal incentives such as grants, loans and tax concessions;

b) Indirect forms of assistance such as the provision of industrial parks and improvement of transportation and communication facilities;

c) Negative incentives, i.e., control over location.

2.4 The research

These three elements --objectives, policies and instruments-- although present a hierarchical structure (see Fig. 2.1) are interrelated; they constitute a system. As such, each component affects the other, i.e., each element is interrelated with the other two (see Fig. 2.2).

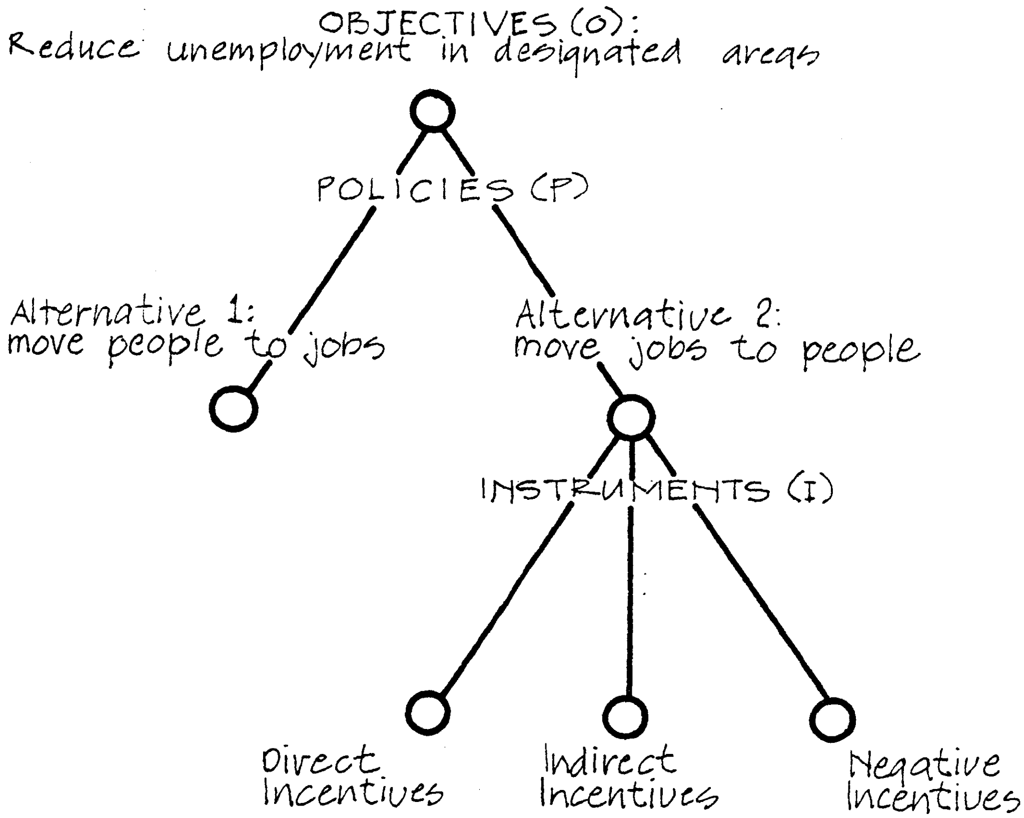


FIG. 2.1 HIERARCHICAL STRUCTURE OF OBJECTIVES, POLICIES, AND INSTRUMENTS

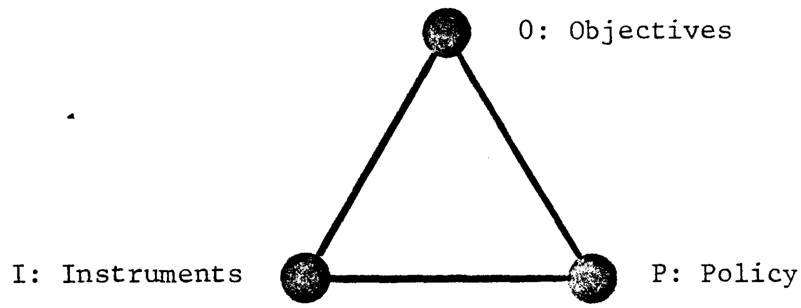
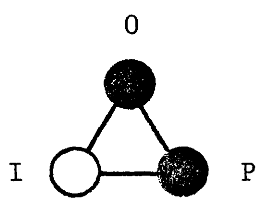


Fig. 2.2 Interrelation between Objectives, Policy and Instruments

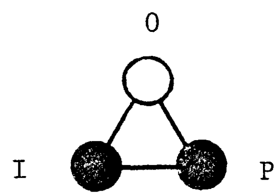
Three primary relations can be observed in Fig. 2.2, which give rise to the following questions:



Question 1: Has the policy of industrial deconcentration fulfilled the regional objectives? (Objective-Policy relation)

To evaluate if the policy itself has made a contribution or has been a success, one should return to the objectives listed earlier and estimate the contribution of each. Furthermore, ideally we should assign a weight to each objective since, a priori, we can expect them to differ in importance. However, such as exercise is impractical and could only achieve a superficial result.

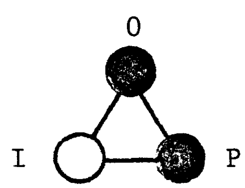
In spite of the difficulties mentioned, this question of the actual impact on regional objectives is a very important one. Industrial establishments, for example, may move to the assisted areas but bring their employees with them. They may also recruit labor from the existing workforce, rather than from among the unemployed, causing wages to rise. In these two cases, they may make only an indirect contribution to the objective of increasing employment opportunities in the designated regions, even though from the point of view of the policy --moving industry to development areas-- it is successful.



Question 2: Is the changing pattern of industrial location a result of the policy instruments applied? (Instruments-Policy relation)

A careful consideration of the policy instruments used in Venezuela may suggest that they have merely accentuated existing market trends: on the one hand, incentives may be given to firms that will locate in the development areas anyway, and on the other hand, the incentives offered may not be sufficient to attract desirable industries to the assisted regions.

In the former case, it is possible that the opening of a branch plant in a development area, for example, is due to the firm's response to an increase in the regional demand for its products. In this situation, the incentives received by the firm become an additional source of profits. In the latter case, where the incentives offered are not sufficient to attract desirable industries to the designated areas, it is possible that the number of locational choices available to some industrial firms is strongly limited. An example may be the need of the entrepeneur of a small firm to be close to the central government, either because the government is his major client or because it grants him special licenses. Spatially, this implies the need to be located in the Metropolitan Region.



Question 3: How have policy instruments affected the regional objectives? (Instruments-Objectives relation)

Worldwide, the mechanics and impact of policy instruments are rarely fully understood. Rather, incentives and restrictions are often applied indiscriminantly, and, as a result, discrepancies between intended purposes and unintended effects can lead to severe misallocation of resources. For example, subsidies to capital are often believed to encourage capital-intensive technology with consequently a limited effect on the creation of new employment opportunities. Furthermore, subsidies may help non-competitive industries to survive, or get industries to move, which would move without subsidies.

These researchable questions are so broad and complicated that any one of them could become by itself a dissertation topic. However, there is a need, therefore, to limit the scope of this work. Due to the fact that the Venezuelan government is currently considering modifying the policy instruments applied, so as to accelerate the deconcentration of industry, the primary question to be examined in this dissertation is a variant of question 2, above:

Have Government instruments (both incentives and restrictions) contributed to the deconcentration of industry?

2.5 Difficulties in measuring the effects of regional policies

The main difficulty in trying to assess the effect of policy on the variables chosen to represent policy objectives such as employment figures is that these variables are far from being influenced by regional policy alone. There are other causal factors, such as long-term structural changes, migration, and short-term variations ascribed to the trade cycle. The problem is even more complicated because the policy instruments are unlikely to have been consistently applied over time and space.

The government's regional deconcentration policy is designed to be implemented by a battery of instruments. This makes it harder to represent policy by a single indicator. Hence, the following additional questions have to be answered: How to separate the effects of the various government instruments? Are these effects additive? Do the instruments augment one another's effectiveness? An additional difficulty is the long-term lag between cause and effect which has been observed in regional policy.

Finally, the analysis is costrained by the availability of data and the method of analysis used. It is notable that in similar studies done in Great Britain and Germany (OECD,[4]), for example, the analysis often relies on statistics, not generally available in other countries, relating to the various economic characteristics of quite small development areas.

In Venezuela, this last problem is very pronounced. In some instances the data do not exist, and in others, data exist but the institutions which have the information are reluctant to release it. In most cases, when data are available, the uses of the data are limited by problems of unreliability and inconsistency.

2.6 Limitations of the research

For the purpose of reducing research to reasonable proportions:

* The dissertation will not analyze the conflicts and merits of the regional development objectives.
* The study will not consider the controversy regarding the mobilizarion of industries versus the mobilization of people.
* The research will not analyze the reasons why the government should or should not attempt to induce firms to settle in development areas (concentration versus deconcentration strategies).
* As indicated earlier, the dissertation <u>will</u> attempt to evaluate the effects of the instruments on the policy of industrial deconcentration (question 2, above), but will not deal with the effects on the regional objectives, caused by either the policy or the instruments (questions 1 and 3).

3 THE POLICY OF INDUSTRIAL DECONCENTRATION

3.1 The economic environment of the industrial spatial policy

The Venezuelan industrial deconcentration policy is aimed at discouraging the location of new manufacturing industry in the north-central region of the country as well as redirecting industrial firms to designated areas. To put the manufacturing spatial policy into perspective, a brief description of the Venezuelan sectoral economic policies for industrial promotion will be outlined here. Five policy tools for promoting industrialization in Venezuela will also be identified (World Bank,[1]):

1.- Tariffs and licensing.

The first and most important tool is a set of tariffs and quantitative restrictions to provide protection from import competition. Along with import licensing, the Venezuelan protective system has relied greatly on specific tariffs, which were generally low for those imports either not produced domestically or subject to licensing, but which were prohibitively high for other imports which competed directly with national production. This practice was apparently encouraged by the commercial treaty signed with the United States in 1939, under the terms of which both countries agreed not to increase tariff levels on a specified list of products. This commercial treaty was ended by Venezuela and a new tariff was announced later in 1972 and introduced in May 1973. In this new treaty specific tariffs and import licenses were less important than formerly but not eliminated.

Licences serve to plug gaps in the tariffs wall. Thus, if a customs category covers a variety of products, only some of which are produced in the country, that category becomes subject to a low tariff combined with licencing. Licences requests made for the purpose of importing a product produced within the country are denied; requests for importing other products are approved (World Bank,[2]).

2.- Tariff exonerations.

The granting of tariff exonerations on the importation of industrial goods is done on a case by case basis by the government. The magnitude of tariff exonerations deserves emphasis. In 1970, for example, foreign trade data show imports of raw materials and machinery for industry valued at Bs. 1,216 million for which exonerations were granted. This was equal in magnitude to almost half of the Bs. 2,571 million of imports for which duties were collected (World Bank,[3]).

3.- Local content regulations.

Content regulations as a tool for government industrial policy set dates by which a certain percent of a given industry's output, measured by either value or weight, must be of national origin. Such regulations are best known in the automobile industry. (Other products governed by these regulations include: air conditioners, washing machines, and pumps). These regulations stipulate the firms authorized to engage in production and the brands they are authorized to produce. The regulations have also been used to reduce the number of firms, brands, and models in order to minimize costs caused by loss of economies of scale. Furthermore, this policy stipulates that any part, once having been produced locally and included in local content, may not be imported at a future date, i.e., this tends to insulate parts producers from the threat of future imports competition. Enforcement of these regulations is carried out merely by denying licences and tariff exonerations to unauthorized firms or brands.

4.- Provision of credit facilities.

This fourth government policy for industrial promotion involves the provision of credit facilities with subsidized interest rates. The study done by the World Bank[4] indicated earlier concludes that up to 1973 government institutions were of secondary importance as sources of long-term credit except in the cases of food processing and the steel industry. This situation changed in 1974 with the reformulation of the economy. The marked increase in petroleum prices produced a large increase in government revenues, much of which were subsequently earmarked for industrial development. To this end, the Venezuelan Investment Fund (Fondo de Inversiones de Venezuela) was created in 1974.

This Fund has been the recipient of up to 50% of the country's oil revenues annually, and it is authorized to use these revenues to finance expansion and diversification of the Venezuelan economy, make loans and investment abroad to preserve the value of petrodollars, and to promote development of international financial cooperation programs. Hence, the Venezuelan Investment Fund deals mainly with very large projects such as petroleum, petrochemicals, electric power and basic metals. The Venezuelan Development Corporation (Corporación Venezolana de Fomento) traditionally is a major source of long-term credit for very large enterprises which are mostly government-owned.

More diversified lending to industry is the responsability of the Industrial Credit Fund (Fondo de Credito Industrial) also created in 1974 and the Corporation for the Development of Small and Medium Sized Industry, or Corpoindustria (Corporación de Desarrollo de la Pequeña y Mediana Industria). The Industrial Credit Fund finances projects ranging in size from 6 to 40 million bolivares and its lendings are channeled through other financial institutions such as private banks and investment houses (financieras). Smaller loans, under Bs. 6 million, are the concern of the National Commission for Industrial Development, or Conafin (Comisión Nacional para el Fomento Industrial) which has been in existence since the 1960's. Conafin was reestructured as a corporation in 1974 changing its name to Corpoindustria.

5.- Export incentives.

A number of incentives, the most important of which involved preferential access to credit, have been in effect since the early 1960s. Nevertheless, the principal incentive lies not in financing but in subsidies, expressed as a percent of f.o.b. export value. The rate depends on the import value embodied in the exported product, ranging from 30% subsidy for products with no import content, down to 11% for 70% import content (World Bank,[5]).

From the above description of the tools used in Venezuela for industrial promotion, we may agree with the study done by the World Bank,[6] quoted earlier, that says:

> "The salient feature of the Venezuelan industrial environment is the high degree of protection from import competition made possible by government policies."

Later on the report adds:

> "By this process the industrial sector has become highly dependent on favorable treatment by government policymakers. Possible variations in government policy carry greater potential effect on profitability than does any likely development in cost reduction or new product promotion."

3.2 The legal framework of the policy

The implementation of the industrial decentralization policy is effected through a set of presidential decrees, laws and resolutions which together are intended to prohibit the location of new manufacturing activity in or near Caracas, to induce firms considered hazardous to leave their locations for safer places, to stimulate industries already located in the congested Metropolitan Region to move to designated areas, and to attract new manufacturing activity to designated development areas. From the set of legal instruments issued since 1974 to implement the industrial deconcentration policy, the following are the most relevant to our study.

Presidential Decree No.134 (June 4, 1974)

Authorize the granting of incentives to firms which locate in less developed parts of the country.

Presidential Decree No.135 (June 4, 1974)

Prohibit new manufacturing establishments from locating in the city of Caracas unless they qualify under special conditions, i.e., they supply or give basic services to the inhabitants.

Presidential Resolution No.5608 (August 20, 1974)

Create the Deconcentration Commision to advise the executive branch of the government about further implementation of the industrial deconcentration policy.

Presidential Decree No.713 (January 21, 1975)

Modifies decree No.125 by augmenting the prohibited area to include not only the city of Caracas, but its surrounding area, i.e., the nearby towns such as Los Teques and La Guaira.

Presidential Decree No.1477 (March 23, 1976)

Divides the country into five geo-demographic regions (Zones A, B, BM, C and D) for the purpose of establishing the variation in the level of incentives that firms will receive in each of the designated areas. (See Fig. 3.1: The zones are described further, below).

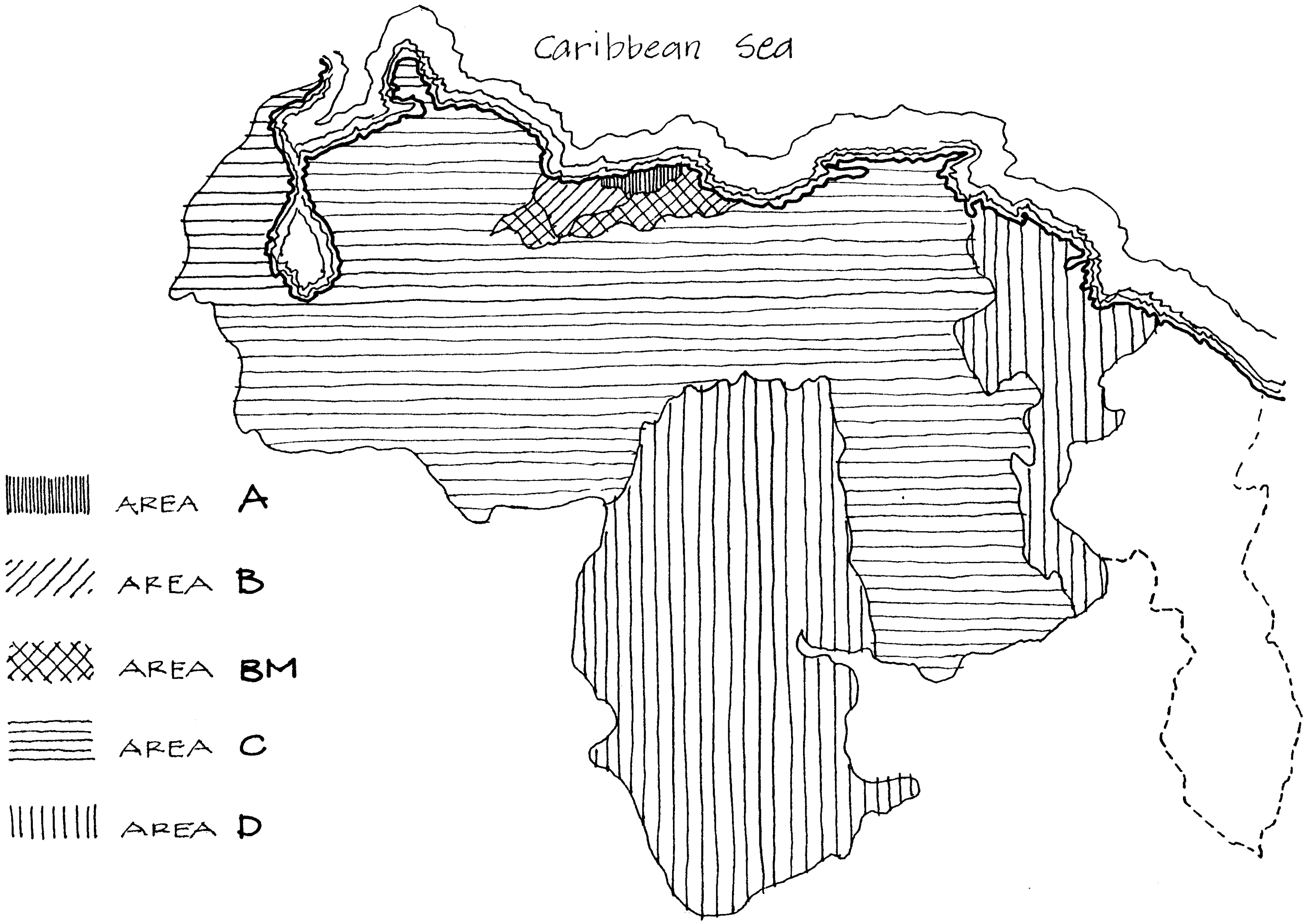


FIG. 3.1 INDUSTRIAL DECONCENTRATION AREAS

Presidential Decree No.1478 (March 23, 1976)
Draws up two lists of industries: one is comprised of those existing firms that are allowed to relocate within area A, the Caracas Metropolitan Area; the other list groups those industries deemed to be dangerous, such as those involved with industrial chemicals, petroleum and coal derivatives, etc., which should leave their locations for safer places. These lists are identified here as group II and III.

According to Dra. Inírida Toledo[7] the wording of this decree was carefully chosen for the purpose of closing the loophole opened by decree 135, so that in effect no new establishment would be allowed to locate in Caracas. Indeed, a careful analysis of this decree shows that attempts were made to avoid listing those industries that, according to decree 135, were allowed to locate in Caracas because they "supply or give basic services to the inhabitants." On the other hand, annex 1 of the policy document (Ministerio de Fomento,[8]) lists those industries which are considered to supply and give basic services to the inhabitants. Although this list is used in the policy document to establish priority for industries to be located in a particular zone of area BM (chiefly, locations adjacent to Caracas), we will expand its use to designate those industries that can locate in Caracas according to decree 135. (This list will be identified as group I). Expanding the use of the list allows a more lenient evaluation of the policy, i.e., industries on list I located in Caracas, are not "trangressors" of the policy.

From the above discussion, we may infer that the industrial deconcentration policy has three lists of industries, identified here as groups I, II and III.

List I includes producers of household consumer goods and services such as basic foodstuffs, clothing, furniture, and others. New firms belonging to this list are allowed to locate in area A, the Caracas metropolitan area, provided they are of small and medium size. List II is a subset of list I. Existing firms on list II are allowed to relocate within area A. For example, it is possible for a bakery to move to another location within area A for the purpose of enlarging his production system. Firms on list III are those deemed dangerous and should leave area A. In summary, new firms, not assigned to list I, are prohibited from locating in area A. Existing firms not assigned to list III may continue operating in area A and only those firms on list II may relocate within area A.

3.3 The spatial framework of the policy

From the set of presidential decrees and resolutions mentioned above, it can be seen that the underlying idea of the Venezuelan policy of industrial deconcentration is to limit the expansion of manufacturing activity in the Metropolitan Region and to divide the country in various zones. Each of these zones has incentives to attract industries. These incentives vary among zones, following the national goal of reducing inter-regional disparities in wealth and well being. Venezuela's five areas of industrial deconcentration are (see Fig. 3.1):

Area A Corresponds, as already noted, to the Metropolitan Area of Caracas. Only small and medium size firms on list I are permitted to locate in this area. Existing firms on list II are allowed to relocate within the region. Highly polluting and/or dangerous industries (list III) are forced to leave this area. Only firms forced to move their plants receive tax and other concessions to ease the relocation burden. All other industries receive no incentives.(See Fig. 3.2).

<u>Area B</u> Corresponds to the populated centers west of the Metropolitan Area, i.e., from Caracas to Valencia, comprising most of the Venezuelan industrial axis. Industries locating in this area receive no incentives.

<u>Area BM</u> Corresponds to the area that is marginal, i.e., surrounds areas A and B (see Fig. 3.2). Some incentives are given to firms who locate in this area, especially to those who were forced to leave area A.

<u>Area C</u> Comprises those regions covering the bulk of the country's geographical area (see Fig. 3.1) that are considered best fitted for the absorption of new economic activities. Consequently this zone receives a number of incentives. Within this area, 33 settlements were selected to receive the incentives. Following the concentrated-decentralization strategy (Rodwin,[9]), five cities were selected from the 33 settlements to become the Venezuelan growth centers. The following is a list of the five cities or conurbations (see Fig. 3.3):

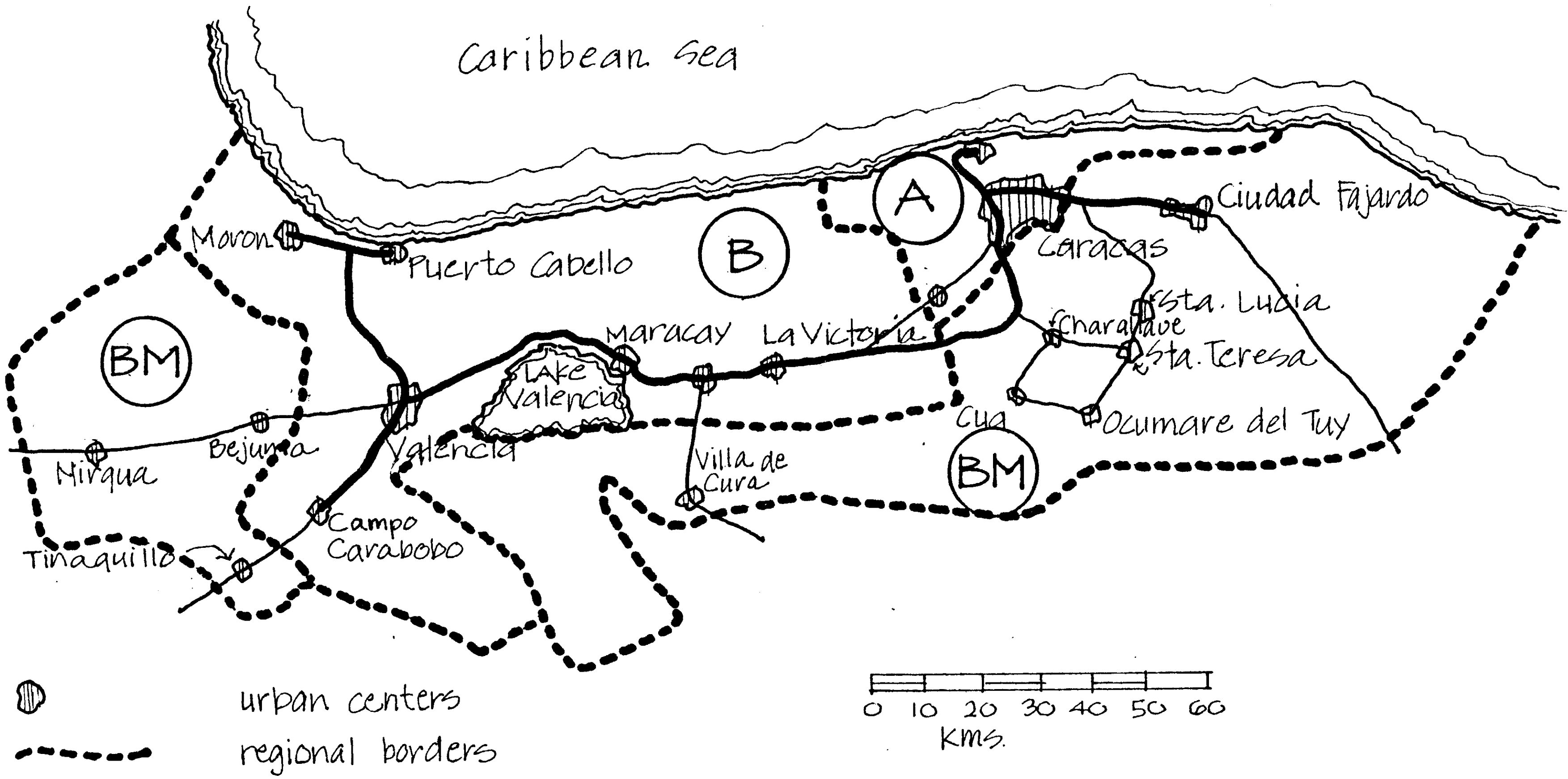


FIG. 3.2 INDUSTRIAL DECONCENTRATION AREAS A, B, & BM

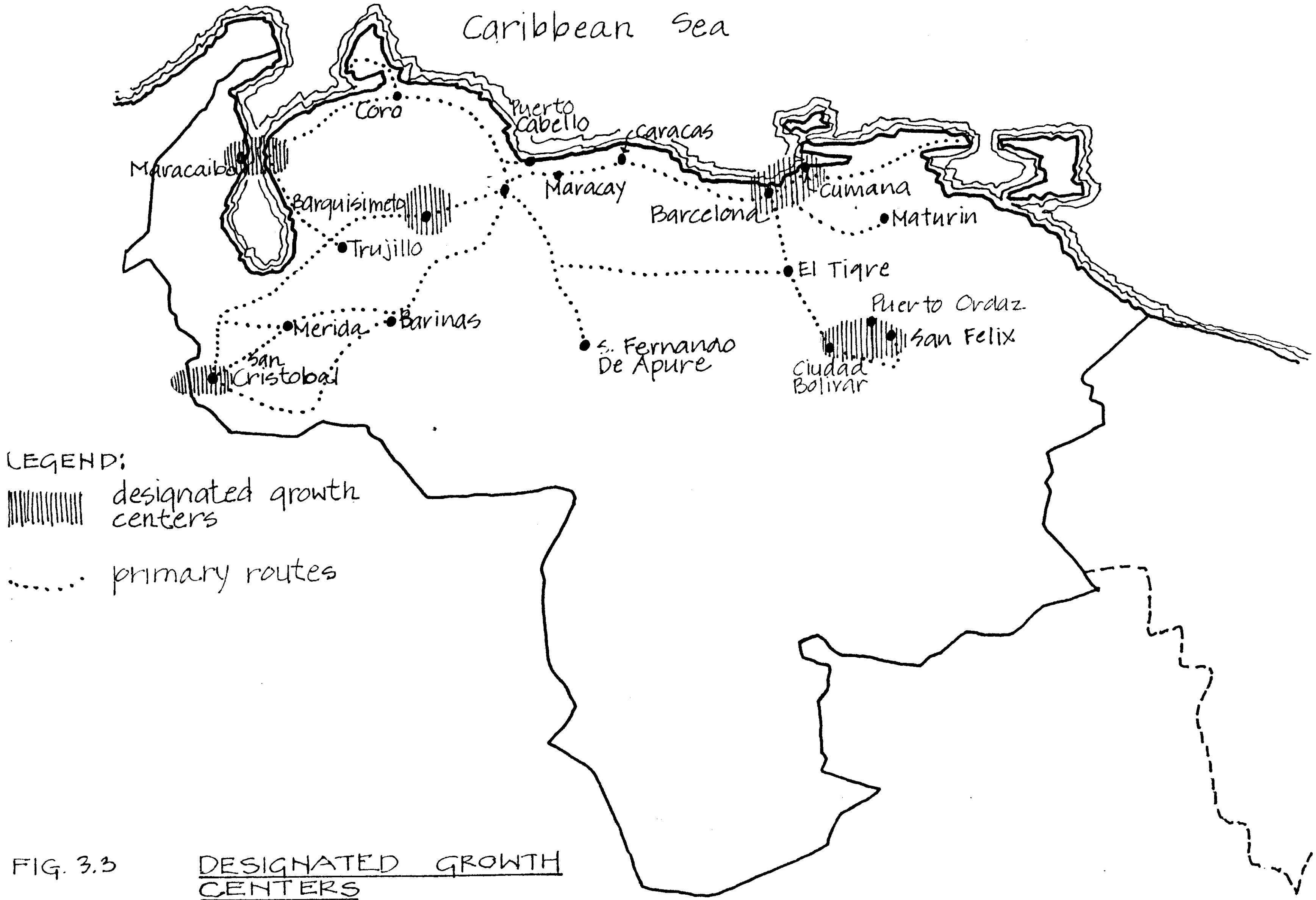


FIG. 3.3 DESIGNATED GROWTH CENTERS

1 Barcelona-Puerto La Cruz-Cumaná

2 Barquisimeto

3 Maracaibo-Costa Oriental del Lago

4 San Cristobal-San Antonio-La Fria

5 Ciudad Bolivar-Ciudad Guayana

Area D Corresponds to the national territory that does not belong to any of the other areas. This area might get the same government incentives as area C, but only under special permission following detailed study.

In chapter 2 it was argued that aggregate spatial data will not necessarily reflect the amount of industrial activity in each of the five areas identified by the industrial deconcentration policy. The use of an administrative region as the spatial unit may be misleading since the area subdivisions setup according to the administrative regions, are different from the subdivisions that follow from the policy of industrial deconcentration. This can be observed when Fig. 1.2 and Fig. 3.1 are compared. A more detailed example of these discrepancies can be seen in the Capital Region, i.e., one of the eight administrative regions. Fig. 3.4 shows the Capital Region. When comparing Fig. 3.4 with Fig. 3.2, we see that the Capital Region overlaps area A and part of Area BM. Hence, if industries have moved from Caracas to, say, Santa Lucia or the town of Cúa, which are in a designated area receiving incentives (BM), this movement is not registered by the Capital Region which may show that no change has taken place.

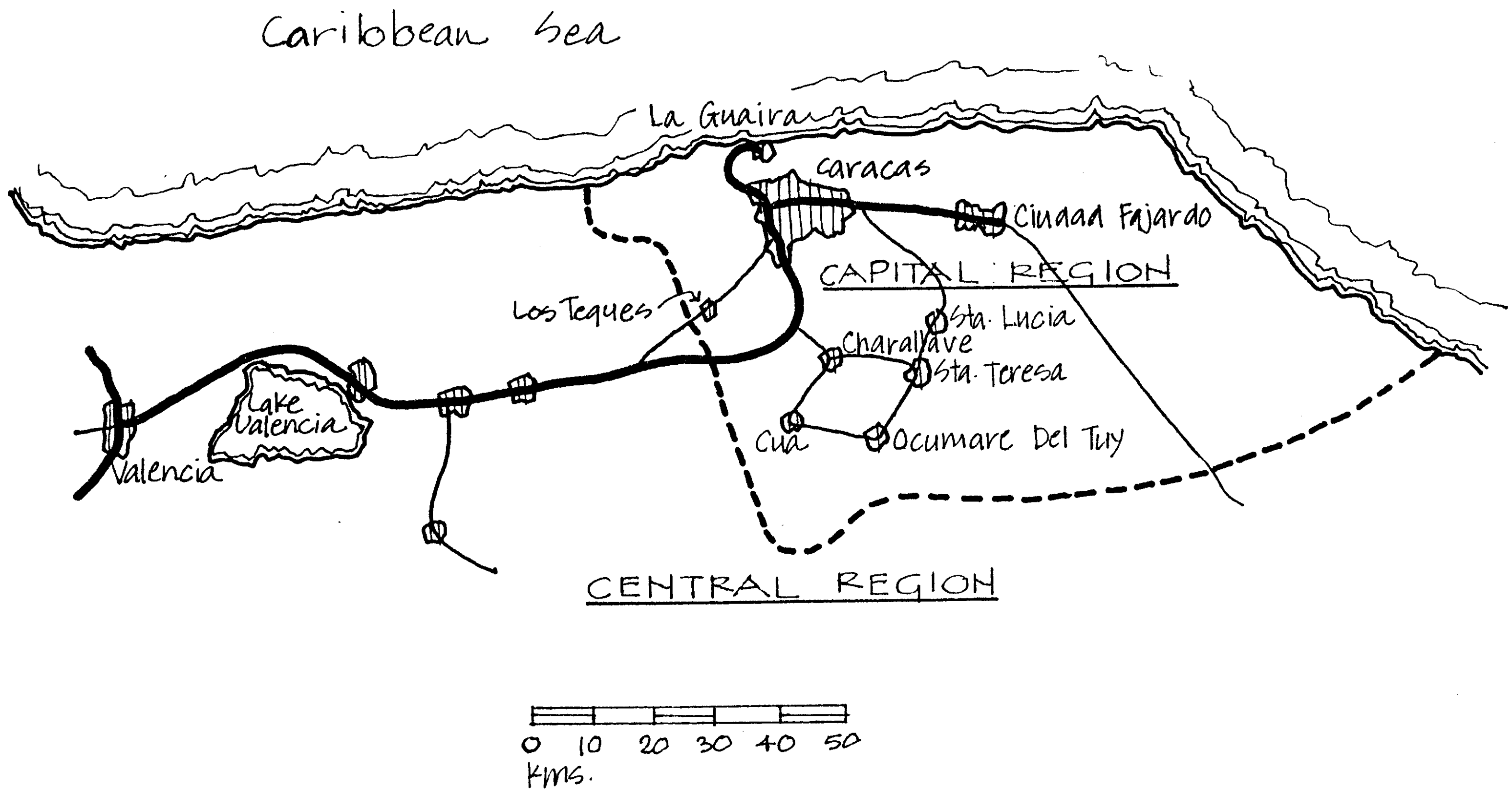


FIG. 3.4 THE CAPITAL REGION

3.4 The operational framework of the policy

The nature of the impact of government incentives on locational choice may be better appreciated by examining a summary of the operational framework within which decisions are taken. The process begins in a given manufacturing sector with the decision, for example, to undertake national production in partial substitution of imports. The decision may result from the initiative, either of an entrepeneur or of the Ministry of Development which continually searches out new possibilities for import substitutions and advertises them to the private sector. Once a proposal for import substituting production, as well as the location of a new plant, is approved by the Ministry of Development, the Government becomes committed to providing a certain degree of tariff protection. Once tariff protection is given against a particular competing import, such protection is available to any firm wishing to produce the import-substituting product. However, three additional policy instruments are administered on a case-by-case basis individually for each firm: exonerations on imported inputs, access to government credit --financial incentives-- and tax holidays --fiscal incentives. According to the World Bank[10] study, cited earlier, when three or four companies have initiated production and completely eliminated imports of the equivalent product, additional latecomer firms desiring to enter the new industry are often denied government support in the form of exoneration and credit.

The highly centralized decisions that take place in Caracas should be stressed. Exonerations on imported inputs are granted by the Ministry of Development. Government financial institutions for large size loans are located in Caracas, while for small and medium size loans the financial institutions are in the city of Maracay (Corpoindustria headquarters). The Regional Corporations --there is one in each of the administrative regions-- in theory may function as an intermediary between the firms and the government financial organizations, but entrepeneurs prefer to operate directly with the principal office. Hence, they travel all the way to the North-Central area to submit their applications and obtain approval.

3.5 Expected outcome

Based on the description of the industrial promotion and industrial deconcentration policies presented earlier, we may ask what could be the outcome of the policy of industrial deconcentration? In order to answer this question, we may want to look first to what history can teach us.

In Latin American countries as well as in many other countries, policies aimed at the regional dispersal of industry have a long history. These countries have chosen deliberately to plan and promote the process of deconcentration with the expectation that industrial activity will probably concentrate further, if left to the vagaries of the market forces. For example, the first country in Latin America to adopt financial incentives was Mexico (Gilbert,[11]) when, in the 1930's, several states bordering the United States were granted concessions from import duties. Other countries such as Brazil, Argentina and Chile also had long experiences with policies of industrial deconcentration (United Nations,[12]).

This richness of experiences available in other countries may give us a clue as to what we may expect in Venezuela as a consequence of the policy of industrial deconcentration. For example, a study done by Lavell[13] on the administrative controls upon location in Mexico indicates:

> "The Mexican government also applied some controls on industrial location but did not implement them vigorously. A more typical method was the attempt to influence industrial location by threatening to refuse companies additional water, fuel and gas supplies. Although there are cases where they have been effective, in Mexico controls upon location would seem to have had comparatively little effect. In general more companies have set up in Mexico City, to gain access to the government bureaucracy, than have dispersed as a result of location controls."

In the Latin American context Gilbert[14] stresses that:

> "In several Latin American countries, political conditions have allowed governments to implement policies aimed at the regional dispersal of industry. But, in general, these policies have employed rhetoric rather than action, and only in Chile, Brazil, Cuba and Puerto Rico have any major changes been made in the regional distribution of industry. Even in these countries government action has only slowed the tide towards a highly localized spatial distribution and not reversed it. Such a situation has not arisen because governments lacked suitable tools for dispersal, for a

variety of methods have been employed. Rather, it seems as if the political will to implement these methods is the element that was lacking."

It may be argued that in Venezuela, the possible lack of political will may not necessarily be the only major constraint faced for a satisfactory implementation of the policy. There is something equally important that is missing: the institutional process that will allow "things to happen." For example, even under the assumption that there is political will as well as properly designed tools for dispersal, it is not clear how the government machinery is going to go around to coordinate the implementation of the policy. In other words, there seem to be no answers to questions such as the following:How should the various government organizations such as those dealing with housing, water supply, transportation, health and education expand their activities in the designated growth centers in a coordinated way? The growth centers are clearly defined but it is less clear how the actual improvement of these centers will take place, i.e., how the proper physical and social infrastructure will be constructed and serviced so that the new schools have teachers and the new industrial parks have water.

Other unanswered issues are: How will the Ministry of Development control the prohibition to locate in the city of Caracas? What should the relationship beteen the local authorities of Caracas and the national authorities be (such as the Ministry of Development) in terms of the policy of industrial deconcentration? In other words, it seems that the following assumptions were made by government officials when designing the industrial deconcentration policy:

* The establishment of industrial parks in designated areas will be properly coordinated by the corresponding government agencies. This implies that industrial parks will have the necessary life-support systems, i.e., a good water supply, a reliable supply of energy, an appropriate drainage system, etc. Furthermore, government agencies in charge of the social infrastructure such as housing, schools, health facilities, etc. will also coordinate their efforts to supply the expected needs of the designated growth centers.

* Government financial institutions will follow the guidelines of the deconcentration policy and only give subsidized interest rates to firms locating in the designated areas.

* Municipal Councils will collaborate. Local authorities of towns where new manufacturing activity is not encouraged by the deconcentration policy, will not try to have their own industrial park.

It can be argued that these assumptions do not hold, not only in the Venezuelan context but also in most of the more developed countries. It is necessary to properly address the issue of the institutional process which would explicitly deal with these problems and which will indicate procedures to be followed so that what has been assumed will really exist. We may argue that the lack of a proper specification of the institutional process that should be used to implement the industrial deconcentration policy (independently on how well each policy instrument has been designed) may lead the whole operation to failure.

It would be appropriate at this point, to review some other assumptions that seem to have been made by government officials when designing the policy instruments:

* The financial and fiscal incentives are large enough to overcome the cost disadvantage of not locating in the preferred area.

It can be argued that it is doubtful that the financial and fiscal incentives given are large enough to overcome the cost disadvantage of not locating in the preferred area --generally the north-central area. Some of these cost disadvantages that must be overcome are related to the large investments of capital in inventories of materials that may be needed to insure continuity in production at distant locations. Another disadvantage to be overcome by the incentives offered is the preference of managers and technicians for a way of life which can be had only in the major cities. Any location away from the big city is often regarded as a place of exile. To get high level personnel away from the big cities, substantial increments in salaries and benefits must be offered. To this should be added the need for face-to-face relations when exonerations and licenses are required for imported inputs. Furthermore, conditions change frequently and unpredictably: regulations are changed, ministries are reorganized, etc. Indeed, it is often crucial to be at the center of influence, decision and information.

* New manufacturing firms rely heavily on government sources of finance. By confining the loans to designated areas, new industries will be directed towards the designated growth centers.

It can be argued that the assumption about new manufacturing firms having to rely heavily on government sources of finance may not necessarily be true. This may be the case of small size industries, but not necessarily for medium and large firms, since the countries exporting the needed machinery and equipment often grant --as subsidy to exports-- attractive loan conditions at below market interest rates.

* Few firms will contravene the prohibition to locate in Caracas and unauthorized new firms located in the city of Caracas will be easily detected and forced to leave the area. Furthermore the government has the power and the will to force a hazardous industry located in an unsafe place to move to a better location.

Although the government has the legal instruments to enforce the law, it is highly unlikely that these instruments will be used to force certain manufacturing firms to leave Caracas. Furthermore, unauthorized firms of small size may locate in Caracas because they can camouflage their manufacturing activity as an operation that is not banned, such as commerce or service.

From the above discussion, we migh, in general, expect to find that the industrial deconcentration policy has yet not worked. If any deconcentration occurred, it is likely to be due to other factors such as diseconomies of agglomeration (e.g. high land cost, congestion, etc). Overall, we may expect (with or without the industrial deconcentration policy) very little deconcentration of industry. At most we may speculate that the Venezuelan industrial axis will expand, not only to the south of Caracas, but to the west as well, following the establishment of settlements able to supply the life support systems and social infrastructure needed for industrial growth.

For market, agglomeration potentials and many other considerations mentioned earlier, industries will want to locate in the Metropolitan Area. The high cost of congestion in Caracas itself will make industries look for nearby towns in which to locate. Since the towns to the south of Caracas --Cúa, Santa Teresa and others-- and to the east --Ciudad Fajardo-- are very close to the capital city (see Fig. 3.2) and since they additionally belong to a deconcentration area receiving some incentives, i.e., BM, we may expect a spillover effect in these towns. We may expect some industries that supply the national market but for whom being very close to Caracas is less crucial to locate towards the west of the industrial axis, such as in the towns of Bejuma and Nirgua (see Fig. 3.2). In this way they can be close to both the geographic center and to the industrialized axis of the country.

Overall, we may expect the industrial deconcentration policy to have little or no effect on locational decisions and that any deconcentration that may have occurred, to be due to locational factors not related to the policy instruments.

3.6 The research issues

So far we have speculated about the possible outcome of government policy and we may ask ourselves whether some of the issues discussed above have taken place. Nevertheless, we should recall the previous discussion in chapter 1 about the limitations imposed by the very short period that has elapsed since 1974 when the first presidential decree relating to industrial deconcentration policy was issued.

As discussed earlier, it is important to have an "early understanding" of the possible consequences of the policy. The answer to the main issue posed in chapter 2, i.e.,

Have government instruments (both incentives and restrictions) contributed to the deconcentration of industry?

requires answers to the following more specific questions:

Issue 1 Has deconcentration of industry indeed taken place?

Issue 2 Is any such deconcentration a result of the policy instruments applied?

<u>Issue 3</u> What have been the other factors influencing industrial location and what has been their relative importance?

In the following chapters, attempts will be made to answer each of these questions by using, first, the available aggregate data. Since aggregate data prove inadequate to the task, an operation was set up to organize data already in existence, but which are disperse or incomplete.

PART II: THE RESEARCHABLE QUESTIONS

4 Has deconcentration of industry taken place?

This chapter will attempt to investigate the locational pattern of industry in Venezuela over time. First, results using aggregate data will be analized, and then results by stratifying the sample by industry subgroups will be presented. Finally, results for new manufacturing activity (disaggregate data) will be shown.

4.1 Choice of indicators

A priori, the effects of the policy of industrial deconcentration are expected to be felt in the level of relative participation of the regions. Hence, it is necessary to decide which indicators of industrial activity will provide a satisfactory picture of what regional policy may have achieved. The choice of indicators has to take into account data availability and the type of changes that are going to be measured. Since our interest is to find out to what extent the regional policy has affected the pattern of industrial location, it is clearly desirable to choose indicators which measure the size and dispersion of the manufacturing industry. Some commonly used indicators are, for each of the several regions considered:

- Total employment
- Number of industrial establishments
- Number of manufacturing projects
- Manufacturing investment
- Production value

From the point of view of data collection, the basic statistical unit is the firm (defined as identical with an "establishment" in this study). Once this unit has been identified, some of its characteristics may be obtained. This sequence is necessary because it is impossible, for example, to acertain number of employees or production value before identifying the firm.

Since regions may not be dependent upon new industry for their development but can have an indigenous industry capable of expansion, the effect of the policy on expansion of an existing establishment will not be detected by measuring the number of firms. A better indicator under these circumstances will be employment figures.

4.2 Data issues

Today, the collection, processing and publishing of information regarding the manufacturing industry in Venezuela is mainly in the hands of the Central Statistical Office (Oficina Central de Estadística e Informática). In 1971, the systematic collection of data on the manufacturing industry was initiated, taking into account the spatial dimension. Since then, a yearly survey of industries has been conducted. The results, in aggregate form, are available for the years 1971 , and 1974 to 1978. Results for other years are not available.

Published data are presented by administrative regions. Since representative sampling of the region is conducted, any attempt to infer behavior of the industry in smaller area subdivisions may lead to misleading results.

4.3 Aggregate results for Venezuela

Using available aggregate data, the distributional pattern of establishments over time can be seen. Table 4.1 shows the number of establishments in each region, as a share of the national total, for the years 1971, 1974, 1976 and 1978.

Changes can be observed in the Capital Region, where from 1974 to 1976, the region's share of the national total grew from 50% to 55%. The Central Region seems to have steadily been reducing its share, from 17% in 1974 to 15% in 1978. The Andean and Nor-oriental Regions on the other hand, grew 1% between 1976 and 1978 (from 7% to 8% and from 5% to 6%, respectively).

From the results shown in Table 4.1, we can hardly conclude that the spatial pattern of industry by administrative regions have change substantially. At most we may say that between the years 1974 and 1976, the manufacturing industry as a whole, increased its concentration in the Capital Region by five percentage points, at the expenses of the other regions. (Variations of one percent are meaningless, because of rounding errors, when percentages are estimated).

We may argue, in addition, that results for the Venezuelan manufacturing industry when presented as a whole may fail to illuminate the fact that each industrial subgroup may behave differently by reacting in a different way to a particular stimuli.

TABLE 4.1

ADMINISTRATIVE REGION'S SHARE OF ESTABLISHMENTS OF THE NATIONAL TOTAL, FOR ALL THE VENEZUELAN MANUFACTURING INDUSTRY

Region	1971	1974	1976	1978
Capital	51	50	55	54
Central	16	17	16	15
Centro-Occidental	8	7	7	7
Zuliana	8	9	7	7
Andes	7	8	7	8
Sur	1	0	0	0
Nor-Oriental	7	6	5	6
Guayana	2	3	3	3
Total	100	100	100	100
Number of establishments	6,401	7,554	9,538	10,478

SOURCES:
- Cordiplan, Encuesta Industrial 1971, (Caracas: Cordiplan 1973).
- OCEI, Encuesta Industrial, (Caracas: Oficina Central de Estadistica e Informatica, 1974 and 1976).
- OCEI, Directorio Industrial, (Caracas, 1978).

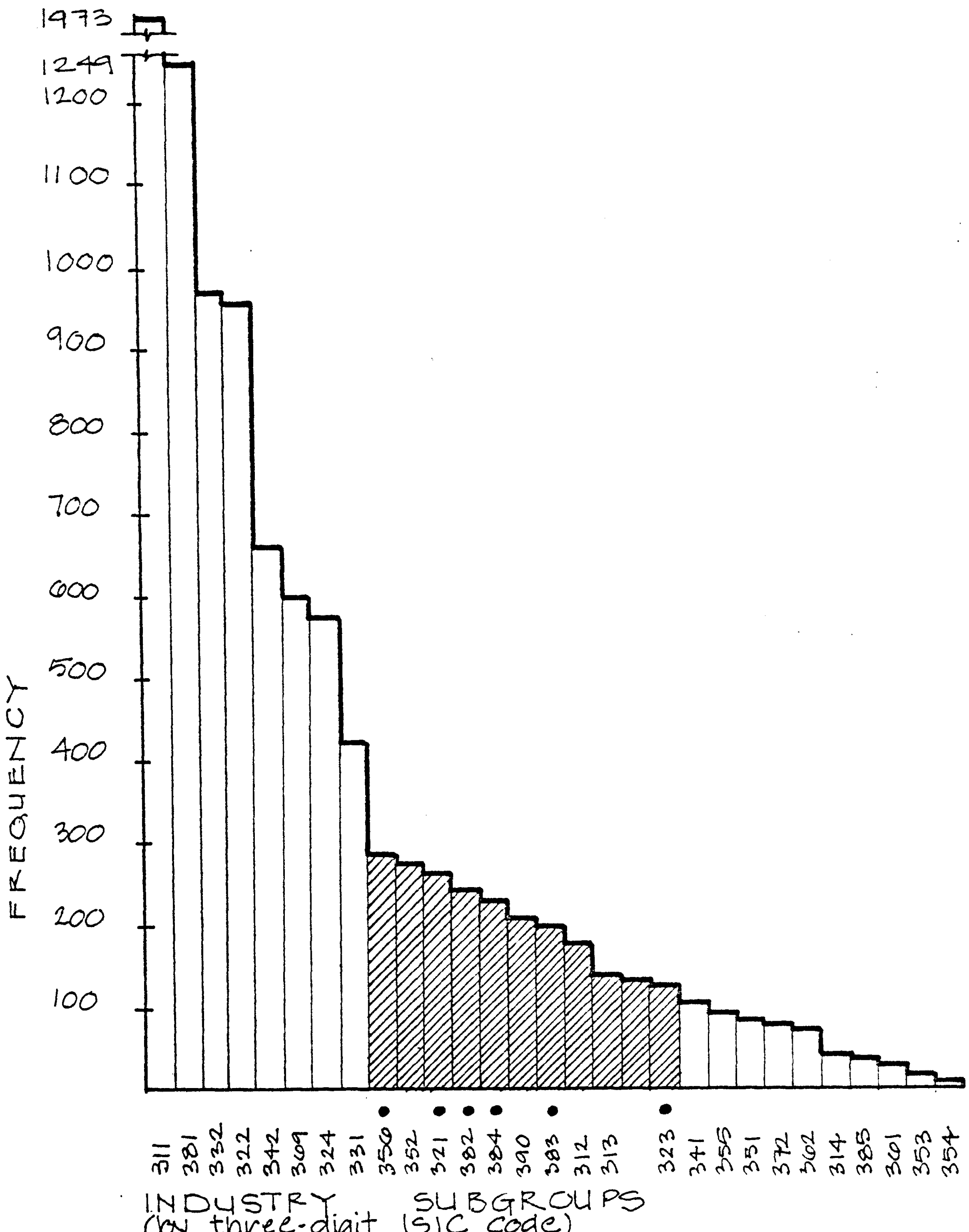
An exhaustive analysis of all the manufacturing sectors of the Venezuelan economy is beyond the scope of this research. There is a need however, to select some manufacturing sectors to highlight the methodology developed here and to give additional insight into the locational dynamics of Venezuelan industrial firms.

4.4 Selection of the manufacturing sectors

There are over 27 3-digit ISIC (International Standard Industrial Classification) manufacturing codes. A decision had to be made as to which ones to study. In choosing these industries, the following criteria were used:

a) Sectors falling within the middle range of firm numbers --those having between 140-300 establishments-- were chosen. Fig. 4.1 shows the frequency of establishments by 3-digit ISIC code. Hence, 11 sectors were chosen initially. The reasoning behind this is as follows: On the one hand, industrial sectors with a large number of establishments, for example bakeries, serve a very local market and the regional policy will have a neglible effect on them. On the other hand, there are sectors that have very few plants probably serving national or international markets --such as oil refineries. Because there are so few of them, studying them will give very limited insight into the locational behavior.

b) During the time periods studied industries chosen had to experience a great deal of new activity i.e., a high rate of growth.



Industry subgroups initially chosen

• Industry subgroups selected

FIG. 4.1 <u>FREQUENCY OF ESTABLISHMENTS BY INDUSTRY SUBGROUPS</u>

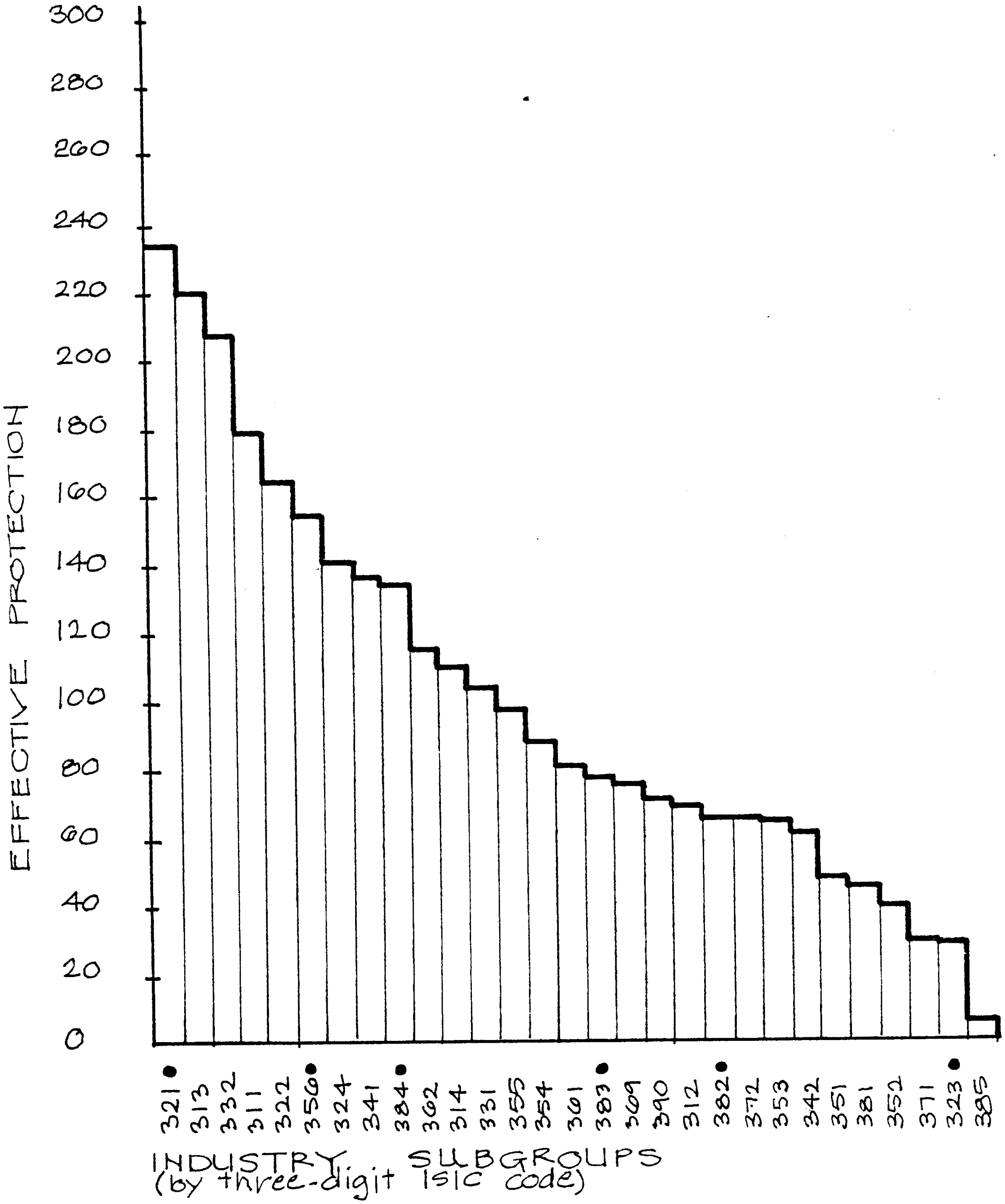
Source: O.C.E.I., Survey Tape, 1977

c) The industries chosen had to have strong linkages with other manufacturing industries, and with localized inputs and markets, as indicated by the input-output table of the Venezuelan economy. (Conavial,[1]). This criterion was introduced so as to include the possible effect of government spatial policies on the location of transport-oriented industries.

d) Diversity in the level of effective protection --Since government economic policies to protect or spur manufacturing may have inadvertent effects on the locational decision of firms, the selection of the manufacturing groups should take this factor into account. Fig. 4.2 shows the level of effective protection by 3-digit ISIC industry group (World Bank,[2]).

e) Diversity in the industries' capital/labor intensity --For this purpose, the mean electricity consumption value in KWH per thousand hours worked was used as a proxy, acknowledging its limitations. Fig. 4.3 presents the range available. This criterion was incorporated to reflect the possible tendency of labor intensive industries to deconcentrate.

As a result of the above considerations, the following 3-digit ISIC, code were chosen for further study:



• Industry subgroups selected

FIG. 4.2 LEVEL OF EFFECTIVE PROTECTION

Source: World Bank, Current Economic Position and Properties of Venezuela (Washington, 1977)

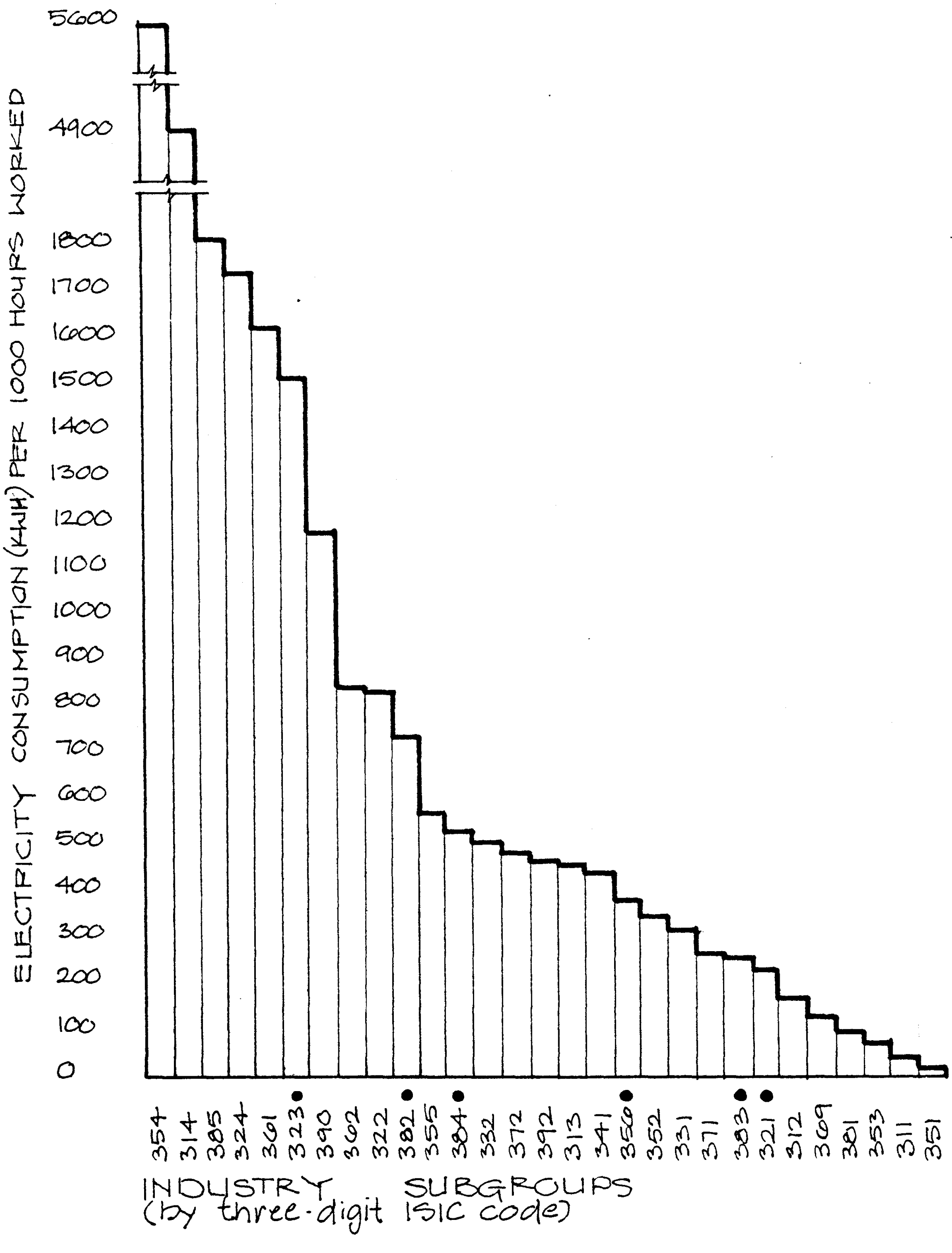


FIG. 4.3 ELECTRICITY CONSUMPTION (KWH) PER THOUSAND HOURS WORKED

Source: O.C.E.I. Survey Tape, 1977

ISIC code	
321	Textiles
323	Leather and leather products
356	Plastics products
382	Machinery and equipment, except electrical
383	Electric machinery and equipment
384	Transportation equipment

A detail description of these industrial subgroups is presented in table 4.12 at the end of this chapter.

4.5 Aggregate results by sectors

Since results for the Venezuelan manufacturing industry as a whole may fail to indicate the fact that each industrial subgroup may behave differently, results for each of the six manufacturing groups selected will be presented for analysis. The time series of a region's share of establishments from the national total of manufacturing subgroups selected, are presented in tables 4.2 to 4.7.

Textiles (ISIC 321)

In table 4.2 we can see that the Capital Region had a steady increase from 1971 to 1978 at the expense of the Central Region, while the other regions remained almost unchanged. We may conclude that during the period 1971-1978, the textile industry was steadily concentrating in the Capital Region.

Leather and leather products (ISIC 323)

From observation of table 4.3, we can see that during the period 1974-1976, the Capital Region had an increase at the expense of all the other regions except the Nor-oriental --which only had a slight increase. In other words, the leather industry concentrated even more in the Capital Region from 1974 to 1976. From 1976 up to 1978, it remained unchanged.

Plastic industry (ISIC 356)

Table 4.4 shows that although some deconcentration took place in the Capital Region between the years 1971 and 1974, after this period no significant changes occurred in any of the administrative regions.

Machinery and equipment, except electrical (ISIC 382)

Table 4.5 indicates that during the period 1974-1976, the relative share of the Capital Region increased sharply --from 49 to 59 percent-- at the expenses of the Central and Zulia Region, and then remained almost unchanged.

Electric machinery and equipment (ISIC 383)

From table 4.6 we can see that the Capital Region's share declined from 1971 to 1978. The Central Region's share has been increasing since 1971 but in 1976 started to decline. This decline was compensated by an increase in the Zulia Region and the Nor-oriental Region. It seems there was a spillover effect from the Capital Region to the Central Region.

Transportation equipment (ISIC 384)

We can see in table 4.7 that the Capital Region's share increased from 1971 to 1978, although in the period 1976-1978 the increase is negligible. Furthermore, we can see that the Andean and Nor-oriental Regions increased their shares slightly during the same period at the expense of the Central and Centro-occidental Regions.

4.5.a Preliminary conclusions

As pointed out earlier, Venezuelan manufacturing activity is concentrated in an industrial axis extending over part of the Capital Region as well as over part of the Central Region. One way to ascertain whether or not deconcentration of manufacturing activity has taken place, is to combine the shares of the Capital and Central Regions. This is presented in table 4.8.

From this table it can be seen that, with the exception of the plastic industry and the non-electrical machinery industry, which show a relative higher share for 1971 and 1976 respectively, as compared to the other years, no major changes took place during the period of the study, i.e., no significant evidence of concentration or deconcentration trends can be found.

4.5.b Limitations of the preliminary conclusions

Two major observations can be made about the preliminary conclusions presented above. One is that the results are not given by the officially defined areas of industrial deconcentration. Hence, a proper evaluation of

TABLE 4.2

ADMINISTRATIVE REGION'S SHARE OF THE NATION'S TEXTILE PLANTS

Region	1971	1974	1976	1978
Capital	60	67	70	71
Central	24	21	18	17
Centro-Occidental	5	4	4	4
Zuliana	2	1	1	1
Andes	5	6	6	6
Sur	0	0	0	0
Nor-Oriental	3	1	1	1
Guayana	1	0	0	0
Total	100	100	100	100
Number of establishments	136	192	247	264

SOURCES:
- Cordiplan, Encuesta Industrial 1971, (Caracas, 1973).
- OCEI, Encuesta Industrial, (Caracas: Oficina Central de Estadistica e Informatica, 1974 and 1976).
- OCEI, Directorio Industrial, (Caracas, 1978).

TABLE 4.3

ADMINISTRATIVE REGION'S SHARE OF THE NATION'S LEATHER INDUSTRIAL PLANTS

Region	1971	1974	1976	1978
Capital	62	56	66	65
Central	14	15	11	10
Centro-Occidental	3	6	3	3
Zuliana	3	5	2	2
Andes	13	13	11	14
Sur	0	0	0	0
Nor-Oriental	4	4	6	5
Guayana	1	1	1	1
Total	100	100	100	100
Number of establishments	77	93	126	142

SOURCES:
- Cordiplan, Encuesta Industrial 1971, (Caracas, 1973).
- OCEI, Encuesta Industrial, (Caracas: Oficina Central de Estadistica e Informatica, 1974 and 1976).
- OCEI, Directorio Industrial, (Caracas, 1978).

TABLE 4.4

ADMINISTRATIVE REGION'S SHARE OF THE NATION'S PLASTIC INDUSTRIES

Region	1971	1974	1976	1978
Capital	81	72	73	73
Central	16	18	17	16
Centro-Occidental	1	2	3	4
Zuliana	1	5	4	4
Andes	1	2	2	2
Sur	0	0	0	0
Nor-Oriental	0	1	1	1
Guayana	0	0	0	0
Total	100	100	100	100
Number of establishments	129	216	291	316

SOURCES:
- Cordiplan, Encuesta Industrial 1971, (Caracas, 1973).
- OCEI, Encuesta Industrial, (Caracas: Oficina Central de Estadistica e Informatica, 1974 and 1976).
- OCEI, Directorio Industrial, (Caracas, 1978).

TABLE 4.5

ADMINISTRATIVE REGION'S SHARE OF THE NATION'S MACHINERY AND EQUIPMENT

(EXCEPT ELECTRICAL) INDUSTRIES

Region	1971	1974	1976	1978
Capital	52	49	59	57
Central	17	22	18	18
Centro-Occidental	10	7	7	7
Zuliana	12	12	7	7
Andes	3	4	4	4
Sur	0	0	0	0
Nor-Oriental	3	4	3	4
Guayana	3	2	2	3
Total	100	100	100	100
Number of establishments	112	166	229	251

SOURCES:
- Cordiplan, Encuesta Industrial 1971, (Caracas, 1973).
- OCEI, Encuesta Industrial, (Caracas: Oficina Central de Estadistica e Informatica, 1974 and 1976).
- OCEI, Directorio Industrial, (Caracas, 1978).

TABLE 4.6

ADMINISTRATIVE REGION'S SHARE OF THE NATION'S ELECTRIC MACHINERY AND EQUIPMENT INDUSTRIES

Region	1971	1974	1976	1978
Capital	73	64	63	62
Central	18	24	27	25
Centro-Occidental	2	4	3	3
Zuliana	5	7	4	6
Andes	0	0	0	0
Sur	0	0	0	0
Nor-Oriental	1	0	1	3
Guayana	1	1	2	1
Total	100	100	100	100
Number of establishments	128	162	202	205

SOURCES: - Cordiplan, Encuesta Industrial 1971, (Caracas, 1973).
- OCEI, Encuesta Industrial, (Caracas: Oficina Central de Estadistica e Informatica, 1974 and 1976).
- OCEI, Directorio Industrial, (Caracas, 1978).

TABLE 4.7

ADMINISTRATIVE REGION'S SHARE OF THE NATION'S TRANSPORTATION EQUIPMENT INDUSTRIES

Region	1971	1974	1976	1978
Capital	29	34	41	42
Central	24	38	34	30
Centro-Occidental	10	8	10	9
Zuliana	9	5	3	3
Andes	2	5	4	6
Sur	0	0	0	0
Nor-Oriental	6	5	3	5
Guayana	2	5	5	5
Total	100	100	100	100
Number of establishments	149	157	205	233

SOURCES: - Cordiplan, Encuesta Industrial 1971, (Caracas, 1973).
- OCEI, Encuesta Industrial, (Caracas: Oficina Central de Estadistica e Informatica, 1974 and 1976).
- OCEI, Directorio Industrial, (Caracas, 1978).

TABLE 4.8

COMBINED SHARES OF THE NATION'S ESTABLISHMENTS FOR THE CAPITAL AND CENTRAL REGIONS

Industry	1971	1974	1976	1978
Textile	84	88	88	88
Leather	76	71	77	75
Plastic	97	90	90	89
Non-electrical machinery	69	71	77	75
Electrical-machinery	91	88	90	87
Transportation equipment	71	72	75	72

SOURCES:
- Cordiplan, Encuesta Industrial 1971, (Caracas: Cordiplan 1973).
- OCEI, Encuesta Industrial, (Caracas: Oficina Central de Estadistica e Informatica, 1974 and 1976).
- OCEI, Directorio Industrial, (Caracas, 1978).

the effects of the policy instruments is difficult. Secondly, aggregate figures, like the ones used so far in this research, do not allow us to properly assess the spatial tendency of the manufacturing industry, i.e., to have an "early understanding" of what may be happening. Since the data are given in terms of the net number of establishments that existed in a particular year, nothing is known about the actual number of new firms established in an area, or about firms that went out of business, or of plants that changed locations. Data of these kind may give us valuable information for our evaluation. Therefore, attempts will be made to find the necessary data that will allow us to overcome the above mentioned limitations.

4.6 Alternative sources of data

Published survey data from the industry sample (Encuestas Industriales) are presented by administrative regions. In this study this source of data will be called survey results (SR). A survey is made every year of a representative sample of the region. Results are stored in computer tapes which will be called survey tapes (ST).

The sample's values stored in the survey tapes are statistically expanded to give results to represent all the Venezuelan manufacturing activity. However, the survey data cannot be used to analyze changes by areas of industrial deconcentration for two major reasons: first, the administrative region subdivisions are different from the subdivisions that follow from the policy of industrial deconcentration and second, as suggested earlier, any attempt to use the sample to infer behavior of the industry at any smaller area subdivision is not representative and may lead to misleading results.

A better source of sample-error-free information will thus be Venezuela's annual official directory of manufacturing industries. The directory contains the listing of all industries in a particular year. Each firm is registered by name, five-digit industrial code, location and number of employees. It is from this list of industries that the Central Statistical Office sample is selected. The directory is updated every year: new firms are added and establishments that went out of business are removed. Therefore, the directory is the ideal basic source of information or changes in industrial location. The only drawback is that the updating is done on the original computer tape of the directory. Thus, the record of the previous year's directory is erased by the changes, i.e., there is only one copy of the directory and this reflects only the conditions of the latest surveyed year. Fortunately, along with the 1978 directory (the latest one) it was possible to obtain a printout of the 1975 directory, which inexplicably had been saved. Since there was no other source of information, it was decided the best approach would be to recreate the previous directories, employing the two available directories (for 1975 and 1978) and the yearly surveys as well as some other partial lists.

Once the decision to recreate the directories was made, the next task was to decide which years to restore. Consequently, it was necessary to identify the periods to be analyzed.

This research centers on two important events:

(1) Changes in the economy owing to the additional revenues from oil, and

(2) Implementation of the Industrial Deconcentration Policy.

Changes in the economy began to accelerate in 1974 due to additional revenues from oil. The national budget increased threefold during this year as can be seen in table 4.9. Only a fraction of this increase could be explained by inflation.

TABLE 4.9

VENEZUELAN NATIONAL BUDGET

Year	Million bolivares, current prices
1971	12,768.0
1972	13,478.4
1973	14,872.0
1974	42,518.5
1975	39,878.0
1976	44,571.0
1977	50,693.5
1978	51,212.7

SOURCE: Venezuela, Mensaje Presidencial, 1980

Although the first presidential decree setting up the framework of the industrial deconcentration policy was issued in June 1974, the complete legal instrumentation was only established in March, 1976 when the areas of deconcentration were defined. Consequently, any possible effects of the negatives incentives, i.e., control over location, as well as, changes in the economy, may be reflected from 1975 on. Similarly, effects of other government instruments, such as financial and fiscal incentives, will be observed only after 1976, The above discussion, coupled with data limitations --no survey tapes are available prior to 1974-- suggest two major periods:

Period I: 1975-1976,

Period II: 1977-1978.

To detect changes in the periods chosen, directories for the year 1974, 1976 and 1978 were needed. Since the 1978 directory was available, directories for 1974 and 1976 had to be recreated.

4.7 Recreation of the directories

The basic sources

The basic sources of information used to recreate the 1974 and 1976 directories were:

a) Directories: Available for 1975 and 1978. They list all the establishments (about 7,386 in 1975 and 10,478 in 1978) that existed in each particular year. They list the name, 5-digit industrial code, I.D. number, location, and number of employees for each firm.

b) Survey tapes: Available for years 1974 to 1977. Contain the information on each of the surveyed establishments that was selected from the corresponding directory.

c) Survey results: Available for 1971, 1974 and 1976. Contain the aggregate results of the survey. These are obtained by expanding the sample so as to reflect the total population of firms.

d) Combined list: A working OCEI list, grouping together all the establishments that existed in 1975, 1976 and 1977. The list also indicated I.D. numbers that were re-assigned to new firms once the original firm disappeared from the region. This reallocation of I.D. started to take place in 1976.

This scattered information obtained from the above sources was further complicated by problems such as the following:

a) Each establishment has an I.D. number that is unique only within a particular four-digit code and region. This implies that there is really no unique number since a firm's region and four-digit code must also be specified. As a consequence, when an establishment transfers to another region it is difficult to follow because once in a new location, the firm receives a new I.D. number.

b) From 1976 on, the I.D. number of an establishment that went out of business was assigned to a new firm.

c) Sometimes, an establishment was inadvertedly registered twice, i.e., it has two I.D. numbers.

d) In 1975, the 8 administrative regions that were used as the basis for the I.D. numbers were reorganized into 9. This change implies that the I.D.'s of many establishments were changed to reflect the new region to which they belonged.

4.7.a The process

For the recreation of the directories, we used different building blocks of information depending on whether we were dealing with the periphery or with the core regions (Central and Capital regions in 1974 and Centro Norte Costera in 1976).

Periphery

For regions in the periphery, the source of information was the survey tape from the corresponding year. The reason for choosing the survey tape is that in these regions, the survey is not a sample, but a census, i.e., all the firms are interviewed. Hence, the directories for the peripheral regions were obtained by listing all the firms that were counted. Because the survey tape does not register the name of the establishment, this was obtained from the 1975 and 1978 directories.

Core regions

Core regions required a different treatment, since only establishments employing over 50 people are fully represented in the encuesta. For others, the survey tape only had a sample. Hence the problem was to find out which other establishments existed in a particular year. The year each firm was established, at first thought to be a very interesting piece of information, was found to be unreliable as major evidence. There were instances when, for the same establishment, different beginning years were found in consecutive survey tapes. After several schemes, the approach used was to add firms (following a numeric procedure) to those already identified in the survey tape, up to the number of establishments that the survey results listed that year. The basis for this aggregation procedure is the fact that the Central Statistical Office (Oficina Central de Estadística e Informática) assigns consecutive I.D. numbers to establishments. The main assumption that the Central Statistical Office makes is that each consecutive number is assigned to a newer firm in the region, i.e., the newer the firm, the higher its I.D. number.

The procedure used can be explained better with an example. Let us suppose that for a particular four-digit industrial category in a specific region, the 1975 directory (D75) specifies the existence of 7 establishments. The survey results (SR) indicate that in 1974 there were only 5 establishments, (f=5). Furthermore, the 1974 survey tape (ST74) has information about two firms with, say, I.D. numbers 12 and 14.

	I.D. number							
	11	12	13	14	15	16	17	18
D75	X	X	X	X	X	X	X	
ST74	↓	X	↓	X	↓			
Added from D75	X		X		X			
SR74: f=5	1	2	3	4	5			

Hence, establishments 11, 13 and 15 were added to the two establishments appearing in the 1974 survey tape so as to reach the specified total of 5. This example presents the basic principle of the methodology. During the process itself, many different conditions had to be faced. Some of these cases will be briefly presented in order to give a better idea of the case-by-case approach that had to be used. For example, in some instances, it was found that in the D75, an I.D. number was missing, implying that the corresponding firm was not in the region by 1975. To find out whether the firm corresponding to the missing I.D. number existed in the region in 1974, we first looked into the ST74 for this establishment. If it was found, then the procedure followed the general scheme:

	I.D. number							
	11	12	13	14	15	16	17	18
D75	X	X	X	-	X	X	X	
ST74	↓	X	↓	X	↓			
Added from D75	X		X		X			
SR74: f=5	1	2	3	4	5			

If the missing I.D. number was not found in the ST74, a null hypothesis was tested, indicating that the establishment dissappeared from the region prior to 1974. Then, the general procedure was again followed:

	I.D. number							
	11	12	13	14	15	16	17	18
D75	X	X	X	-	X	X	X	
ST74	X	↓	X		↓	↓		
Added from D75		X			X	X		
SR74: f=5	1	2	3		4	5		

The next task was to find out whether the last establishment added --I.D. number 16-- had a foundation year of 1974 or earlier. If affirmative, then establishment 14 dissapeared prior to 1974 --otherwise f would be 6 instead of the specified 5--. If establishment 16 was found to have its year of foundation more recently than 1974, --implying that it could not belong to the set of 1974 firms--, then establishment 14 was considered to have existed in 1974 and the null hypothesis was rejected. Care was taken to find appropriate evidence with regard to the year of an establishment's foundation, for example, by checking that in two survey tapes, the year declared was the same.

The aggregation procedure for recreating the 1974 directory had to be different from that of the 1976 directory, since the sources of information were different. For the recreation of the 1974 directory, the 1974 survey tape was used as the core and the 1975 directory was used to supply the additional establishments (see above example). For the recreation of the 1976 directory, the 1976 survey tape was used as the core, and to supply the additional establishments needed, the OCEI working list was used. This working list, prepared initially by the Central Statistical Office, contained all the establishments that existed in 1975, 1976 and 1977, not classified by year but indicating those I.D. numbers that were re-assigned to new firms once the original firm left the region. The procedure used to aggregate establishments for D76 was similar to the one employed for D74, but it was complicated by the fact that from 1976 on, old I.D. numbers were re-assigned to new establishments. Hence, care was taken to consider the effect of this problem when recreating the 1976 directory.

4.8 Comparison of directories

Once the directories were recreated, various factors could be examined for each of the periods under consideration. For example, which firms were new, i.e., founded during the period; closed down, i.e., went out of business; were stationary, i.e., remained in the same location; and which ones moved to another location or arrived from another region. For this purpose, a classification methodology was developed. The methodology developed is based on a comparison of directories and has the following two steps:

1.- Matching of directories

2.- Fine tuning

Step one: Matching of directories

By comparing D74 with D76 it was possible to identify changes that occurred in the years 1975 and 1976. Furthermore, by comparing D76 with D78, changes during the years 1977 and 1978 were identified. This matching was done using the I.D. number, the 5-digit industrial code and the administrative region. This step can be better explained by Fig. 4.4, which makes reference

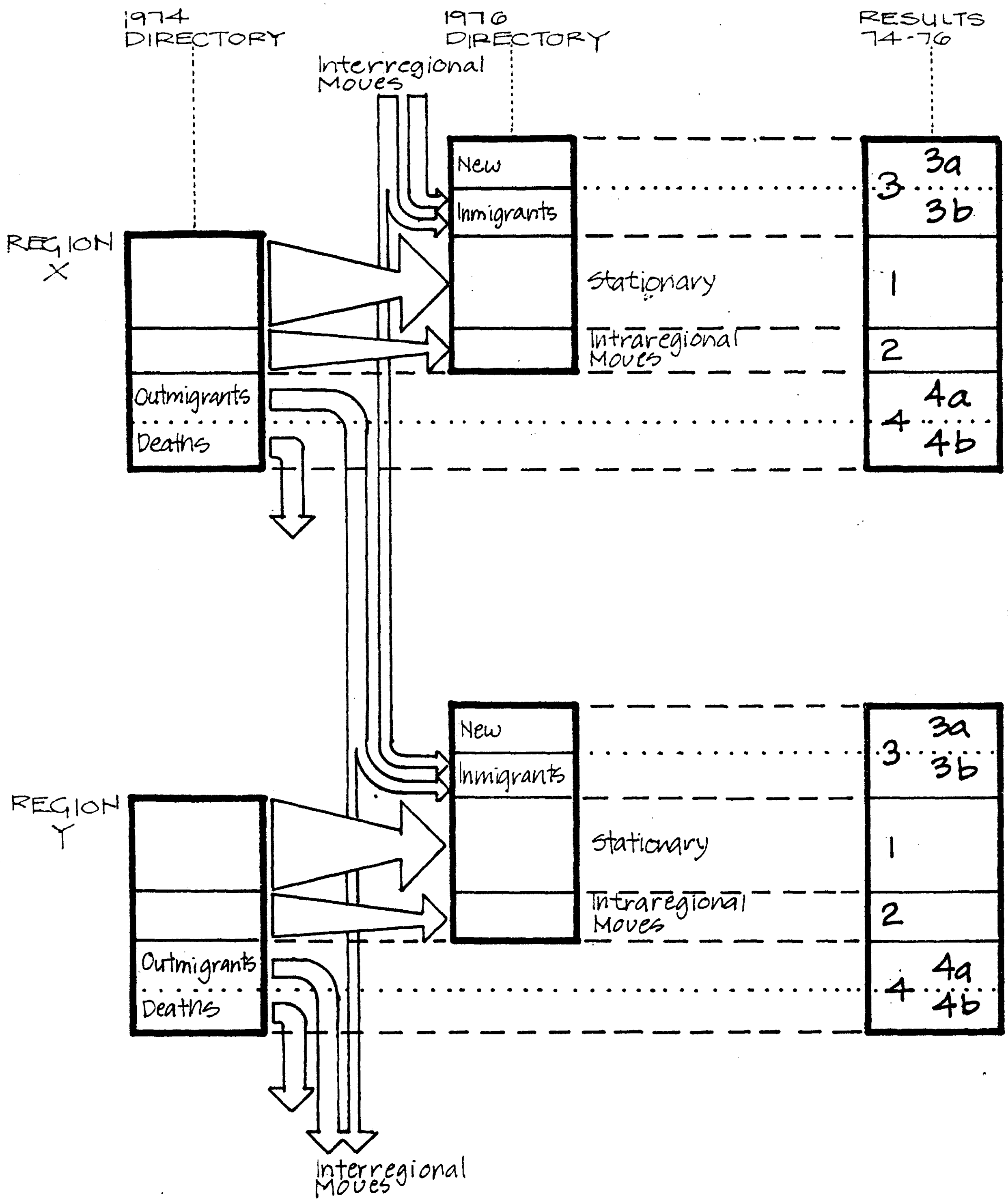


FIG. 4.4 MATCHING OF DIRECTORIES

to changes between 1974 and 1976. A similar diagram would apply to 1976-1978.

The matching process resulted in the following:

Group 1 This list of establishments comprises those firms whose location in 1976 was the same as in 1974. Therefore they were stationary during the period under study.

Group 2 Firms on this list are those whose location in 1976 was different from 1974, but they remained in the same administrative region, i.e., they moved within the region (inter-regional movers).

Group 3 Establishments on this list are those who appear in D76 but do not appear in D74, i.e., they are newcomers to the region.During the period 1975-1976 they may:

a) have left another region to come to the region under consideration, i.e., immigrant firms;

b) be newly created firms.

Group 4 This list contains those establishments that appeared in D74 but did not appear in D76. During the intervening period they may:

a) have left the region and moved into another region, i.e., outmigrant firms;

b) have gone out of business, i.e., closedowns.

The following case exemplifies how some of the complications were handled during the matching of the directories. Suppose that during 1975-1976, establishment C identified with the I.D. number 3 disappeared from the region. Furthermore, in 1976 establishment F appeared and was assigned the I.D. number 3 because that number was vacant.

D74

I.D. No.	
1	A
2	B
3	C
4	D

D76

	I.D. No.	
A	1	A
B	2	B
-	3	F
D	4	D

We can see that when comparing D74 with the left hand of D76, establishment C will be shown on list 4. Furthermore, when comparing D74 with the right hand of D76, establishment F will appear on list 3.

Step two: Fine tuning

This step differentiates between 3a (immigrants) and 3b (new plants), as well ad 4a (outmigrants) and 4b (closedowns). Each establishment on list 3 --newcomers to the region by 1976-- was looked up by its name in an alphabetical listing of all Venezuelan establishments that existed in 1974. Whenever possible, the establishment's previous location in another region was also obtained. In this manner list 3a was created. In a similar way, each establishment in list 4 --those who disappeared from the regional directory in 1974-- was looked up in the 1976 national listing, and if possible its new location was obtained. Hence list 4a was created. List 3b (new firms) was obtained as a residual. In a similar way, industries on list 4b (closedowns) were obtained from the difference between lists 4 and 4a.

4.9 Disaggregate results

The recreation and comparison of directories gave us disaggregate data. This type of data allowed us to determine the location of new manufacturing firms for each of the periods analized. This is shown in table 4.10. Because deconcentration area D had a negligible level (less than 0.25%) of total manufacturing establishments, it was removed from the analysis. Table 4.10 shows the deconcentration areas' share of the national total of new establishments, (new plants) and for the six selected industrial subgroups. We can observe in table 4.10 that during the first period, i.e., years 1974-1976, the number of new establishments was almost three times the number in the second period. This could be explained by the fact that during the first period, the sudden change in the national economy due to the additional revenues from oil created a larger demand than before. To supply this demand increase, new manufacturing firms sprung up. By 1977, the economy had leveled off at its new value and the new plants dealt mainly with the normal economic growth.

In table 4.10 we can also see that in the case of leather, non-electric machinery as well as for electric machinery and equipment, area A's share of new establishments dropped more than 33 percentage points, while area C's share increased by at least the same percentage. In general, area B seems to reflect the same trends as area A.

TABLE 4.10

DECONCENTRATION AREA'S SHARE OF THE NATIONAL TOTAL OF NEW ESTABLISHMENTS

Area	TEXTILES 1974-76	TEXTILES 1976-78	LEATHER 1974-76	LEATHER 1976-78	PLASTICS 1974-76	PLASTICS 1976-78
A	76	69	79	41	71	52
B	6	8	0	0	13	7
BM	7	4	2	6	8	15
C	11	19	19	53	8	26
Total	100	100	100	100	100	100
Number of new firms	82	26	52	17	98	27

Area	NON-ELECTRICAL MACHINERY 1974-76	NON-ELECTRICAL MACHINERY 1976-78	ELECTRIC MACHINERY 1974-76	ELECTRIC MACHINERY 1976-78	TRANSPORTATION EQUIPMENT 1974-76	TRANSPORTATION EQUIPMENT 1976-78
A	66	30	51	17	41	38
B	11	6	26	8	20	12
BM	10	15	11	8	15	9
C	13	49	12	67	24	41
Total	100	100	100	100	100	100
Number of new firms	87	33	61	12	74	34

SOURCES: Own estimations based on recreated directories and OCEI, Directorio Industrial, (Caracas, 1978).

NOTE: See chapter 3 for definition of the areas of deconcentration.

An important aspect to note is that for the six industrial subgroups analized, all new manufacturing activity in area BM took place in the Capital Region. This give us some indication of the possible spillover effect, i.e., industries finding difficulties locating in area A because of say, congestion, high land cost, or prohibition to locate, went to Caracas' nearest desirable area.

As indicated earlier, the Venezuelan manufacturing activity is concentrated in an industrial axis that extends itself over areas A, B and that part of area BM belonging to the Capital Region. Since all the new manufacturing in area BM falls in the Capital Region --for the industrial subgroups analized-- we may combine the shares obtained from areas A, B and BM, to see whether deconcentration of manufacturing activity took place. These results are presented in table 4.11 which shows the Venezuelan industrial axis' share of the nation's total of new establishments.

4.9.a Tentative conclusions

We see from table 4.11 that each of the six industries shows a similar trend to deconcentrate. Some of this deconcentration may be explained by the big increase in income and demand during 1974-76 which took place more near Caracas and led to an unusually high concentration of new firms during this period. Nevertheless, as indicated earlier, for leather, non-electric equipment and for electric machinery, the industrial axis has reduced by more than 33 percentage points its share of the national total in the second period. Hence, it may be argued that these three industrial subgroups experienced deconcentration during the second period.

TABLE 4.11

VENEZUELAN INDUSTRIAL AXIS' SHARE OF THE NATIONAL TOTAL OF NEW ESTABLISHMENTS

Industry	1974-76	1976-78	Change in share, percentage points
Textiles	89%	81%	-8
Plastics	92	74	-18
Transportation equipment	76	59	-17
Leather	81	47	-34
Non-electric machinery	87	51	-36
Electric machinery	88	33	-55

SOURCE: Own estimations based on the recreated directories and OCEI, Directorio Industrial (Caracas, 1978).

For the other manufacturing groups analyzed --textiles, plastics and transportation equipment-- we may conclude that the changes in their shares are mainly due to the distortions created by the big increase in demand and therefore, are not significant enough to suggest that changes have occurred in their spatial distribution.

4.9.b Limitations of the tentative conclusions

One of the major limitations of the conclusions indicated above is the absence of disaggregate data prior to 1974. When an industrial subsector shows a tendency to deconcentrate in the second period, we do not know whether this tendency started that period or was a phenomena that had its origins in a previous period. This limitation will make it more difficult to relate the pattern of industrial deconcentration to possible effects of government policies. Nevertheless, what is important at this moment is to see whether deconcentration of manufacturing activity took place during the period analized. The next chapters will attempt to deal with causality issues.

Another limitation of these results derives from the way in which the disaggregate date were obtained, i.e., to the possible margins of errors when recreating the directories. There is no doubt that the process of recreating the directories may have added some possible sources of errors. These will be discussed in the light of the tentative conclusions reached. The disaggregate data in table 4.11 shows for all the industrial subgroups studied, a tendency --sometimes very slight-- to deconcentrate. We may ask ourselves whether there is a built in bias in the methodology used to recreate the directories, that gives us these sort of results. For dispersion to be seen, we have to have a greater number of new establishments in area C when compared to areas A, B and BM combined (see table 4.11). We should remember that the new establishments were obtained from the survey tapes. Furthermore, in area C, the survey tapes are not a sample but a census and only those firms registered in the survey tape were considered and some identified as new firms. Therefore, it is unlikely that the methodology registered more establishments than those that were in the survey tapes. For the other deconcentration areas --A, B and BM-- the survey tapes contain a sample. There is a chance that when adding the establishments needed to complete the directory, some errors were made. These errors could lead to the identification of an existing establishment, first as going out of business and then, becoming a new firm. If this happened for some firms, we may expect to find more new establishments in areas A, B and BM than existed in reality. This would give a higher weight to the industrial axis which will then indicate a tendency to concentrate. Therefore, if errors were made, they would have tended to show an opposite effect to the deconcentration effect found. We may conclude that the deconcentration effect that can be seen in table 4.11 is a conservative one. Furthermore, we may expect in some cases, to find the disaggregate more accurate than the aggregate data.

4.10 Summary of chapter 4

The purpose of this chapter was to find out whether dispersion of the Venezuelan manufacturing industry has taken place. Under the hypothesis that aggregate data may hide spatial tendencies, a major effort was undertaken to recreate the manufacturing directories so as to obtain disaggregate data. Results using disaggregate data give some evidence that the leather, non-electric machinery as well as electric machinery manufacturing groups have deconcentrated their locations during the period 1976-1978. For the others industrial subgroups studied, textiles, plastics and transportation equipment the evidence is less unequivocable. These results suggest the following questions: Why do some industrial subgroups show a tendency to deconcentrate while others do not? Furthermore, we may ask: Is deconcentration a result of the policy instruments? The next chapters will attempt to address these questions.

TABLE 4.12

DESCRIPTION OF THE MANUFACTURING GROUPS SELECTED FOR STUDY

Major group	Group	
321		Manufacture of textiles
	3211	Spinning, weaving and finishing textiles Preparing fibres for spinning, such as ginning, retting, scutching, scouring, carding, combing, carbonizing and throwing; spinning; weaving; bleaching and dyeing; printing and finishing of yarns and fabrics. Manufacture of narrow fabrics and other small wares; braids and other primary textiles. Yarn, fabric and jute mills.
	3212	Manufacture of made-up textile goods except wearing apparel Establishments not engaged in weaving which are primarily engaged in making up from purchased materials, house furnishings such as curtains, draperies, sheets, pillow cases, napkins, table cloths, blankets, bedspreads, pillows, laundry bags and slip covers; textile bags; canvas products; trimmings of fabrics; embroideries; banners, flags and penants. Also included are stitching, pleating and tucking for the trade.
	3213	Knitting mills Establishments, such as hosiery and knitting-mills, primarily engaged in producing hosiery. Outwear, underwear, nightwear, other knitted apparel; and knitted fabrics and laces from natural and synthetic fibres. Included are the bleaching, dyeing and finishing of knitted products.
	3214	Manufacture of carpets and rugs The manufacture of woven, tufted or braided carpets and rugs of any textile fibre or yarn and mats or mattings of twisted paper, grass, coir, sisal, jute or rags.
	3215	Cordage, rope and twine industries The manufacture of rope, cable, cordage, twine, net and related products from abaca (Manila), sisal, henequen, hemp, cotton, paper, jute, flax, man-made fibres, including glass, and other fibres. The twisting of these fibres is also included.

TABLE 4.12-Continued

Major group	Group	
	3219	Manufacture of textiles not elsewhere classified The manufacture of linoleum and other hard-surfaced floor coverings other than of cork, rubber, plastic, irrespective of type of backing; oil-cloth, artificial leather which is not wholly of plastic, and other impregnated and coated fabrics except rubberized; felt by processes other than weaving; laces except knitted; batting; padding, wadding, and upholstery filling from all fibres; processed wast and recovered fibres and flock; tire cord and fabric.
323		Manufacture of leather and products of leather, leather substitutes and fur, except footwear and wearing apparel
	3231	Tanneries and leather finishing The tanning, currying, finishing, embossing and japanning of leather.
	3232	Fur dressing and dyeing industries The scraping, currying, tanning, bleaching and dyeing of fur and other pelts for the trade and the manufacture of fur and skin rugs and mats and other fur and skin articles not elsewhere classified.
	3233	Manufacture of products of leather and leather substitutes, except footwear and wearing apparel. The manufacture of products of leather and leather substitutes, except footwear and other wearing apparel, such as luggage, handbags, pocketbooks, cigarette and key cases and coin purses; saddlery and harness whips; and similar articles made of leather, plastics, fibreglass and other leather substitutes.
356	3560	Manufacture of plastic products not elsewhere classified The moulding, extruding and fabricating of plastic articles not elsewhere classified, such as plastic dinnerware, tableware, and kitchenware; plastic mats; synthetic sausage casings; plastic containers and cups; laminated sheets, rods and tubes from purchased plastic raw materials; plastic components for insulation; plastic footwear; plastic furniture; and plastic industrial supplies, e.g., machinery parts, bottles, tubes and cabinets.

TABLE 4.12-Continued

Major group	Group	
382		Manufacture of machinery except electrical
	3822	Manufacture of agricultural machinery and equipment The manufacture and repair of agricultural machinery and equipment for use in the preparation and maintenance of the soil, in planting and harvesting of the crop, in preparing crops for market on the farm, or in dairy farming and live-stock raising; for use in performing other farm operations and processes, such as planting, seeding, fertilizing, cultivating, harvesting; ploughs, harrows, stalk cutters, milking machines, farm tractors, etc.
	3823	Manufacture of metal and wood working machinery The manufacture, alteration and repair of wood-working and metal-working machinery, such as machinery for sawmills, planing mills, furniture makers and veneer workers; lathes, boring, drilling, milling, grinding, shearing and shaping machines; power saws and sanders; drop forges and other forging machines; rolling mills, presses and drawing machines; extruding, melting and non-electrical welding machines; and machine tool cutters, dies and jigs. The manufacture of attachments and accessories for wood-working and metal-working machines is included.
	3824	Manufacture of special industrial machinery and equipment except metal and wood working machinery The manufacture, alteration and repair of special industrial machinery and equipment except metal-working and wood-working machinery, such as food machinery, textile machinery, paper industry machinery, printing-trade machinery and equipment, chemical industry machinery and equipment, oil refining machinery and equipment, cement-making and clay-working machinery, heavy machinery and equipment used by construction and mining industries.
	3825	Manufacture of office, computing and accounting machinery The manufacture, renovation and repair of office machines and equipment, such as calculating machines, adding machines, accounting machines; punched-card system machines and equipment; digital and analog computers and associated electronic data processing equipment and accessories; cash registers; typewriters; weighting machines except when scientific apparatus for laboratories; duplicating machines except photo-copying machines; and other office machines.

TABLE 4.12-Continued

Major group	Group	
	3829	Machinery and equipment except electrical not elsewhere classified The manufacture, renovation and repair of machinery and equipment, except electrical machinery, not elsewhere classified, such as pumps, air and gas compressors; blowers, air conditioning and ventilating machinery; fire sprinklers; refrigerators and equipment; mechanical power transmission equipment; lifting and hoisting machinery, cranes, elevators, moving stairways, industrial trucks, tractors, trailors, and stackers; sewing machines; small arms and accessories, heavy ordinance and artillery; industrial process furnaces and ovens; automatic merchandising machines; washing, laundry, dry-cleaning and pressing machines; cooking ranges and ovens; and other service industry machines. Included are manufacture of general purpose parts of machinery, such as ball and roller bearings, piston rings, valves; and shops engaged in manufacturing, rebuilding or repairing various kinds of machinery and equipment and associated parts and accesories on a job or order basis for others.
383		Manufacture of electrical machinery, apparatus, Appliances and supplies
	3831	Manufacture of electrical industrial machinery and apparatus The manufacture, renovation and repair of electric motors; generators and complete turbine-generator and engine-generator sets; transformers; switch gear and and switchboard apparatus; rectifiers; other electrical transmission and distribution equipment; electrical industrial control devices such as motor starters and controllers, electronic timing and positioning devices, electromagnetic clutches and brakes; electrical welding apparatus; and other electrical industrial apparatus.
	3832	Manufacture of radio, television and communication equipment and apparatus The manufacture of radio and television receiving sets, sound reproducing and recording equipment, including public address systems, gramophones, dictating machines and tape recorders; gramophone recorders and pre-recorded magnetic tapes; wire and wireless telephone and telegraph equipment; radio and television transmitting, signalling, and detection equipment and apparatus; radar equipment

TABLE 4.12-Continued

Major group	Group	
		and installations; parts and supplies specially used for electronic apparatus classified in this group; semi-conductor and related sensitive semi-conductor devices; fixed and variable electronic capacitors and condensors; radiographic, fluoroscopic and other X-ray apparatus and tubes.
	3833	Manufacture of electrical appliances and housewares
		The manufacture of electrical appliances and housewares, such as electric space heaters; blankets; and heating pads; hot plates, broilers, roasters, toasters and food mixers; ironers and mangles; fans, vacuum cleaners and floor waxes and polishers; hair driers, tootbrushes, electric hair clippers, shavers and hot water heaters.
	3839	Manufacture of electrical apparatus and supplies not elsewhere classified
		The manufacture of other electrical apparatus, accessories and supplies not elsewhere classified, such as insulated wires and cables; storage and primary batteries, wet and dry; electric lamps and tubes; fixtures and lamp sockets and receptacles; snap switches, conductor connectors, and other current-carrying wiring devices; conduits and fittings; electrical insulators and insulation materials except porcelain and glass insulators.
384		Manufacture of transport equipment
	3841	Ship building and repairing
		Shipyards and boatyards engaged in building, repair and specialized painting and calking of all type of ships, barges, lighters, and boats, except rubber boats; specialized marine engine and ship parts manufactures; the conversion and alteration and breaking-up of ships.
	3843	Manufacture of motor vehicles
		The manufacture, assembly, re-building and major alteration of complete motor vehicles such as passenger autobobiles, commercial cars and buses, lorries and truck trailers, universal carriers, special purpose motor vehicles (ambulances, taxi-cabs, etc); trailer and pickup coaches; vehicle-drawn canravans; motorized sleighs; specialized manufacture of motor vehicle parts and accessories such as engines, brakes, clutches, axles, gears, transmissions, wheels and frames.

TABLE 4.12-Continued

Major group	Group	
	3844	Manufacture of motorcycle and bicycles The manufacture, assembly, re-building and major alternation of motorcycles, scooters, bicycles, tricycles, pedicabs, and specialized parts such as motors, saddles, seat posts, frames, gears and handle bars.
	3849	Manufacture of transport equipment not elsewhere classified The manufacture of transport equipment, not elsewhere classified, such as animal-drawn wagons, carts and sleighs; hand-drawn pushcarts, wheel-barrows and baby carriages.

SOURCE: United Nations, Indexes to the International Standard Industrial Classification (ISIC) of All Economic Activities, Publication No. E.71.XVII.8, (New York: United Nations, 1971).

5 IS DECONCENTRATION A RESULT OF THE POLICY INSTRUMENTS APPLIED?

In the previous chapter, an attempt was made to determine the spatial pattern of distribution of the Venezuelan manufacturing industry. This chapter will attempt to find out whether government incentives have affected the locational pattern of industry. An earlier chapter described the difficulties in measuring the effects of regional policies. Due to these difficulties, it will not be possible in this chapter to employ conventional statistical methods for either rejecting or accepting locational hypotheses. Instead, we will assess the reasonableness of alternative hypotheses on the basis of the assembled indirect evidence. In later chapters, an attempt to find additional evidence will be made by the use of econometric models.

5.1 Description of the policy instruments

In Venezuela, there is an array of policy instruments for carrying out industrial deconcentration. The instruments can be classified as:

1) Direct incentives, i.e., straightforward financial and fiscal incentives;
2) Indirect forms of assistance, such as the provision of industrial parks and improvement of transportation and communications facilities;
3) Negative incentives, i.e., prohibition against certain locations.

Each of these instruments will be described and analyzed in turn.

5.2 Financial incentives

As indicated in chapter 3, prior to the policy of industrial deconcentration and following the government's interest in industrial development, a set of policy tools for industrial promotion was operational. These tools were not locationally oriented. Therefore, credit at low interest rates, for example, was granted to firms independent of their location. In 1976, with the policy of industrial deconcentration, government financial agencies were authorized to give credit under more advantageous conditions than those prevailing in the market (Decree 1477). The interest rate, loan period and grace period varied with:

1) The use of the loan --for land and construction, machinery and equipment or working capital;
2) The investment decision --new firms, expansion or relocation;
3) The size of the establishment --small, medium, medium-large or large;
4) The area of deconcentration --A, B, BM, C or D.

5.2.a Financial institutions

In Venezuela, there are three major financial institutions dealing with the manufacturing sector:

1) Corpoindustria or Corporation for the Development of small and medium sized industries (Corporación para el Desarrollo de la Pequeña y Medíana Industria) handles credit applications for up to 6 million bolivares. Hence, it deals

mainly with small (5-20 employees) and medium-sized (21-50 employees) establishments.

2) Industrial Credit Fund (Fondo de Credito Industrial) handles credit applications between 6 and 40 million bolivares. Therefore, it deals mainly with medium-large (51-100 employees) and large (more than 100 employees) establishments.

3) Venezuelan Development Corporation (Corporación Venezolana de Fomento) is the major government source of long-term credit. Since it handles a few very large enterprises, which are mostly government-owned, the locational aspects of such applications are dealt with on a case-by-case basis.

5.2.b Level of subsidy

According to the original policy document (Ministerio de Fomento,[1]), the announced interest varied between 3% in area C to 9% in area B; the loan period varied between 2 years for working capital and 20 years for land and construction. Similarly, the grace period varied between 6 months for working capital and 3 years for land and construction. These conditions can be seen in tables 5.1 and 5.2.

In actual practice, it seems that the conditions given were different from those indicated by the policy. For example, area BM was supposed to have more favorable conditions than area B. But in reality both areas apparently received the same benefits. This can be seen in Table 5.3, which shows the loan terms actually given by Corpoindustria. Unfortunately, it was not possible to obtain the actual loan terms given in practice by the Industrial Credit Fund.

In order to determine how much savings an entrepreneur could have made by locating in the areas of deconcentration, a single indicator for the level of subsidy in each area was needed. This indicator had to combine into one measure subsidized interest rates, a market interest rate, loan period and a grace period. Furthermore, these aspects varied with the use of the money: whether for land and construction, machinery and equipment, or for working capital. After studying several approaches, one was chosen which was based on the concept of net present value and reflected the percentage savings, in present value terms, obtained by an entrepreneur locating in each of the areas of deconcentration. For each of the components of the loan, e.g., machinery, working capital, etc., the present discount value of the series of payments was calculated at the actual rate of interest. This measure allowed us to combine both subsidized and market interest rates, as well as grace and loan periods. The market rate of interest was 10% at that time. It should be noted that when the subsidized and market rates were the same, the percentage savings was zero.

From the information available, it was possible to determine what proportion of a loan was for working capital, for machinery, etc. The following are the percentages for the loans given by Corpoindustria:

TABLE 5.1

ANNOUNCED FINANCIAL INCENTIVES FOR NEW, SMALL AND MEDIUM-SIZE ESTABLISHMENTS OFFERED BY CORPOINDUSTRIA

Area		Land & construction	Machinery & equipment	Working capital
			SMALL-SIZE	
A	No. years	-	-	-
	Grace period, years	-	-	-
	Interest rate	-	-	-
B	No. years	10	8	2
	Grace period, years	1	1	0.5
	Interest rate	7	7	8
BM	No. years	15	8	2
	Grace period, years	1	1	0.5
	Interest rate	5	5	6
C&D	No. years	20	10	2
	Grace period, years	2	1	0.5
	Interest rate	3	3	4
			MEDIUM-SIZE	
A	No. years	-	-	-
	Grace period, years	-	-	-
	Interest rate	-	-	-
B	No. years	10	8	2
	Grace period, years	1	1	0.5
	Interest rate	8	8	9
BM	No. years	15	8	2
	Grace period, years	1	1	0.5
	Interest rate	7	7	8
C&D	No. years	20	10	2
	Grace period, years	1	1	0.5
	Interest rate	4.5	4.5	5

SOURCE: Ministerio de Fomento, Politica de Desconcentración Industrial, (Caracas, 1977) pp.82-83

NOTE: For description of the areas of deconcentration see chapter 3.

TABLE 5.2

ANNOUNCED FINANCIAL INCENTIVES FOR NEW, MEDIUM AND MEDIUM-LARGE SIZED ESTABLISHMENTS, OFFERED BY THE INDUSTRIAL CREDIT FUND

Area		Land & construction	Machinery & equipment	Working capital
A	No. years	-	-	-
	Grace period, years	-	-	-
	Interest rate	-	-	-
B	No. years	10	10	5
	Grace period, years	2	2	1
	Interest rate	8.5	8.5	8.5
BM	No. years	12	12	10
	Grace period, years	3	3	2
	Interest rate	7	7	7
C&D	No. years	15	15	15
	Grace period, years	3	3	3
	Interest rate	7	7	7

SOURCE: Ministerio de Fomento, Polítíca de Desconcéntracióñ Industrial, (Caracas, 1977) pp. 82-83

NOTE: For description of the areas of deconcentration see chapter 3.

TABLE 5.3

ACTUAL FINANCIAL INCENTIVES FOR NEW, SMALL AND MEDIUM SIZED ESTABLISHMENTS, GIVEN BY CORPOINDUSTRIA

Area		Land & construction	Machinery & equipment	Working capital
A	No. years	15	8	2
	Grace period, years	1	1	0.5
	Interest rate	7	7	8
B	No. years	15	10	2
	Grace period, years	1	1	0.5
	Interest rate	7	7	8
BM	No. years	15	10	2
	Grace period, years	1	1	0.5
	Interest rate	7	7	8
C&D	No. years	20	10	2
	Grace period, years	2	1	0.5
	Interest rate	3	3	4

SOURCE: Personal interviews with Corpoindustria's personnel.

NOTE: For description of the areas of deconcentration see chapter 3.

Land and construction	30%
Machinery and equipment	60%
Working capital	10%

By multiplying the percentage savings for each use by its corresponding participation proportion, and summing the three uses, a single indicator of the percentage savings in present value terms was obtained for each deconcentration area. Results are presented in table 5.4 for Corpoindustria. For an example and more details about the discounting procedure used, the reader is referred to Appendix C.

TABLE 5.4

PERCENTAGE SAVINGS BY AREAS OF DECONCENTRATION ACTUALLY OFFERED BY CORPOINDUSTRIA

Area of deconcentration	Percentage savings
A	13.69
B	14.77
BM	14.77
C	35.08
D	35.08

SOURCE: Own estimations based on data supplied by Corpoindustria personnel.

Looking at the savings that may be obtained in each of the areas of deconcentration (see table 5.4), it is interesting to notice that:

a) For those establishments that were allowed to locate in area A and hence received financial incentives, the difference between choosing area A instead of area B or BM amounts to about one percentage point.

b) The percentage savings obtained by locating in area BM instead of area B is zero.

c) Considerably greater savings, in relative terms at least, would be found from locating in either area C or D rather than A, B or BM.

The percentage savings indicated above are for Corpoindustria. For the Industrial Credit Fund, which handles establishments of more than fifty employees, the percentage savings are presented in table 5.5.

TABLE 5.5

PERCENTAGE SAVINGS BY AREAS OF DECONCENTRATION OFFERED BY THE INDUSTRIAL CREDIT FUND

Area of deconcentration	Percentage savings
A	0.00
B	8.51
BM	20.60
C	23.08
D	23.08

SOURCE: Own estimations based on the conditions stated in the policy document, Ministerio de Fomento, Política de Desconcentración Industrial, (Caracas, 1977).

Values for the Industrial Fund are based on the conditions stated in the policy document, since information on the actual conditions given is not available. It should be noted that for these larger firms the percentage savings between selecting area C instead of a preferred one can be quite small. For example, in the case of chosing BM instead of C, the savings is only 2.48 percentage points.

5.2.c Impact of the financial incentives

To determine the extent to which financial incentives affected the locational pattern of new industry, a closer examination of the behavior of the financial institutions was necessary. As is always the case, data were limited. Corpoindustria happened to have better data available than did the Industrial Fund and, since small and medium-sized industries formed a very large percentage of new establishments, it made sense to analyze Corpoindustria in more detail.

During the years 1974 to 1978, Corpoindustria managed 22% of the lending money handled by the three above-mentioned government agencies. This relatively small amount of funds, however, represented 78% of the number of loans granted by the three agencies. Furthermore, of the six manufacturing groups studied in detail, 86% of the new establishments were of small or medium size.

Within the limitations of the data, the following proposition was analyzed: If industrialists took advantage of the financial incentives in developing areas, this should be reflected in the number of credit applications in these areas. Since the data available are in terms of number of credits awarded, not in terms of number of applications, it was assumed that the proportion of applications approved did not vary with the region. Hence, the number of credits granted in each region was used as a proxy for the number of applications. Similarly, because the information available did not differentiate between credits for new firms or for expansions, it was assumed that the proportion of expansions to new firms did not vary by regions. Although both of these assumptions may be questionable, we had no evidence in either case on which to base a different proportion.

Table 5.6 shows the actual shares for period 0 (1973-74) and period I (1975-76). Furthermore, it indicates the expected share for 1977-78 (period II) when the incentive was operational. The expected share was estimated by extrapolation of the tendencies, i.e., by the change in share between period 0 and period I. For example, for the bulk of the national territory (regions 3 to 8), there was an increase of 7.7 percentage points between the first two periods (55.9 - 48.2 = 7.7). By adding this change in share to the actual share of period I (7.7 + 55.9), we obtain the expected share for period II, i.e., 63.6%. Because data were not available by deconcentration areas, the results are presented by administrative regions.

For regions 3 to 8, (see table 5.6), an upward trend is found between period 0 (1973-74) and period I (1975-76). This trend can be explained by the fact that this lending office, although in existence since the 1960's under the name of Conafin (Comisión Nacional de Fomento Industrial) or National Commission of Industrial Development, was restructured in 1974. With this reorganization --Conafin, now a Corporation-- reached out to entrepreneurs in developing areas who were slowly becoming aware of the existence of this financial organization. This awareness made more and more industrialists in regions 3 to 8 apply for credits as seen in the 1975-1976 period. This upward trend between period 0 (1973-74) and period I (1975-76) could be expected to continue into period II (1977-78). When compared with the actual credits made in 1977-78, the differences between actual and expected values by region are small. This is shown in table 5.7.

TABLE 5.6

TRENDS IN REGION'S SHARE OF CREDITS

Region	Actual share in period 0 (1973-74)	Actual share in period I (1975-76)	Change in share	Extrapolated share in period II (1977-78)
1 (Capital)	27.1	20.3	-6.8	13.5
2 (Central)	24.7	23.8	-0.9	22.9
3-8 (Others)	48.2	55.9	+7.7	63.6

SOURCE: Own estimations based on data from Ministerio de Fomento, Memoria 1978, Anexo Estadístico.

NOTE: For definition of regions see chapter 3.

The implication of the results shown in table 5.7 is that the regional trends existing prior to the granting of financial incentives seem to have continued over the next two year period and that the introduction of the incentives may have had little or not additional effect on the spatial distribution of manufacturing industry.

TABLE 5.7

DIFFERENCES BETWEEN ACTUAL AND EXTRAPOLATED REGION'S SHARE OF CREDITS FOR THE 1977-78 PERIOD

Region	Extrapolated share in period II	Actual share in period II	Difference Actual-Ext
1	13.5%	12.4%	-1.1
2	22.9%	25.6%	+2.7
3-8	63.6%	62.0%	-1.6

SOURCE: Own estimation based on data from Ministerio de Fomento, Memoria 1978, Anexo Estadístico.

NOTE: For definition of regions see chapter 3.

5.3 Fiscal incentives

The policy of industrial deconcentration grants (Ministerio de Fomento,[2]):

a) 100% tax holidays for five years to new firms producing new products in areas C and D; 50% in area BM.

b) 80% tax holidays, for five years, to new establishments processing agricultural and livestock produce, which locate in areas C and D; 40% tax holidays, for five years, for those in area BM.

c) Tax holidays of up to 100%, for five years, to those firms forced to leave area A and move into areas BM, C or D.

It has been impossible to find out how these incentives have been applied in practice. Data on tax holidays are in the hands of the Ministry of Treasury (Ministerio de Hacienda). Because this is a sensitive matter that is probably handled on a case-by-case basis and subject to a certain amount of administrative discretion, the Ministry is reluctant to release any information. A study done by the Ministry of Environment (Ministerio del Ambiente,[3]) estimates that the savings from tax holidays may represent only 1.5 to 2% of the sales value. Another study done by the World Bank[4] in regard to the industrial policy in Venezuela indicates that:

> "The conclusion of this analysis, subject to the caveats regarding statistical reliability, is that industrial profit rates are very high in Venezuela. When petroleum refining and the state-enterprise-dominated basic metal industries are removed from the total, the average industrial profit rate, net of depreciation and taxes, rises from 19% to 28%. This figure more accurately reflects what the private sector, of both national and foreign ownership, is able to earn through industrial investment."

Hence, in relation to the average profit margins of the Venezuelan manufacturing industry, the saving due to fiscal incentives may well be insignificant in many cases.

Indirect incentives

The first presidential decree related to the policy of industrial deconcentration (No. 134), indicates that the Ministers of the Presidential Cabinet will be in charge of implementing policies designed to encourage the deconcentration of industrial activity. One such incentive is the provision of industrial parks in the designated growth centers. Another incentive is the provision in these growth centers of special housing and public services programs.

5.4.a Industrial parks

The term industrial park, as used here, can be defined as a subdivided tract of land, suitable located in reference to transportation routes and adequately serviced with utilities, that is restricted and promoted solely for industrial use by a sponsoring management organization. From theory and intuition, industrial parks are said (Rosenstein-Rodan,[5]) to:

a) Attract to designated areas private investment in industrial activities that otherwise would not have come into the region;
b) Create substantial employment opportunities which will reduce the unemployment level of the region;
c) Reduce the out-migration of the local population;
d) Capture the external economies of scale (for which purpose, it is better to have all the industries of the area located in one very large site);
e) Cause a better division of labor by securing common technical, repair and information services;
f) Save effort, trouble and red tape in creating a factory.

Brown[6], in his analysis of the deconcentration of manufacturing activity in England, indicates that "the high success of the early postwar years was certainly due in large part not to the incentives or restrictions but to the existence of factory space belonging to the Board of Trade either newly or converted from wartime use." Rosenstein-Rodan's ideas, and the experiences of other countries such as Britain, are reflected in the policy of industrial deconcentration in Venezuela. Decree 1477 assigns to the Venezuelan Development Corporation, the Regional Corporations and Corpoindustria the promotion of industrial parks.

Since 1974, the Ministry of Development has been charged with keeping a record of all the projects for industrial parks. Unfortunately, this has not been done in all cases. Hence, it is not possible to know the total supply of land designated for industrial parks during the 1974-1978 period. Moreover, we do not know the level of services available. A study done by the Ministry of the Environment (Ministerio del Ambiente,[7]), as well as a recent report prepared by the National Planning Office (Cordiplan,[8]), conclude that the private sector and other institutions (mainly the Municipal Councils) have not always followed the policy of industrial deconcentration when building the industrial parks.

Because of the lack of a control mechanism, they have promoted and built industrial parks in many areas which, according to the policy of industrial deconcentration, should have had no new industrial activity. Furthermore, in so doing, they are alleged to have used scarce resources --increasing the cost of services, contributing to inflation, and favoring speculation.

5.4.b Social infrastructure

Another aspect that the industrial deconcentration policy emphasizes is coordination in the supply of social infrastructure (such as housing, schools, hospitals) for growth centers in designated areas. A report prepared by the National Planning Office (Cordiplan,[9]) indicates, however, that there is little evidence that in practice the government agencies in charge of building the social infrastructure followed the guidelines set by the policy of industrial deconcentration.

Interviews with entrepeneurs who located their plants in small towns along the Caracas-Valencia highway indicated that they were satisfied with the location chosen up to 1974. In 1975 and 1976, when changes in the Venezuelan economy occurred, they saw a great deal of newly created factories locating around them. Since then, problems started to appear: scarcity of water, frequent blackouts, congestion and so on. One of the managers interviewed said: "It seems like the new entrepeneurs coming to our area assumed that either their consumption of basic infrastructure such as water or electricity will not affect others, or that government agencies will quickly come and increase the limited supply of infrastructural services." This sort of problems became known to prospective entrepeneurs who then realized the infrastructure limitations as well as the scarcity of labor force and of housing, education and health facilities. Indeed, entrepeneurs when choosing a location for their manufacturing plants after 1976, seemed to have learned from these experiences and to have been more careful in selecting their locations.

5.5 Negative incentives

As early as June 1974, a decree was issued (No.135) which prohibited new establishments from locating in Caracas unless they qualified under special conditions. Later in January 1975, with decree No.713, the prohibited area was expanded to include not only the city of Caracas but the whole Metropolitan Area (This enlarged area is identified as area A by the policy of industrial deconcentration). Furthermore, as discussed in chapter 3, the government drew up three lists of industries (identified here as Group I, II and III). A firm's right to continue operating in, or to locate in, area A depends on the list to which it is assigned. In this study, it will be assumed that these lists, although approved in 1976, had actually been in effect since January 1975 when the prohibition to locate in area A first took place. Even if this assumption is not accepted because it may be argued that it is more likely that the lag constituted an informal grace period to reduce hardship on those firms whose location was already planned, we will see that the results presented here are not changed.

To determine whether control of location took place during the periods studied, data are required which reflects, as accurately as possible, what really happened in terms of the location of manufacturing activity. Otherwise, we would have to resort to sources of information which, although reliable, may not reflect what actually happened. An example of the latter can be seen in a document prepared by the Ministry of the Environment (Ministerio del Ambiente,[10]). When refering to the prohibition of new industries in area A, this report indicates that "...it has been a complete success: From 1975 to 1977 inclusive, the Ministry of Development approved only 33 projects for new industries in the Capital District. The prohibition is accomplished and growth has stopped." It is possible, however, that "approved" projects are not the only ones to locate in prohibited areas. To find out if this is true, we need disaggregated data not heretofore available, such as the directories whose recreation was described in chapter 4. Some errors may have occurred during the recreation and comparison of the directories. Therefore, the results obtained should be considered as a first approximation which might give us an indication of what probably occurred. The results for newly created firms, as well as for existing firms will be presented.

As indicated earlier, an analysis of all the manufacturing sectors of the Venezuelan economy is beyond the dimensions of this research. There are over 27 3-digit manufacturing ISIC codes. Using the criteria discussed in section 4.4, the following codes were chosen for further study, and the results presented here are drawn solely from these six manufacturing groups:

ISIC code	Description
321	Textiles
323	Leather and leather products
356	Plastic products
382	Machinery and equipment, except electrical
383	Electric machinery and equipment
384	Transportation equipment

5.5.a New firms

New firms belonging to list I are the only ones --according to the policy-- allowed to locate in deconcentralization area A. All the others are considered "transgressors." The results obtained by a careful analysis of the six industrial groups are presented in table 5.8.

TABLE 5.8

NUMBER OF NEW FIRMS LOCATED IN AREA A THAT WERE NOT ALLOWED BY THE POLICY

Period	Years	Number of new firms in area A	Number of "transgressors"	Percentage of transgression
I	1975-1976	290	127	43.8
II	1977-1978	64	33	51.6

SOURCES: Own estimations based on the recreated directories and OCEI, Directorio Industrial 1978

In terms of percentages, period I seems to have fared somewhat better than period II. A possible explanation could be that at the beginning of the policy, government officials were more stringent. Because there are no disaggregate data prior to 1975, it is not possible to know what was happening before the control on location. It may well be the case that the percentage of transgression would have been much higher. The opposite view may be that the control on location was not effectively implemented during the 1975-1978 period. It should be pointed out that there is no surveillance system for industrial location in Venezuela, i.e., there are no government officials "patrolling" the streets looking for "transgressors." At most, they may check certain localities when a complaint has been submitted by residents of the locality. This may take place when the affected neighbors want to get rid of the noise, congestion or other nuisances caused by the manufacturing plant.

5.5.b Moves of existing establishments

Before we attempt to see the extent to which the negative incentives may have affected the location of manufacturing activity, we will use the disaggregate data to see whether existing firms have moved into the designated areas. Table 5.9 shows an origin-destination matrix of inter-area moves for each of the two periods studied and for the six industrial subgroups analyzed. The framed cells represent the expected impact of the policy of industrial deconcentration. As can be observed, in spite of the reduced number of cases, the general trend seems to be one of concentration.

5.5.c Moves and negative incentives

During the study period, some firms moved from other areas into area A (in-movers), some moved within area A (relocators), and other establishments left area A for other regions (out-movers). An attempt will be made to relate each of these cases to the control on location posed by the policy of industrial deconcentration.

In-movers: Technically speaking and according to the policy, no firms are allowed to move into area A. Nevertheless, since it is possible that firms specified on list I can introduce themselves as "new" in area A, i.e., that they can circumvent the policy by closing down the existing plant and re-opening as a "new" one in area A, list I has been used in this analysis. The results are shown in table 5.10.

TABLE 5.9

ORIGIN-DESTINATION MATRIX OF INTER-AREA MOVERS

from \ to	A	B	BM	C	D	Move out	Move in	Net change
A		7	4			11	12	+1
B			1			1	7	+6
BM	12					12	5	-7
C						-	-	-

Inter-area moves 1975-1976

from \ to	A	B	BM	C	D	Move out	Move in	Net change
A		2	2			4	5	+1
B	2					2	2	-
BM	3					3	2	-1
C						-	-	-

Inter-area moves 1977-1978

SOURCES: Own estimations based on the recreated directories and OCEI, Directorio Industrial 1978.

NOTE: The framed cells represent the expected impact of the policy.

TABLE 5.10

NUMBER OF FIRMS MOVED INTO AREA A, THAT WERE NOT ALLOWED BY THE POLICY

Years	Number of in-movers	Number of transgressors	Percentage of transgression
1975-1976	12	4	33.3
1977-1978	5	3	60.0

SOURCES: Own estimations based on the recreated directories and OCEI, Directorio Industrial 1978

Relocators: Firms which appear on list II are allowed to relocate within area A. As indicated earlier, list II is a subset of list I. Hence, an existing firm, (not belonging to list II but to list I), wanting to relocate in area A, may circumvent the policy by appearing as a new firm. For this reason, in analyzing this issue, list I will be used when identifying "transgressors" rather than the more stringent list II. The results are presented in table 5.11.

During the second period, industries appear to have learned that, in spite of the policy, they could easily relocate. The increased level of transgressors suggest the decrease effect of existing control mechanisms.

Out-movers: During the study period (1974-1978), some firms moved from area A to other areas. This aspect has already been presented in the analysis of the spatial pattern of the manufacturing industry. Our concern now is with those industries which, according to list III must leave area A because they are hazardous to the inhabitants, i.e., involved with industrial chemicals, petroleum and coal derivatives, etc.

At the end of the first period, there were 21 establishments in the hazardous category (belonging to the six industrial groups) located in area A. These were supposed to leave since they are specified on list III. However, during 1975-1976, only one of these firms left the area. Hence, at the end of the first period, 95% of the transgressors remained. Similarly, by the end of the second period, of the 23 establishments which were supposed to leave, none has left. Therefore, during the second period, not only did firms belonging to list III remain in area A, but the number increased.

TABLE 5.11

NUMBER OF FIRMS THAT RELOCATE WITHIN AREA A, WHICH ARE NOT ALLOWED BY THE POLICY

Year	Number of relocators	Number of transgressors	Percentage of transgression
1975-1976	35	15	42.9
1977-1978	14	10	71.4

SOURCE: Own estimations based on the recreated directories and OCEI, Directorio Industrial 1978

5.6 Preliminary conclusions of chapter 5

From the results presented above, there seems to be little or not evidence that changes in the spatial pattern of industry can be related to the application of government instruments. From the financial incentives point of view, the nearly stable trend in the development region's share of credit does not support the hypothesis that these incentives influenced the location of new firms. In spite of the fact that information is generally not available on the actual application of fiscal incentives, their value is likely to be insignificant when compared to the profits of the manufacturing industry in Venezuela, and it is therefore probable that they have had little or no effect on location. Control over location, i.e., negative incentives, does not seem to have been applied effectively during the study period.

Based on the conclusions indicated above, we may ask ourselves the following question: If it seems as though the pattern of industrial location was unaffected by government incentives, why is that in chapter 4 we found some evidence that a group of manufacturing industries have a tendency to deconcentrate? What made them select locations other than the traditional industrial axis? In other words, we may ask: what other influences have affected industrial location, and what has been their relative importance? Answers to these questions will be attempted in the next chapter.

6 WHAT HAVE BEEN THE OTHER FACTORS INFLUENCING INDUSTRIAL LOCATION AND WHAT HAS BEEN THEIR RELATIVE IMPORTANCE?

In chapter 4 we found some evidence that a group of manufacturing industries has had a tendency to deconcentrate. In chapter 5 it was shown that little or no evidence existed to support the supposition that changes in the spatial pattern of industry were related to the application of government instruments. Hence, we may ask: if government incentives did not affect the location of industry, why did some industry subgroups deconcentrate while others did not?

Any attempt to answer this question requires first an understanding of why manufacturing industries locate in one place rather than another. Since there is a whole body of theoretical knowledge, it will be convenient at this point to review the existing theories of industrial location and to determine whether the theoretical locational factors are operational in the Venezuelan manufacturing context.

6.1 Industrial location theory

In the context of standard microeconomic theory, several models have been developed to be used as tools for historical analysis of the location of a firm. A summary of the primary approaches is presented in appendix A.

Location theory attempts to explain why economic activities locate in particular places. It turns out that the explanation depends almost entirely on the existence of irregularities in space, including variations in the physical configuration of the land, discontinuities in the means of transportation, the fact that resources are localized rather than ubiquitous, or that wages are not spatially uniform. Because of these irregularities and discontinuities, the business firm's cost of production or transportation is potentially lower at some places than at others, or the business firm's revenue is potentially higher at some locations than at others. Places offering lower costs (or higher revenues) attract economic activity, become centers of production and, therefore, increase in market size and attract market-oriented activity, which contributes to further growth.

6.2 Limitations of the traditional location theory

The traditional location theory concentrates mainly on transportation costs because these vary in a patterned way over space, and it barely touches such things as labor cost, which vary in no regular way. For these latter expenses, all that is necessary is to compare the savings-per-unit among alternatives. There are no theoretical difficulties here. But the theory has little to say on some important topics (Alonso,[1]), such as:

* Locational interdependence: In the typical modern oligopoly a major location determinant for an individual firm is the location and markets of like firms. Firms maneuver to control or share competitors' markets. This is very difficult to incorporate into a theory.

* The impact of large modern corporations. It is difficult to incorporate large enterprises into location theory as they contain a wide variety of plants some of which may originally have located for reasons independent of the present concern. Large enterprises may also produce a wide variety of products, not all of which can be produced at one optimum location. Furthermore, traditional location theory uses the methods of partial equilibrium analysis, assuming that the firm in question is so small in relation to the relevant market that its activities have no perceptible effect on the prices and on the location of other economic units. When we are dealing with large firms relative to the economic environment the method of partial equilibrium analysis breaks down.

* Firms may only be satisfiers: This problem raises the continuing question of whether firms actually do "maximize" profits. For a state concern, an "adequate" return on public money, with some considerations of social cost and benefits, may be more important than maximum returns. Alternative aims have also been suggested for private enterprises. It is increasingly recognized that "profit maximization" may be an oversimplified conception of the motivating force behind business decisions, including those involving location (Hoover,[2]).

* Behavioral factors: These factors have been generally neglected. Behavioral factors, such as the businessman's attitude to the troubled labor conditions of certain areas, or his attitute to the

social life of "the North" compared with that of "the South", may play an important role in industrial location (Hamilton,[3]).

* Uncertainty: The future is always uncertain. Tastes may change; there may be a technological revolution; tax laws and custom duties may be revised.

* Time: This dimension is not sufficiently considered in the existing location theory. The decision that is best in the light of today's situation may not be best at some future time; production methods will change; transportation routes and costs, location of resources and of customers, and the nature of the competition, may also change. Even when these changes can be predicted with certainty, we do not have a method of making a decision that will be best over a period of time rather than at a moment in time (Alonso,[4]).

Any of the above elements may account for almost the whole locational phenomenon. Alternatively, the location decision may respond to a wider variety of causes, many of which might be active at the same time. This complexity is augmented by the fact that the "determinant" causes may be, in general, different for each manufacturing group.

6.3 Location theory and the Venezuelan environment

So far, we have mentioned many factors involved in location, not only from location theory but also from intuition. We may next ask whether these factors are operational in the Venezuelan industrial context. A group of industrialists interviewed by the researcher pointed out that the most important factors influencing location were availability of labor, good transportation facilities --good roads, closeness to port facilities, etc.-- and availability of infrastructure, both life support --such as energy and water-- and social facilities --such as housing and schools. Among the entrepeneurs interviewed were representatives of the electric machinery and equipment industrial subgroup, the non-electric machinery manufacturing sector and the plastic industry.

Some of these industrialists complained that the lack of housing facilities in the town where their factories were located --exacerbated by the sudden increase in demand due to the 1974 economic changes-- forced workers to live in nearby settlements, and "when it rains heavily, there is high absenteeism". Other industrialists indicated that in the last few years they were having frequent blackouts, and the shortages of water have been aggravated. None of the industrialists interviewed gave an indication that the government locational incentives were high enough , financially, to compensate for the disadvantages they would face if they located in a less desirable area. One entrepeneur who selected a site in a designated area indicated that he would have located there anyhow because he needed to be close to the source of raw material and that particular place seemed to be the only place in the country where the required input was available. Overall, entrepeneurs who have their plants in the industrial axis reported that although the infrastructure and related services were inadequate, they manage to operate. But from 1974 onward, the situation had become worse. The sudden increment in new manufacturing activities in their surroundings has led to the repeated breakdown of the already inadequate services in the form of frequent blackouts, water rationing, scarcity of labor, etc.

A study done by SAEDI[5] surveyed more than 800 Venezuelan manufacturing firms. This survey was carried out with the purpose of finding out the major limitations industrialists encountered when increasing their production of capital goods or when getting involved in the production of these goods. The answers and priorities collected by this survey were:

1) Scarcity of labor and absenteeism
2) Difficulties to obtain inputs
3) Limited demand for the products
4) Unsatisfactory physical and social infrastructure

The elements of the SAEDI study (SAEDI,[6]) coupled with the results of our interviews give us some idea of the possible factors that may affect the locational choice of the Venezuelan manufacturing industry. Furthermore, it gives us some indication as to the awareness of Venezuelan industrialists to the problems that may have to be faced when a location has not the appropriate mix of the factors of location.

The above discussion has highlighted some locational factors that may have affected the locational choice of the Venezuelan industrialist. Nevertheless we may ask how these factors of location relate to the spatial pattern of distribution of industries, in other words, why some industry subgroups deconcentrate while others did not?

6.4 Working hypothesis

Based on the information so far collected about the Venezuelan manufacturing environment and the spatial distribution of economic activities, we will attempt to answer the question posed above. We may speculate that the changes in the Venezuelan economy which occurred in 1974 (when the national budget increased threefold) had two major effects on the Venezuelan manufacturing environment. On the one hand, these changes gave rise to a large number of new manufacturing firms, most of which were concerned primarily with satisfying the sudden increase in demand and benefitting from the resulting high profits. Most of period I entrepeneurs, i.e., those who set up a factory during the years inmediately following the economic changes, could be characterized as having a commercial or opportunistic approach to manufacturing rather than a long-term approach or industrialist viewpoint. As a consequence, we may speculate that most of the new firms, during the period 1975-1976, chose locations without much concern for cost factors or other locational factors. On the other hand, the steep increase in the number of manufacturing establishments further accentuated the diseconomies of the insufficient physical and social infrastructure. This was a phenomenon that started in Caracas and slowly spread to many of the surrounding cities. New industries locating in places where the level of services was insufficient suffered along with those plants already located there .

By our second period of analysis (1977-1978), the economy reached a point of equilibrium in terms of supply and demand for national manufactured products. At this time, most of the entrepeneurs were not only aware of the problems of locating in the already congested industrial axis, but they were also aware of the fact that the "bonanza", or high profit period, was over. Therefore, entrepeneurs planning to set up a factory during the second period were more concerned with locational factors than period I entrepeneurs. In other words, period II entrepeneurs probably planned the selection of their plants sites more carefully. They would have looked for places with lower wages, a satisfactory water supply, a good social infrastructure, low transportation costs, etc. It may have been the search for a location with the above characteristics which led some industrialists to consider settlements outside the industrial axis. Consequently some deconcentration occurred. Although deconcentration may have begun prior to the economic boom of 1974, the sudden change in the economy at that time may have accentuated the deconcentration process.

The arguments presented above may have explained why some manufacturing sectors deconcentrated, but what about those who did not? A clue to the answer to this question may be found in the World Bank[7] report cited earlier. In this report it was argued that the salient feature of the Venezuelan industrial environment was the high degree of protection from import competition by government policies. The report stated that "Possible variations in government policy carry greater potential effect on profitability than does any likely development in cost reduction or new product promotion." If this is the case, and knowing (from chapter 3) that the granting of exonerations and other government benefits to industry were given on a case-by-case basis in the headquarters of the Ministry of Development located in Caracas, we might expect highly protected industries to be attracted to Caracas. We might expect, for example, that small highly protected industries would consider closeness to the government's decision-making center to be crucial. They could argue that exonerations, licences and other benefits received on a case-by-case basis outweighed the disadvantages of locating in the industrial axis. So, they concentrated. An additional and complementary explanation might be that the savings that could have been obtained by deconcentrating were low compared to the large profits made possible by the high level of protection.

If the above hypothesis holds, we would expect to see some evidence to support these issues, such as:

1) Concentration of highly protected manufacturing activity in the industrial axis and deconcentration of less protected manufacturing firms;

2) Less protected industries to be more concerned with locational factors. Furthermore, second period industrialists experiences a higher sensitivity to locational factors, due to their awareness of the physical limitations existing in cities of the traditional industrial axis, and to the return to more realistic profit levels.

3) Relatively little weight attached to government incentives as a factor of location.

An attempt will be made, in the rest of this chapter, to address some of the above issues.

6.4.a Concentration and protection

As indicated earlier, if the benefits obtained by being close to those government agencies which grant exonerations and other benefits outweighed the diseconomies of being in the traditional industrial axis, we might expect highly protected industries to concentrate and the less protected industries to deconcentrate. Fig. 6.1 shows the pattern of association obtained by using the disaggregate data from chapter 4, referring to the six manufacturing groups analyzed as well as to the level of effective protection (World Bank,[8]). An industry subgroup is classified as low level of protection when its effective protection is below 80 percent, and classified as high level when is above 130 percent (see also Fig. 4.2).

One might, of course, argue that those who concentrated did so, not because of government protection, but because of some other reasons, and that the pattern of association observed in Fig. 6.1 is spurious. This is quite possible and we do not want to present the results of Fig. 6.1 as major evidence. Attempts to find some other causes were made. Two of them are described below.

6.4.b Concentration and capital/labor intensity

We may speculate, for example, that labor intensive industries, in search for areas with surplus labor and low wages, will tend to deconcentrate. If this is so, we may expect to find industries with low electricity consumption (our proxy for capital/labor intensity) to deconcentrate. Fig. 6.2 presents the pattern of association between dispersion and electricity consumption per thousand hours worked.

Deconcentration	Effective protection: High	Effective protection: Low
Yes		Leather Non-electric machinery Electric machinery
No	Textiles Plastics Transport equip.	

Fig. 6.1 Pattern of association between deconcentration and effective protection.

Sources: World Bank, Current Economic position and Prospects of Venezuela Vol. 2: Industrial Policy in Venezuela (Washington, 1977) p.98.

OCEI, Directorio Industrial, 1978.

Recreated directories for 1974 and 1976.

The results presented in Fig. 6.2 do not support the proposition that labor intensive industries deconcentrate.

	Capital/Labor Intensity: High	Capital/Labor Intensity: Low
Deconcentration: Yes	Electric machinery	Leather Non-electric machinery
Deconcentration: No	Plastics Textiles	Transportation equipment

Fig. 6.2 Pattern of association between deconcentration and capital/labor intensity.

Sources: OCEI, Encuesta tape, 1977.
OCEI, Directorio Industrial, 1978.
Recreated directories for 1974 and 1976.

6.4.c Concentration and the product cycle theory

Another of the possible explanations explored is related to the product cycle hypothesis. The product cycle model, Vernon[9] concerns the evolution of a product through three distinct stages in its life cycle:

1) The first stage is an innovation stage where a new product is first developed and introduced to the market, or a new production process is developed. The innovation phase, which needs a high input of R & D (Research and Development) is usually carried out in large industrial agglomerations.

2) A growth stage, which is characterized by the gradual adoption of mass production and marketing of the product.

3) A standarization phase when production costs, due to learning curve effects, can shift to low-cost locations. The technical and managerial talents previously important are replaced with low-skilled labor. Labor costs are particularly important because of the higher proportion of labor to total inputs usually associated with the standarization of the production process. Hence, the standarization phase of development can be associated with deconcentration (Rees,[10]).

From the description of the product cycle theory presented above, it may be argued that when the product and/or the process is "new", the manufacturing plants are attracted to large industrial agglomerations. When the product <u>and</u> the process is "old", plants are attracted to peripheral areas.

Examples of old product-new process may be found in the injection molding processes in the footwear industry and in the introduction of the float glass process for producing plate glass. In the opposite case, i.e., new product-old process, examples can be found in the women's high fashion clothing (Finger,[11]). Following this rationale, we may expect, then, to find those industries that deconcentrate, to represent old product-old process and those who concentrate to have either the product or the process new, or both.

Analyzing the results obtained in chapter 4, it is difficult to envisage, for example, that in Venezuela the electric as well as the non-electric machinery and equipment industries (which deconcentrated) to belong to the old product-old process category. Nevertheless, if this description is accepted, then we may argue that the transportation equipment industry also falls into this old/old category. In so doing, the fact that the transportation industry has not deconcentrated contradicts the expected outcome of the product cycle model.

Returning to the pattern of association between concentration and level of protection, we can see that the results presented in Fig. 6.1, although by no means conclusive, indicate an interesting possible relationship which might justify further research efforts in this direction and in the direction of changes in the sensitivity of the Venezuelan entrepeneur towards locational factors. Our next task is not only to determine whether less protected industries were indeed more concerned with factors of location, but in addition, to determine which are these factors and to what extend government financial incentives has been considered a locational factor by industrialists.

The factors of location may be seen as contributing to the space cost curve of a manufacturing plant. The space cost curve represents the average cost per unit of production at any point in space (Smith,[12]). If it would be feasible to construct a space cost curve for each industry subgroup, it is likely that we may find direct answers to the above-mentioned questions. Since it is very difficult --and sometimes impractical-- to construct the firm's space cost curve, we have to rely on other methodological approaches to determine the contribution of government subsidies --as well as other factors of location-- to a firm's space cost curve and hence, to the locational decision of the firm. These issues are discussed next.

6.5 Traditional methodologies

The common approach to identifying the effects of an overall regional policy is to explore the behavior of selected variables in the period prior to the application of the policy. This is done in order to identify likely developments in the absence of the policy, i.e., the consequences of the non-action alternative.

The steps of the classical methodology (Moore and Rhodes,[13]) can be summarized as follows:

1) Select variables which a priori should be affected by regional policy;

2) Identify the periods of changing strength of regional policy (passive and active periods);

3) Examine the behavior of the variables:
   a) Describe the movement of the variables through time;
   b) Predict tendencies in order to identify what would have happened in the absence of stronger policies;
   c) Adjust values to take account of differences in industrial structure. (The technique commonly adopted for eliminating the main effect of industrial structure is shift-share analysis);

d) Compare actual movement with the no action alternatives;

e) Explain reasons for the difference.

This method can be useful because it enables presumptions to be made about the effectiveness of the policy. But it also has weaknesses such as the fact that it is mainly descriptive and its conclusions are easily debatable.

Disentangling the effects of individual policy instruments is even more difficult. The approach used so far by most analysts is to obtain information from a variety of sources and to carry out studies involving a variety of economic and statistical analysis in order to find out whether the results are consistent and whether convincing conclusions can be drawn from a careful review of all the evidence (OECD,[14]).

In addition to the classical methodology described earlier, questionnaires and simple regression analysis also have been widely used.

The questionnaire approach involves direct questioning of firms which are affected by the incentives. The idea is to find out what effects business thinks the incentives have had. A closer look into this approach indicates that in many instances a decision maker may declare that a particular incentive is crucial for his new location because he/she is afraid that the incentive may be eliminated. This is said in spite of the fact that the firm would have moved to a particular location anyhow.

Simple regression analysis, an indirect method of investigation which relates observed movements to a series of possible causal factors, has the advantage of being quantitative, and because of its simplicity it has been commonly used. The main disadvantage is that it does not capture the reality of the actual decision process which is discrete by nature: For example, one either goes to city A, B or C. In addition, the focus of simple regression analysis is usually on aggregate data. The results can yield only statistical inferences about the reactions of particular firms under different conditions.

During the last few years, discrete choice models, which are considered to be at the frontier in econometrics (Zarembka,[15]), have been slowly finding wider application in economics and other fields (Hartman and Hollyer,[16]). Such models have been widely used in the analysis of urban transport choices, and most recently, have made important contributions to the study of modal choices by energy consumers. In all such cases, they have allowed analysts to take the discrete nature of real world choices into account.

Industrial location decisions are obviously of the discrete type, but the new econometric approach has not yet been applied to locational problems in developing countries. A recent paper by Carlton,[17] however, has used discrete choice modelling in the analysis of branch plant location decisions in the United States.

There are three major differences between simple linear probability models fitted to aggregate data by least squares and discrete choice models fitted to individual observations by the technique of maximum likelihood. The first advantage of discrete choice models lies in their imposition of the constraint that all choice probabilities sum to one in a particular context. The second lies in the obvious gain in degrees of freedom which results from a consideration of individual circumstances. Finally (and this is probably the most important point), aggregated models must use group averages for right-hand-side variables. It has been shown that the use of group averages leads to response parameter estimates which are systematically biased (that is, they do not truly reflect the valuation applied by individual decision-makers).

Due to the limitations of the methods used previously, this research will attempt to use discrete choice models for the study of industrial location in Venezuela. Problems such as the concentration of industrial activity in very few locations and the limitations of the data make the use of discrete choice models more difficult than would be the case in an advanced economy. It is expected that by using this type of model, we may obtain additional evidence on issues such as the awareness and sensitivity changes of entrepeneurs to problems in locational factors as well as gain a better understanding of the role of financial incentives as a factor of location.

6.6 Discrete choice models

Discrete choice models assume that the individuals or firms are faced with a choice between two or more alternative sites or cities, and that the choice they make depends on the characteristics both of the cities and the firms. Assuming that we have information about the attributes of each of the firms and the locational choices that they make (for example, city B instead of A, C or D), the discrete choice method formulates an equation that will predict the choices of those firms not in the original sample. Hence, the discrete choice model will attempt to find a relationship between a set of attributes describing a firm (e.g. size, energy consumption, etc.) and the probability that the enterprise will make a given locational choice. Each locational choice is described by its characteristics such as existing unemployment level, availability of government grants, availability of water, etc. Furthermore, the model reflects the fact that a firm, when selecting a city, compares the *relative* values of the attributes of the alternative locations. A description of discrete choice models will be presented in the next chapter.

6.7 Summary of chapter 6

In this chapter, an attempt has been made to suggest why some manufacturing sectors deconcentrate while others do not. As pointed out in chapter 5, it seems unlikely that the policy instruments applied have caused deconcentration. Consequently it is hypothesized that changes in the economy which occurred in 1974 had two major effects on the Venezuelan manufacturing environment. On the one hand these changes gave rise to a large number of new manufacturing firms, most of which were more concerned with satisfying the sudden increase in demand --commercial or opportunistic approach, rather than a long-term approach or industrial viewpoint. On the other hand, the sudden increase in the number of manufacturing establishments further aggravated the existing problems in the industrial axis, created by the already saturated and unsatisfactory physical and social infrastructure. By the second period, i.e., 1977-1978, the economy reached an equilibrium point in terms of supply and demand for nationally manufactured products. As a consequence, most of the new firms created in this second period were headed by industrial-minded entrepeneurs. They were aware of the problems in the congested industrial axis and were more concious about production costs.

These industrialists carefully weighed the advantages and disadvantages of locating in the traditional industrial axis. Some less protected industries considered it more profitable to locate their new plants away from the industrial axis. Others --for example the small highly protected industries-- may have considered that closeness to the government's decision making center a crucial factor. They may argue that the exonerations, licences and other benefits received as incentives, outweigh the disadvantages of locating in the industrial axis. Furthermore, the percentage savings that they may obtained by locating outside the congested industrial axis may be very small when compared to their profit rates. So, they concentrate.

Some evidence to support this hypothesis is presented. Mainly the fact that the less protected industrial subgroups seem to deconcentrate while highly protected ones do not. Furthermore, by interviews with industrialists and from other sources, anecdotal evidence is found to support this view. Nevertheless, in order to gather more evidence and in an attempt to disentangle the effect of government incentives, as well as to detect possible changes in industrialist's sensitivity to locational factors, the use of discrete choice models is suggested. It is expected that this relatively new econometric method of analysis will permit a better understanding of both the factors influencing industrial location in Venezuela and the possible effects of financial incentives as a factor of location.

In the following chapters, --Part III of this research-- the econometric analysis is presented. Chapter 7 will describe the discrete choice model that will be used and chapter 8 will discuss the statistical findings.

PART III: ECONOMETRIC ANALYSIS

7 Methodology

7.1 Introduction

In the preceding chapter we discussed some of the determinants of the location decision of a manufacturing firm, with primary concentration on the theoretical explanation emerging from traditional location theory.

This chapter, along with the next one, represents an attempt to test some of the determinants of locational choice that emerge from this theoretical model as well as those obtained from empirical observation. In addition, we shall consider other causal elements (such as financial incentives) which may cause entrepeneurs to choose a given location.

7.2 The discrete choice of location

The decision to locate a manufacturing plant in a particular city is one of many economic choices having lumpy characteristics. The entrepeneur is confronted with a set of feasible alternatives --cities-- one and only one of which can be selected.

Discrete choice theory is based on the assumption that a decision-maker chooses from a set of feasible alternatives so as to maximize his/her utility. The utility of an alternative is a function of its attributes and differs across individuals. Since some of the attributes are unobserved and imperfectly measured, or because there is taste variation, it is impossible for an observer to determine precisely which alternative any decision maker will select. Thus, we can predict only the probability of a given alternative being chosen. These assumptions lead to a class of models termed random utility models. (Appendix B presents a detailed consideration of models of discrete choice).

The general form of a random utility model is that for a given individual, i, the probability of choosing an alternative j from a set A is equal to the probability that the alternative j has a higher utility than any other alternative k in the set A. Thus:

$$P_i(j:A) = \text{Prob}\ (U_{ij} > U_{ik}) \qquad \text{for all k in set A} \tag{7.1}$$

Furthermore, the random utility model assumes that the utility of any alternative is a function of the attributes of the alternative and of the characteristics of the decision maker. The utility of any alternative j to individual i, U_{ij}, is expressed as follows:

$$U_{ij} = V_{ij} + \eta_{ij} \tag{7.2}$$

where V_{ij} is a systematic or representative component of utility, and η_{ij} is a random element or unexplained random error.

Multinomial logit, the most widely used choice model, is derived from the assumption that the random effects of the unobserved attributes of the alternatives as well as the unobserved characteristics of the decision maker are independent and identically distributed with the Weibull distribution. The functional form derived from this assumption is as follows:

$$P_{ij} = \frac{e^{V_{ij}}}{\sum_{k=1}^{K} e^{V_{ik}}} \qquad (7.3)$$

where P_{ij} is the probability that a decision-maker i will select alternative j and e is the natural logarithm base. K is the number of feasible alternatives.

By specifying the utility function as linear in its parameters, we have

$$V_{ij} = \sum_{n=1}^{N} \beta_n X_{nj} \qquad (7.4)$$

where V_{ij} = utility that decision maker i attaches to alternative j.

X_{nj} = level of the nth attribute of alternative j.

β_n = parameter associated with the explanatory variable n.

N = number of explanatory variables.

An example of X_{nj} may be the prevailing wage level in city j. It should be noted that this variable can reflect interaction between, say, the number of employees of an establishment (a firm's characteristic) and the wage level of alternatives (a city's characteristic). The interaction reflecting the total payroll that a firm will have if it locates in a particular city.

Substituting equation 7.4 in equation 7.3, we may express the logit model as

$$P_{ij} = \frac{\exp\left(\sum_{n=1}^{N} \beta_n X_{nj}\right)}{\sum_{k=1}^{K} \exp\left(\sum_{n=1}^{N} \beta_n X_{nk}\right)} \tag{7.5}$$

The estimation process used is based on the maximum likelihood method where the estimated β_n's are those maximizing the likelihood function:

$$L = \prod_{i=1}^{I} \prod_{k=1}^{K} P_{ik}^{Q_{ik}} \tag{7.6}$$

$$\text{where} \quad Q_{ik} = \begin{cases} 1 \text{ when the firm choses city } k \\ 0 \text{ otherwise} \end{cases}$$

I = number of observations

Now, given L in equation 7.6 the log-likelihood function L^* may be written

$$L^* = \sum_{i=1}^{I} \sum_{k=1}^{K} Q_{ik} \,\ell n\, P_{ik} \tag{7.7}$$

If we now replace P_{ik} in equation 7.7 by the expression 7.5 the result is an equation which is a function of the unknown βs since all the other quantities in equation 7.7 are known (the Xs and Q_{ik}'s).

L^* is then maximized with respect to the βs in the usual manner, the resulting estimates being the Maximum Likelihood Estimates (MLEs) for the model's parameters.

Equation 7.7 is maximized with respect to the parameters (βs) using nonlinear maximization algorithms. These algorithms are usually iterative in nature, the analyst being required to provide an initial guess as to the value of β. These values are used in equation 7.5 to calculate P_{ij}'s. These latter values are then used in equation 7.7 to calculate a starting value of L^*. The usual procedure is then to search in some fashion for "better" values of βs to use in equation 7.5 to get new P_{ij}'s which will cause the value of L^* in equation 7.7 to increase. The iterative procedure will continue until some predetermined level of tolerance is reached (Hensher and Johnson,[1]). There are several methods which may be used to search for the optimal value of β. The Newton-Rapheson method has been used in this study.

For predicting purposes, we choose one of the alternative cities as a standard and we use it as the basis for performing differences:

$$\frac{P_{ij}}{P_{is}} = \exp\left[\sum_{n=1}^{N} \beta_n \left(X_{nj} - X_{ns} \right) \right] \qquad (7.8)$$

where s is the standard category.

Equation 7.8 can be linearized taking logarithms, thus

$$\ell n \left(\frac{P_{ij}}{P_{is}}\right) = \sum_{n=1}^{N} \beta_n \left(X_{nj} - X_{ns}\right) \tag{7.9}$$

Therefore, we will estimate K-1 equation such as 7.9, where K is the number of possible alternatives. Given the estimated values for the β_n's the P_{ij}'s can readily be obtained.

7.3 Definition of choice set

The model presented at the begining of this chapter assumed that one could meaningfully characterize the locational decision facing the industrialist: The choice of a city in which to locate his plant is made from a known set of alternative cities. In practice we, as modelers, are faced with the task of explicitly defining this location choice set. In one respect this is virtually a hopeless task: Venezuela consists of many settlements of various sizes and qualities. The subset of these, actively considered by any given entrepeneur is, at best, probably known to the industrialist alone. Central place theory, on the other hand, would argue that a natural hierarchy or system of settlements exists within a country. If such a hierarchy exists, it would be possible to identify the most important settlements of manufacturing activity within the country. (These settlements presumably constitute a large sample of possible locations for those manufacturing entrepeneurs who desire a regional or national market for their products). On this issue the modeling technique employed here is very useful. The logit model assumes one underlying utility function and looks at relative choice frequencies as sample draws.

Because of computational limitations --it is unlikely that existing computer programs could adequately handle more than twenty potential choices of location-- we had to select a limited number of alternative locations. For this purpose, the following criteria were applied:

1) The choice set should be as large as possible so as to have a better representation of the variables to be analyzed, i.e., to have a wide range of values of the potential locational factors.

2) The choice set should include a good mix of core and periphery cities as well as settlements with and without manufacturing activity. The manufacturing activity need not necessarily be new.

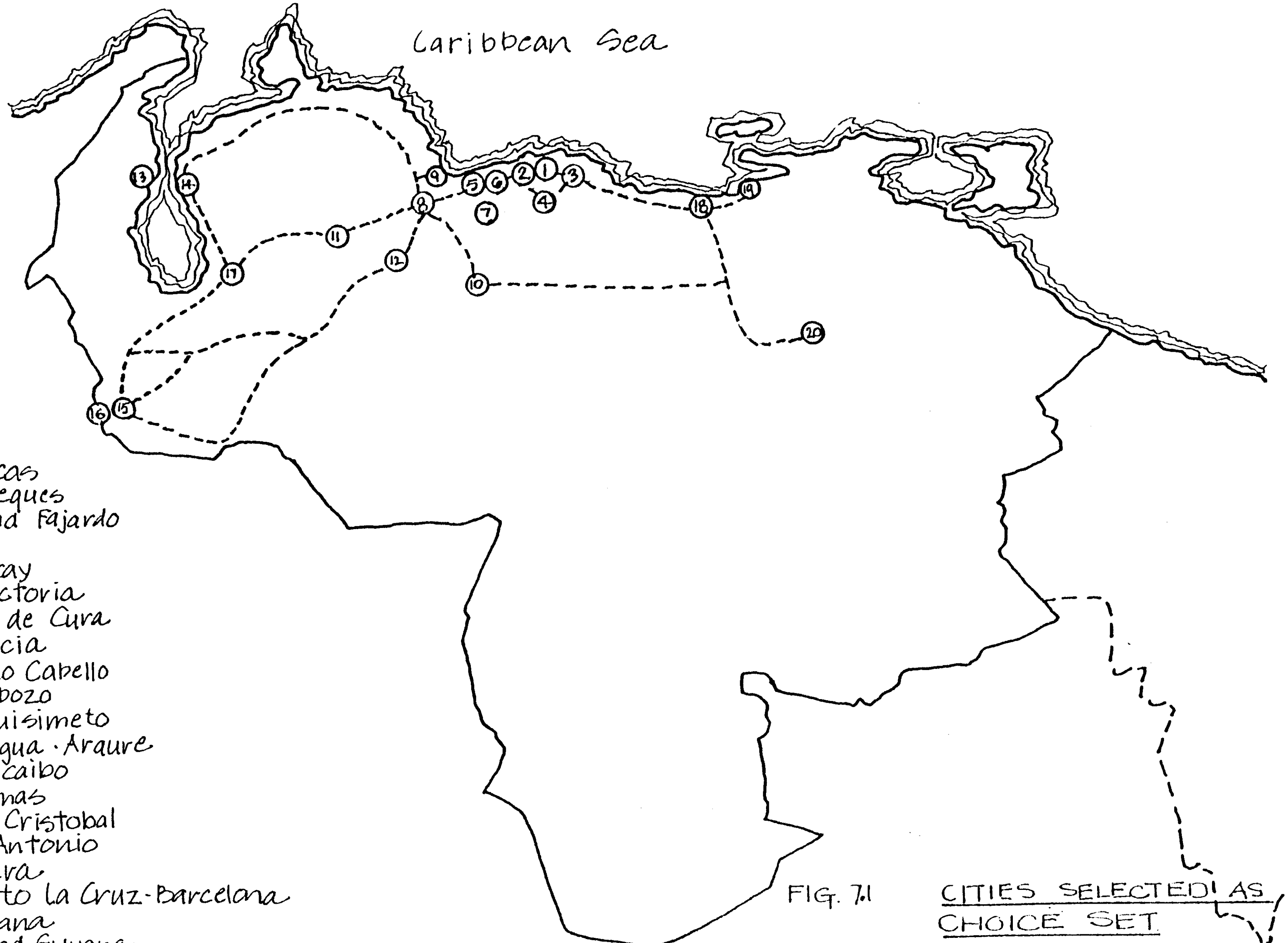
3) The choice set should represent all the areas of deconcentration, as well as the special growth centers identified by the policy of industrial deconcentration.

4) The choice set should have a good geographical balance, with cities located in the east, west and south of the country, as well as in the traditional north-central area.

As a result of the above considerations, twenty cities were chosen (see Fig. 7.1).

7.4 Data requirements

The model focuses on the attributes of the cities, relating them to the



1 Caracas
2 Los Teques
3 Ciudad Fajardo
4 Cúa
5 Maracay
6 La Victoria
7 Villa de Cura
8 Valencia
9 Puerto Cabello
10 Calabozo
11 Barquisimeto
12 Acarigua · Araure
13 Maracaibo
14 Cabimas
15 San Cristobal
16 San Antonio
17 Valera
18 Puerto La Cruz-Barcelona
19 Cumana
20 Ciudad Guyana

FIG. 7.1 CITIES SELECTED AS CHOICE SET

locational choice of manufacturers. We concentrate on explaining the number of new establishments in each city for the two time periods 1975-1976 and 1977-1978. It is then necessary to create a detailed data base for each period across the cities. The data are designed to capture the differences in locational factors among cities. Data required for the estimation of the model can be divided into two types: data describing each of the possible locations, i.e., city characteristics, and data concerning an individual manufacturing firm in each of the locations included in the study, i.e., the firm's characteristics. Each of these data types will be discussed in turn.

7.4.a City characteristics

The attributes of a city which may affect the entrepeneur's choice of location can be divided into seven general categories. These are as follows:

1) Labor conditions
2) Support systems
3) Access to services
4) Amenities
5) Spatial or flow characteristics
6) General economic conditions
7) Government incentives

Appendix C contains a discussion of measurement problems for each of the attributes within each of these categories, as well as other data issues. A description of each category is given below.

1) Labor conditions

A broad range of labor conditions has traditionally been considered relevant in industrial location choice. Out of the many attributes that could be used to describe labor conditions, we managed to obtain data on the following factors, for each of the twenty cities:

Wages: One of the most important determinants in the choice of a location may be the prevailing wage rate. Wage rates at the three-digit ISIC code level were collected for each of the periods. When the three-digit wage was unavailable for a city, the existing data for the city's region was used to estimate the relationship between the three-digit and the average manufacturing wages for the region. Knowing the average manufacturing wage for the city and assuming that the relationship in the city is the same as in the region, the three-digit wage for the city was estimated. When available, the two-digit wage was used instead of the average manufacturing wage.

Manpower: Labor force is a fundamental factor in the location of industry: The quality or level of skill of the labor force necessary for technically advanced industries, or the quantity or abundance of manpower for labor intensive, low skill industries are important issues for industry. In both cases, the productivity of labor is an additional consideration. Data on labor availability at two-digit ISIC were collected. The two-digit code was thought most appropriate because of the possibility of using the same labor across different industries within the same two-digit ISIC code. It should be pointed out that the use of two-digit ISIC code does not necessarly captures the quality or level of skill of the labor force. Nevertheless, due to data limitations, this surrogate was used.

Unemployment: For labor intensive, low technology industries, areas with high unemployment rates may be desirable because the costs of replacing labor is lowered by the slack labor market. To measure this variable, unemployment levels using the two-digit ISIC code were collected. Again, the reasons for using the two-digit code are the same as indicated for the labor force.

Technical expertise: For industries with technological sophistication, the presence of a highly skilled group of professionals is likely to be an important locational factor. Data on the number of professionals, technicians and related ocupations were obtained.

Management potential: Availability of managers, administrators and directors may well be an important locational factor. It was possible to find total number of managers (employed and unemployed).

Cost of living: In their efforts to reduce labor costs, industries may tend to locate where living costs are lower so as to be able to pay lower wage rates. Data on the comparative cost of living at least to the extent of food, drink and tobacco were obtained.

Work stoppages: The troubled labor conditions of certain areas can often be a deterrent to manufacturing activity. Data on time lost due to unexpected stoppages were collected.

Training facilities: Due to the importance of manpower, it is necessary to have institutions capable of training and recycling manpower. As a proxy measurement for this factor, the number of students enrolled in technical training courses was obtained.

2) Support systems

Within the Venezuelan manufacturing environment, the physical infrastructure seems to be one of the most important locational factors. Attempts were made to obtain data on the various support systems. Indeed, the following information was collected for each city:

- Percentage of population serviced with water
- Water availability in cubic meters per inhabitant
- Water cost
- Number of telephones and telexes.

It was originally intended to obtain data on electricity blackouts as a proxy for reliability of the service but this information was impossible to gather. Furthermore, in terms of obtaining electricity costs, it was planned to use the city's tariffs; this approach was discontinued when it became apparent that not only can many combinations be obtained, depending on the characteristics of the firm, but information on these firm's characteristics was not available.

Furthermore, an analysis of electricity costs using aggregate data for each city, showed no major differentials. It was also not possible to obtain usable data on refuse disposal and sewerage.

3) Access to services

Services for manufacturing activities that a city offers can be very important. Firms will tend to locate where service facilities for their machinery and equipment are available as well as such services as marketing and packaging facilities. We were able to obtain the following data regarding city services offered to the manufacturing industry:

- Proportion of total employees in the financial sector
- Proportion of total employees in services to establishments
- Proportion of total employees in research institutions

4) Amenities

Amenity attributes are a particular set of city characteristics which seem to have a strong effect on industrial location decisions. The need for manpower may lead entrepeneurs to locate a plant in a favorable urban environment. Nevertheless, employees will demand certain social and cultural amenities such as housing, school for the children, meeting places, etc. Furthermore, as the level of technical skill increases, there will be a tendency to put higher values on places with better climates, landscapes and surroundings. Amenities are particularly difficult locational factors to measure, since amenity is a generic term for a complex bundle of attributes and may be perceived in many different ways by different entrepeneurs. Nevertheless, we have attempted to measure these attributes by means of several variables. The measure ultimately selected were, expressed in each case, where not indicated to the contrary, relative to total population:

- Number of doctors
- Number of hospital beds
- Number of 5-14 years old children per classroom (primary school)
- Number of 15-19 years old teenagers per classroom (high school)
- Teachers per classroom in primary school
- Teachers per classroom in high school
- Students per classroom in primary school
- Students per classroom in high school
- Number of retail employees
- Number of hotel and restaurant employees
- Number of employees in entertainment and cultural services
- Number of employees in transportation
- Number of public transport vehicles
- Delinquent index

We were unable to find data for all the cities under study for such important attributes as housing, climate and police and fire protection. A comfort index was proposed to be used as a proxy for climatic conditions. The index would combine climatic factors such as wind, humidity and temperature. Because data were only available for some cities, the use of this surrogate was abandoned. Altitude may serve as a single measure for climate, but due to the "U" shape effect (extreme values are unconfortable) the use of this measure was not pursued further.

5) Spatial or flow characteristics

An attempt was made to capture the advantage of proximity to markets and sources of supply. For this purpose, the concept of flow characteristics was defined. Flow characteristics are those attributes of a city that reflect the accessibility to markets, ports, sources of inputs, etc. They are a composite of linkages among economic units and transportation costs. This group of variables is perhaps one of the most difficult to represent and measure.

In order to determine, the proximity advantage of a particular industry subsector, we used a spatial interaction model of the potential type. In this model, it is assumed that the greater the potential for interindustry trade, the higher the attractiveness of a particular location; and the more distant this interindustry activity, the lower the attractiveness of that location.

Seven models were developed. They reflect the agglomeration potential associated with:

1) Local inputs
2) Foreign inputs (imports)
3) Intermediate markets
4) Foreign markets (exports)

5 Domestic final consumers

5.1 Private consumption

5.2 Government consumption

6 The presence of manufacturing activity of the same industrial sector.

A summary discussion of the above-mentioned models is given in the following section while further details are presented in appendix D.

The agglomeration potential model

The "potential" concept may be thought of as a measure indicating the intensity of the possibility of interaction. The basic principles underlying potential models can be formulated as follows (Carrothers,[2]):

At a given location p, the potential influence, or possiblity of interaction with respect to an individual at p, which is generated by the attractiveness of any given point q, will be greater as the attractiveness of q is larger and will be smaller as the distance between p and q increases. Then according to this formulation, the accessibility of an origin p to attractions in the destination point q, can be expressed by the basic equation:

$$V^{pq} = \frac{KW^{q}}{T^{\alpha}_{pq}} \qquad (7.8)$$

where V^{pq} = potential at point p generated by the attractiveness of (or activity at) point q.

W^q = attractiveness of (or level of activity at) point q.

T_{pq} = transfer cost between point p and q.

α = transfer cost exponent. We have used α=2. (See further details on the section dealing with measuring the proximity to places in appendix D).

In our case the constant K is a scale factor which will depend on the industry subgroup being analyzed.

The potential model can also be formulated as a constrained gravity model (production constrained case). The gravity model is developed by analogy with Newton's Law of Gravitation expressed by the formula

$$F = G \frac{M_1 M_2}{d^2} \tag{7.9}$$

where F = force with which each mass pulls the other.

M_1, M_2 = size of masses concerned.

d = distance between them.

G = universal constant, the pull of gravity.

When the potential model is formulated as a production constrained case of the gravity model, the single constant K in equation 7.9 is replaced by a set of proportionality constants $K^{(1)}$ so that the constraint can be satisfied. For a comprehensive review and detailed presentation of spatial interaction models see Reif[3].

Since we are interested in the agglomeration potential of a point p taking into account the activity that takes place in all the points q that are part of the manufacturing spatial structure, we can generalize equation (7.8) by summing over all points q:

$$V^p = \sum_q \left(\frac{K\ W^q}{T^\alpha_{pq}} \right) \tag{7.10}$$

Equation 7.10 may be identified as the generic potential model that will be used in this study to determine the attractiveness of a location based on the flow characteristics. In order to simplify the notation, the superscript p will be dropped, since the potential will always be referred to a particular point p.

To give the reader an overview of how the generic model presented in equation 7.10 is used, the agglomeration potential model associated with local inputs will be briefly presented.

<u>Agglomeration potential associated with local inputs</u>

a) Level of activity:

In this model, the "level of activity" i at point q (W^q_i) can be expressed by the proportion of the national production of sector i that takes place at point q. Hence

$$W^q_i = \frac{X^q_i}{X_i} \tag{7.11}$$

where X^q_i = the level of production of sector i at point q.

X_i = the national level of production of sector i.

b) Interaction factor:

Since we are interested in backward linkages, we shall use as interaction factors, the Leontieff input-output technical coefficients. These coefficients are estimated as follows:

$$a_{ij} = \frac{X_{ij}}{X_j} \tag{7.12}$$

where a_{ij} = amount of inputs that industry j must purchase from industry i to produce one unit of its output.

X_{ij} = production of sector i sold to sector j.

X_j = total production of sector j.

In order to distribute the input requirements among the various sources, we shall assume that sector j can potentially purchase a certain amount from each point q and that other things being equal, the amount purchased might be proportional to the production of i at point q. Hence, in order to compute the purchases of input i, that sector j makes at point q, we have

$$M_{ij}^{q} = a_{ij} W_{i}^{q} \tag{7.13}$$

For the production of sector j, inputs are needed from various sectors i, which may have part of their production in the same point q. Hence

$$M_{j}^{q} = \sum_{i} a_{ij} W_{i}^{q} \tag{7.14}$$

where M_j^q = Amount of inputs that sector j purchases at point q.

c) Proximity to local sources:

Since we assume that as the distance from point p to the source q increases, the attractiveness of source q decreases, the probability of an actual purchase may be inversely related to the travel function, as expressed in equation 7.9. To estimate the attractiveness to sector j of point p, due to inputs located at point q, we have:

$$V_j^q = \frac{\sum_i a_{ij} W_i^q}{T_{pq}^{\alpha}} \qquad (7.15)$$

Hence, to estimate the attractiveness of point p to industry j, due to inputs located at all points q, we compute

$$V_j = \sum_q \left(\frac{\sum_i a_{ij} W_i^q}{T_{pq}^{\alpha}} \right) \qquad (7.16)$$

The technical coefficients, a_{ij}, tell us the relative importance in money value terms of the various industries i which are sources to industry j. These belong not only to the processing sector but to the payment sector as well; for example, payment of wages and taxes. Since our concern in this model is with the relative purchases that industry j makes from the various industries i belonging to the processing sector, we may neglect the factor payment sector and use only purchased goods and services. The purchase coefficients can be derived from the technical coefficients in the following way:

$$a_{ij}^{*} = \frac{a_{ij}}{\sum_i a_{ij}} \quad \text{for} \quad i = 1,2,\ldots k \qquad (7.17)$$

where a_{ij}^{*} = Purchase coefficient.

k = Number of industries in the processing sector.

In doing so, we will be able to compare not only the attractiveness, to industry j, of one geographical point against another point (which is the subject matter of the agglomeration potential model), but to also compare the attractiveness of point p to industry i compared to industry j.

Hence, equation 7.16 should be rewritten as:

$$V_j = \sum_q \left(\frac{\sum_i a_{ij}^{*} \; W_i^q}{T_{pq}^{\alpha}} \right) \qquad (7.16.a)$$

In terms of data requirements, the 1971 national input-output table (Conavial,[4]) was used to determine the technical coefficients. To the extent that production technology differs significantly on a regional basis, these national input-output coefficients are biased estimators. Provided elasticities of substitution between factors of production is not high, the input-output model will provide an approximation of the interlinkages among industrial sectors. The level of economic activity for each industry subgroup at three-digit ISIC code was measured by the bolivares value of output. The purchasing power was estimated by the population times the per capita income; and Government expenditures were measured by the operational budget of each state. To measure transfer costs between two cities, several variables are suitable: straight line mileage, road mileage, transport cost, etc. Based on data availability, travel time was selected (see appendix D).

6) General economic conditions

General economic conditions may represent an important set of locational factors. Some of them are:

Unemployment rates: The level of unemployment in a city can be indicative of economic conditions in that area. Actually, the change in unemployment rates from the long-term city average is often a better measure of economic conditions than the absolute level of unemployment, since systematic differences in unemployment rates prevail among towns (Carlton,[5]). The deviation in the unemployment rate from its long-term city average is used in this study.

Other measures that were obtained for each of the twenty cities are:

* Median household income
* Median per-capita income
* Number of private cars
* Number of wholesale employees

The cost of land for manufacturing activity as well as construction costs are expected to have strong locational implications. Factories that require large amounts of floorspace area are expected to go where these costs are lower. Furthermore, the availability of land for industrial use may also be an important determinant of location. Unfortunately, information on these factors was not available. Attempts to use as a proxy data on residential land and construction costs proved equally difficult, and data for only few cities were obtained.

7) Government incentives

Government incentives can be measured by a number of variables. Among them are financial and fiscal incentives, municipal tax holidays, etc. As indicated in chapter 5, data on financial incentives were obtained. Data on the other incentives were not available. In order to determine how much savings an entrepeneur could have made by locating in an area of deconcentration, a single indicator for the level of subsidy in each area was needed. This indicator had to combine into one measure subsidized interest rates, a market interest rate, loan period and a grace period. Furthermore, these aspects varied according to the use of the money: whether for land and construction, machinery and equipment, or for working capital. We selected a composite measure, as discussed in chapter 5, based on the concept of net present value, which reflected the percentage savings (in present value terms) obtained by an entrepeneur locating in each of the cities. For each of the components of the loan, e.g., machinery, working capital, etc., the present discounted value of the series of payments was calculated. This measure allowed us to combine both subsidized and market interest rates, as well as grace and loan periods.

7.4.b Firm's characteristics

Because the manufacturing sector is so varied, the number of possible characteristics for a firm is very large. (For example industry subgroup, number of employees, electricity consumption, capital/labor ratio, protection level, etc.). In this case we were constrained by data availability. Our recreated directories for 1974 and 1976, as well as the 1978 directory, were used to obtain some information about the new firms. The data for each firm included its five-digit ISIC code, its location and its level of employment. It wan not possible to obtain information on electricity consumption, production values, and other characteristics, for each of the firms, although this information could be obtained as an average for the surveyed firms.

7.5 Summary of chapter 7

In this chapter an attempt is made to describe the general form of a discrete choice model of location. The model begins with the example of an entrepeneur confronted with the problem of making a decision on where to locate a manufacturing plant. It is assumed that the decision will depend on the attributes of both the firm and the city. The model attempts to relate the variables of the cities to the locational choice of entrepeneurs. Then following are sections which discuss the issues related to the selection of the cities to be studied, as well as the data required to estimate the parameters of the model.

The measures presented in this chapter will be used in the specification of the utility functions defined in the next chapter. Table 7.1 presents a summary of the 2,255 measures for which data were collected.

TABLE 7.1

SUMMARY OF MEASURES FOR WHICH DATA WERE OBTAINED

No.	Description	No. of categories*
1	Percentage of the city labor force to its population. 2-digits, 1975 & 1977 (LFR).	20
2	Wage rate. 3-digit, 1975 & 1977 (WAGE).	20
3	Comparative cost of living index for food, drinks and tobacco, 1975 & 1977 (CST).	20
4	Working hours lost due to unexpected stoppages, 1975 & 1977 (STR).	20
5	Number of students enrolled in technical training courses per thousand inhabitants, 1975 & 1977 (TRN).	20
6	Number of employees in research institutes per thousand inhabitants, 1975 & 1977 (RES).	20
7	Water availability m^3 per inhabitants, 1975 & 1977 (WAT).	20
8	Percentage of population serviced with water, 1975 & 1977 (WPR).	20
9	Water cost, 1975 & 1977 (WCT)	20 & 4
10	Number of telephones per thousand inhabitants, 1975 & 1977 (PHN).	20
11	Number of telexes per thousand inhabitants, 1975 & 1977 (TLX).	20
12	Number of beds per thousand inhabitants, 1975 & 1977. (HSP).	20
13	Agglomeration potential associated with local inputs. 3-digits, 1975 & 1977 (LIP).	20
14	Agglomeration potential associated with foreign inputs. 3-digits, 1975 & 1977 (FIP).	20
15	Agglomeration potential associated with intermediate markets. 3-digits, 1975 & 1977 (INM).	20
16	Agglomeration potential associated with foreign markets. 3-digits (FOM).	20

TABLE 7.1-Continued

No.	Description	No. of categories*
17	Agglomeration potential associated with private consumption. 3-digit, 1975 & 1977 (PRC).	20
18	Agglomeration potential associated with government consumption. 3-digits, 1975 & 1977 (GVC).	20
19	Agglomeration potential associated with the presence of manufacturing industry of the same industrial sector. 3-digit, 1975 & 1977 (CMP).	20
20	Population, 1975 & 1977 (POP).	20
21	Number of inhabitants per doctor, 1975 & 1977 (DOC).	13
22	Number of 5-14 year old children per classroom (Primary school) 1975 & 1977 (CHC).	13
23	Number of 15-19 year old teenagers per classroom (Secondary school) 1975 & 1977 (EEC).	13
24	Primary school: teachers per classroom, 1975 & 1977 (PTC).	13
25	High school: teachers per classroom, 1975 & 1977 (HTC).	13
26	Primary school: number of students per classroom, 1975 & 1977 (PSC).	13
27	High school: students per classroom, 1975 & 1977 (HSC).	13
28	Public transport vehicles per thousand inhabitants, 1975 & 1977 (PTV).	13
29	Delinquent index (CRM).	13
30	Number of private cars per thousand inhabitants, 1975 & 1977 (CAR).	12
31	Number of wholesale employees per thousand inhabitants, 1975 & 1977 (WHS).	7
32	Median household income, 1975 & 1977 (FIC).	7
33	Per capita median income, 1975 & 1977 (INC).	7

TABLE 7.1-Continued

No.	Description	No. of categories*
34	Ratio of unemployment rate to the normal level of unemployment, 1975 & 1977 (ECC).	7
35	Unemployment by skills. 2-digit, 1975 & 1977 (UNS).	7
36	Number of professionals, technicians and related occupation per thousand inhabitants, 1975 & 1977 (TEC).	7
37	Number of managers, administrators and directors per thousand inhabitants, 1975 & 1977 (MNG).	7
38	Number of employees in the financial sector per thousand inhabitants, 1975 & 1977 (BNK).	7
39	Number of employees in services for establishments per thousand inhabitants, 1975 & 1977 (INS).	7
40	Number of retail employees per thousand inhabitants, 1975 & 1977 (RET).	7
41	Number of hotel and restaurant employees per thousand inhabitants, 1975 & 1977 (HOT).	7
42	Number of employees in entertainment and cultural services per thousand inhabitants, 1975 & 1977 (ENT).	7
43	Number of employees in transportation per thousand inhabitants, 1975 & 1977 (PTV).	7
44	Percentage savings in present value terms due to financial incentives, Corpoindustria (SFI).	4
45	Percentage savings in present value terms due to financial incentives, FCI (LFI).	4

* 20 means data by city
12 or 13 means data by state
7 means data by administrative region
4 means data by deconcentration area

SOURCE: Various. See appendixes C and D.

8 EMPIRICAL FINDINGS

8.1 Specification of the logit model

8.1.a Selection of the independent variables

As illustrated by the measures discussed in the previous chapter, there are many variables which may affect locational choice. In order to reduce the feasible set, we examined the statistical correlation among all the variables for which we had data. High correlations between variables of the same locational factor group was found, for example, between accessibility to local inputs and accessibility to final consumers. A possible explanation for this colinearity may be found in the strong linkages that the industries studied have with other industries, which in turn are located in highly populated areas associated with above-average income. (See chapter 4 for the criteria used to select the industrial subgroups). Furthermore, we also found colinearity between variables belonging to different factor groups (for example between services, amenities and economic conditions). It is not surprising to find that places with, say, high levels of financial services also have high levels of entertainment facilities and of income.

After a careful examination of the variables in terms of factors such as statistical correlation, existing empirical work (see for example Carlton,[1]), number of categories of the variable (see table 7.1), and reliability of the source (see appendix C), and relying heavily on the economic theory of location, the following variables were selected to represent each of the factor groups:

Labor conditions:	- Wages (WAGE)
	- Technical expertise (TEC)
	- Work stoppages (STR)
Support system:	- Percentage of population serviced with water (WPR)
	- Number of telephones (PHN)
Services, amenities and economic conditions:	- Number of doctors (DOC)
Flow characteristics:	- Agglomeration potential associated with local inputs (LIP)
	- Agglomeration potential associated with foreign inputs (FIP)
Government incentives:	- Financial incentives (FI)

The independent variables used are summarized in table 8.1.a. The variables are re-expressed as logarithms. The logarithmic transformation serves several purposes (Tufte,[2]):

1.- The resulting regression coefficients sometimes have a more useful theoretical interpretation compared to a regression based on unlogged variables (e.g. elasticities).

2.- Logarithmic transformation pulls the extremely large values in toward the middle of the scale and spreads the smaller values out in comparison to the original, unlogged values of the variable.

3.- Some of the assumptions underlying the regression model and the associated significance tests are better met when the logarithm of the measured variables is taken.

The variables representing the characteristics of a firm are interrelated with the characteristics of a city. See for example TWAGE (total firm's payroll) in table 8.1.a.

The first variable, U1, is a constant term in the utility function. This constant measures the so-called "pure alternative" effect, that is, the net effect of all attributes of an alternative which are not measured by the other variables. Since the city of Caracas is the location chosen by about 66% of the new manufacturing industries, it was decided to assign a dummy variable to this city.

The second variable, FI, represents the financial incentives of the industrial deconcentration policy. This measure was developed because there are a large number of elements that have to be considered, such as interest rate, grace and loan periods, uses of money: whether for land and construction, machinery and equipment, or for working capital. See

TABLE 8.1.a

INDEPENDENT VARIABLES USED IN THE LOGIT ESTIMATIONS

Variable		Definition
(1) U1	=	1 in the Caracas alternative; 0 otherwise
(2) FI	=	Percentage savings in present value terms due to financial incentives (log).
(3) TWAGE	=	Wage times number of employees in the firm (log).
(4) LIP	=	Agglomeration potential associated with local inputs (log).
(5) TEC	=	Proportion of the city's professionals, technicians and related ocupations to its population (log).
(6) STR	=	Average number of working hours lost per thousand workers, per year, due to unexpected stoppages (log).
(7) PHN	=	Number of telephone lines (installed capacity) per thousand inhabitants (log).
(8) DOC	=	Number of inhabitants per doctor (log).
(9) FIP	=	Agglomeration potential associated with foreign inputs (log).
(10) WPR	=	Percentage of the city's population serviced with water (log).

appendix C for a detailed presentation of this variable.

The third of these variables, total wage (TWAGE), represents the interaction between the prevailing wages of the city and the firm's number of employees. In other words, the variable represents the total payroll that each firm would have in each of the twenty cities. This interaction reflects the hypothesis that firms with large payrolls are proportionally much more sensitive to labor costs, than smaller ones. Furthermore, we may hypothesize that firms will tend to locate where wages are lower, hence, a negative coefficient would be expected.

Variable 4, agglomeration potential associated with local inputs, LIP, was designed to reflect the accessibility to local inputs that a firm might have, if it located in each alternative city. It is a composite variable reflecting not only industrial linkages, but also transportation costs. It is assumed that as the distance to a particular source of inputs increases, the attractiveness of that source decreases.

Due to the high correlation found between this variable (reflecting accessibility to local inputs) and the variables measuring accessibility to markets, we may argue that variable 4 (LIP) reflects accessibility to both local inputs and markets. We further hypothesize that the higher the agglomeration potential associated with local inputs and markets a city has, the more attractive it will be to an industrialist. A positive sign is expected.

The variable TEC reflects the hypothesis that entrepeneurs look for places where technicians and related professionals are available. This should be especially true for firms with a high level and proportion of skilled workers. We may expect a positive coefficient.

The variable STR reflects the hypothesis that entrepeneurs tend to locate their plants away from areas of high labor unrest. By measuring this variable in terms of the yearly average working hours lost per thousand workers, (due to unexpected stoppages), a negative coefficient is expected.

The seventh variable, PHN, reflects the effect of telephones on an industry's desire to locate in cities with appropriate telecommunication facilities. A positive coefficient may be expected.

Variable DOC measures the number of inhabitants per doctor. Since we may hypothesize that entrepeneurs will be more attracted to cities with better health facilities and assuming that lower number of inhabitants per doctor implies better health services, we may expect a negative coefficient. As indicated earlier, due to the high colinearity found between the amenities, services, and economic condition group factors, we may argue that this variable measures the locational effect of these three groups.

Variable 9, agglomeration potential associated with foreign inputs, FIP, was designed to reflect the accessibility to foreign inputs that a firm may have if it locates in each alternative. It is a composite variable reflecting the dependence on foreign raw materials and components, as well as the transport cost to international ports. It is assumed that as the distance to ports increases, the attractiveness of that port decreases. We may expect that the higher the proportion of imported components for local assembly, the closer the assembly plant will tend to be to international ports. A positive coefficient is expected.

The last variable used in the logit model, WPR, reflects the hypothesis that industries, --especially those which are high water consumers-- tend to locate where there is availability of water.

8.1.b Selection of the model specification

For any applied model of locational choice, however, the selection of an appropriate specification must include some experimentation with the data. It is, of course, important to avoid "mining" the data. In order to guard against this danger, all experimentation was done with the sub-sample of data for the period prior to the introduction of the financial incentives package. As will be seen in the reported results, this model fits the second sub-sample equally well. As indicated earlier, this study has relied heavily on the economic theory of location and existing empirical work in selecting an appropriate model specification and set of right-hand side variables.

Several distinct logit model specifications were estimated with data for the first period. These models correspond to different combinations of variables selected earlier. The details of five of the model specifications estimated are given in Table 8.1.b to give the reader a perspective on some of the results obtained. For each model, the t-statistics are given in parentheses below their corresponding parameter estimates. In addition, five summary statistics are given, defined as follows:

Sum of squared residuals at convergence: The unexplained variation.

Degrees of freedom: The number of available observations minus the number of constraints placed on the data.

Percentage correctly predicted

This summary statistic is a goodness of fit measure indicating the accuracy with which a model approximates the observed data, where accuracy is judged in terms of the ability of the model to forecast observed responses (Domencich and McFadden,[3]). The percentage correctly predicted shows the fraction of the observations for which the alternative with the greatest systematic component of the utility (when evaluated at the estimated parameters) was actually selected (Ben-Akiva and Lerman,[4]). Note that we do not expect this statistic to be 100% since some decision-makers may not choose the alternative that gives them the highest utility from the model's perspective. (Recall that utility is measured in terms of observable attributes, see appendix B).To give the reader an idea of how the percentage correctly predicted is calculated, an example is given below.

Let us suppose that we have a sample of 30 establishments and three alternatives: cities A, B, and C. The actual choices made by the 30

TABLE 8.1.b

PARAMETER ESTIMATES FOR THE 1975-1976 PERIOD FOR FIVE MODEL SPECIFICATIONS

Variable	Model specification No. 1	2	3	4	5
1 U1	.35 (.87)	-.95 (1.50)	-2.85 (2.71)	-3.04 (2.88)	-1.06 (1.75)
2 FI	.	.	.	.	.
3 TWAGE	-1.32 (2.90)	-.91 (1.93)	-1.42 (3.16)	-1.45 (3.21)	-1.47 (3.18)
4 LIP	1.12 (8.18)	1.16 (8.06)	1.36 (7.48)	1.29 (6.91)	1.09 (7.19)
5 TEC	1.90 (3.01)	3.20 (4.20)	3.26 (4.25)	3.41 (4.48)	2.71 (3.90)
6 STR	-.19 (1.99)	-.16 (1.52)	-.49 (3.69)	-.51 (3.68)	-.31 (2.77)
7 PHN		1.24 (3.21)		.76 (1.94)	1.15 (3.16)
8 DOC			-2.37 (3.52)	-.82 (2.46)	
9 FIP		-.50 (3.74)			
10 WPR	1.39 (1.83)		4.12 (3.28)	3.78 (2.83)	1.59 (1.73)
Sum of squared residuals	12350	19890	43820	40660	15300
Degrees of freedom	7157	7156	7156	7155	7156
Percentage correctly predicted	70.29	70.29	70.29	70.29	70.29
Likelihood ratio index	.5637	.5742	.5696	.5714	.5686
Likelihood ratio statistic	1273	1297	1287	1291	1284

Number of firms in the sample: 377

entrepeneurs are distributed in the following way: 15 firms selected city A, 10 firms chose city B and 5 industrialists selected city C. Table 8.2 present the prediction success table for this example.

TABLE 8.2

PREDICTION SUCCESS TABLE. AN EXAMPLE.

		Predicted A	Predicted B	Predicted C	
Actual	A	10	2	3	15
	B	3	5	2	10
	C	2	2	1	5
				Total	30

From the prediction success table we see that, for example, out of the 15 entrepeneurs which actually chose city A, the model correctly predicted only 10; the other 5 of these 15 firms were allocated by the model to cities B and C, i.e., 2 establishments to city B and 3 to city C. It can be seen that the diagonal of the matrix represents those specific firms for which the model predicted the alternative actually selected. The percentage correctly predicted is estimated by adding the numbers in the diagonal and dividing by the sample size, that is, (10 + 5 + 1)/30 = 53.3%

Note that in the example cited, the model predicted that a total of 15 firms would locate in city A, 9 in city B, and 6 in city C. The prediction success criteria, however, count as "correct" only the case when an individual firm does precisely as predicted, not when a group of firms on the average behave as anticipated. The success criteria is thus considerably more stringent than is found in the more common measures of statistical goodness of fit.

Likelihood ratio index

Is a goodness of fit measure indicating the accuracy with which a model approximates the observed data, where accuracy is judged in terms of the fit between calculated probabilities and observed frequencies (Domencich and McFadden,[5]).

The likelihood-ratio index, ρ^2, which can be used much as R^2 is in ordinary regression, is calculated by the statistic

$$\rho^2 = 1 - \frac{L^*(\hat{\beta})}{L^*(0)}$$

where $L^*(\hat{\beta})$ = The value of the log likelihood function at convergence, i.e., the maximized value of the log likelihood function.

$L^*(0)$ = This is the value of the log likelihood function when all the parameters are zero, or are zero except for coefficients of alternative dummies. (Constant term). Furthermore, the value of the log likelihood is evaluated such that the probability of choosing the ith alternative is exactly equal to the observed aggregate share in the sample of the ith alternative.

Clearly L^* will be larger when evaluated at $\hat{\beta}$ than when all the parameters are zero, i.e., when the explanatory variables are ignored. Intuitively, the greater the explanatory power of the independent variables, the larger $L^*(\hat{\beta})$ will be in comparison to $L^*(0)$. We note that $L^*(\hat{\beta})$ will be larger than $L^*(0)$ but for the multinomial logit, this means a smaller negative number so that $L^*(\hat{\beta})/L^*(0)$ will be between zero and one. The smaller this ratio, the better the fit of the model and hence, the larger 1 minus this ratio. Therefore, we use ρ^2 (rho squares) as type of pseudo-R^2 to measure the goodness of fit for the model (Hensher and Johnson,[6]).

According to Ben-Akiva and Lerman[7] "ρ^2 is analogous to R^2 used in regression, but it should be used with somewhat more caution. Values of ρ^2 will depend on the type of model being estimated. The measure is most useful in comparing two specifications developed on the exact same data."

Hensher and Johnson[8] refering to this statistic indicate that "It should be noted, however, that values of ρ^2 of between 0.2 and 0.4 are considered extremely good fits so that the analyst should not be looking for values in excess of 0.9 as is often the case when using R^2 in ordinary regression."

<u>Likelihood ratio statistic</u>

This is the standard statistic to test the hypothesis that all the parameters are zero. Under the null hypothesis it is asymptotically chi-square distributed with number of degrees of freedom equal to the number of parameters estimated. This statistic is defined to be:

$$2\left[L^{*}(\hat{\beta}) - L^{*}(0)\right]$$

where $L^{*}(\hat{\beta})$ = Value of the log likelihood function at convergence

$L^{*}(0)$ = Value of the log likelihood function when all the parameters are zero.

The higher the value of this statistic, the less likely it is that the parameters are zero.

The computer program used for the statistical analysis is QUAIL in its version 4.0. The multinomial logit procedure was developed by Daniel McFadden, currently professor in the Department of Economics, at MIT. The IBM version was coded by Jerry Berkman, Scott Luebking, Carlos Puig and Daniel Brownstone. The program was run at the MIT Computer Center using an IBM 370/168 computer. Usually, 1024 k of storage was used, although there were situations when 2048 k was needed.

Since financial incentives were not in effect during the first period, i.e., 1975-1976, this variable (FI) was not considered in the model specifications tested. Table 8.1.b shows that the parameters of the variables TWAGE, LIP and STR remain relatively stable across the five model specifications. This pattern held true in the estimation of alternative model specifications. Variable TEC was also found relatively stable in most of the specifications studied.

From table 8.1.b we can see that the parameter of variable 9 (FIP), the accessibility to foreign inputs, had the opposite sign from the one expected. As a matter of fact, almost all the model specifications tested had a negative coefficient for FIP. Since these findings were puzzling, a closer look was taken. When plotting the number of new establishments in a city against the city's distance to the nearest international port, we found that the bulk of new manufacturing activity takes place at a certain distance from the port: mainly between 30 and 100 minutes. After 100 minutes, it drops very fast. A possible explanation for this parabola-like curve may be the fact that we did not control for variables such as the availability of land for industrial use. It is possible that settlements closer to ports have topographical limitations for the location of industries. If this is the case, we can hardly expect manufacturing activity in these places.

Table 8.1.b shows that the parameters for the health services surrogate, DOC, although having the expected sign, are relatively unstable. This can be explained by the high correlation (0.62) between DOC and the proxy for telephone service, PHN.

To give the reader an idea of some of the aspects considered in the selection process of the model specification used in this analysis, we shall refer to the five models presented in table 8.1.b. For example, out of the five models, we may reject model 2 because of the unexpected sign found in variable FIP. Models 3 and 4 can be dropped because of high variation in the parameter values of the variable DOC. Having to choose, in this example, between models 1 and 5, we may disregard model 5 because it has one more variable than model 1 adding no additional explanatory power to the model.(Both have a likelihood ratio index of .56). Furthermore, the unexplained residuals are higher in model 5.(The sum of squared residuals is 15,300 in model 5 versus 12,350 in model 1). Hence, we select specification 1 in this example. As a matter of fact, specification 1 was selected out of all the specifications analyzed as the model to be used in this research. The likelihood ratio index of .56 for this model indicates that the overall goodness of fit is fairly good.

To analyze the data for the second period (1977-1978), variable FI (financial incentives) was added to the model selected (specification 1) and the parameters were estimated. The results appear in table 8.3.

Table 8.3 allows us to compare the results obtained by using this model with data from both the first period (1975-1976) and the second (1977-1978). Looking at the results presented in table 8.3, the model seems to be structurally stable over time: The sign of the coefficients are the same for both periods. Furthermore, the values of the coefficients are similar, except for WPR (availability of water) which shows a significant increase in the second period.

8.2 Analysis of the coefficients

The coefficients of all variables except the dummy variable associated with Caracas can be interpreted as the proportional change in the probability that results from a one percent change in the independent variable. For example, let the coefficient for water availability, WPR, be twice that of

TABLE 8.3

PARAMETERS ESTIMATES FOR 1975-1976 AND 1977-1978 FOR THE WHOLE SAMPLE OF THE SIX INDUSTRY SUBGROUPS

Variable	1975-1976	1977-1978
U1	.35	-.06
	(.87)	(.08)
FI	∘	.01
		(.31)
TWAGE	-1.32	-1.69
	(2.90)	(3.86)
LIP	1.12	.96
	(8.18)	(5.26)
TEC	1.90	1.41
	(3.01)	(1.50)
STR	-.19	-.21
	(1.99)	(1.91)
WPR	1.39	4.79
	(1.83)	(3.45)
Number of firms in the sample	377	118
Sum of squared residuals	12350	1914
Degrees of freedom	7157	2235
Percentage correctly predicted	70.29	52.54
Likelihood ratio index	.5637	.3683
Likelihood ratio statistic	1273	260.4

the coefficient for telephone services, PHN. A two percent increase in the level of service of PHN in city A will increase by certain amount the probability of a firm to select city A as its location. The same increment in probability can be obtained by enlarging city A's level of water service, WPR, by only one percent. Hence, we see in this example that WPR is two times more important than PHN as a factor of location. Therefore a direct comparison between coefficient magnitudes of different variables can reveal which factors exert the most influence in a new location.

Looking at table 8.3, we can see that the dummy coefficient for Caracas, U1, is subject to a wide confidence interval in both periods. It is possible that the net effect of all attributes of Caracas, which are not measured by the other variables, may be the most important in attracting new industry, but the data simply do not allow us to determine this effect with much precision. The opposite indeed might even be the case; i.e., Caracas may exert a negative effect. Some evidence of the latter is seen in table 8.1.b: in those cases where we have controlled for more variables, a negative coefficient for Caracas is obtained.

The coefficient of the financial incentives variable (FI) is very small and statistically insignificant. The failure of financial incentives to show up as an important influence on location is consistent with our previous finding in chapter 5.

Wage levels, especially when interacting with the number of employees, TWAGE, exerts a large influence on the location of industry. The coefficients are statistically significant in both periods.

The accessibility to both sources of local inputs and to markets, LIP, enters significantly in both periods. The coefficients are highly statistically significant.

Having a pool of technical expertise in the city, TEC, as measured by the proportion of the city's professionals, technicians and related occupations to its population seems to be an important factor of location.

The coefficient of the variable measuring work stoppages is not large but statistically significant in both periods, implying that entrepeneurs are concerned with locating their plants away from cities with high labor unrest.

The coefficient for the variable measuring water availability, WPR, increases more than three times in the second period. At the same time, it becomes even more statistically significant. A closer look at variable WPR in table 8.3 indicates two major issues. On the one hand manufacturing firms seem to be, in general, attracted to places with water availability. On the other hand, it is likely that during the second period, industrialists were more concerned with water, i.e., second period entrepeneurs were more sensitive to water availability.

Based on these sample results, without stratifying by industry subgroups, it seems reasonable to conclude that:

1) Wages are an important factor in explaining the location of industry.

2) The evidence provides little support for the proposition that financial incentives have exerted an effect on the location of manufacturing activity.

3) The accessibility to both local inputs and to markets exerts a large influence on the locational decision of a manufacturing firm.

4) The presence of technical expertise is likely to be important as a locational factor.

5) The more labor unrest a city has, the less likely is it to attract new manufacturing activity.

6) The availability of water exerts a large influence on the location of new manufacturing activity. Furthermore, during the second period of analysis, it seems likely that this variable exerted even more influence in the location decision of firms than during the first period.

8.3 Results stratified by industry subgroups

The results presented so far deal with the establishments corresponding to the six industrial subgroup studied, without stratifying by manufacturing sectors. It is important to ask, then, if these results would apply to each industry subgroup. *A priori* we may expect the importance of the attributes to vary among manufacturing groups.

Table 8.4 indicates the number of establishments (by industry subgroup and by year of foundation) to be used in our econometric analysis. It should be noted that the number of establishments considered is less than the total number of new establishments. The reason for this is that firms locating outside the choice set (the twenty cities selected) are not considered in the logit model.

TABLE 8.4

NUMBER OF ESTABLISHMENTS IN THE CHOICE SET BY INDUSTRY SUBGROUP AND YEAR OF FOUNDATION

	1975-1976		1977-1978	
	Considered	Omitted	Considered	Omitted
Textiles	68	14	23	3
Leather	47	5	14	3
Plastics	79	19	23	4
Non-electric machinery	71	16	24	9
Electric machinery	51	10	9	3
Transportation equipment	61	13	25	9
Total	377	77	118	31

SOURCE: - OCEI, Directorio Industrial, 1978.

- Recreated directories for 1974 and 1976.

In table 8.4 we see that the electric machinery subgroup had a sample of 9 establishments in the second period. Due to the small number of observations, it is unlikely that we can infer any meaningful conclusions from their analysis. Hence, results for the second period for the electric machinery subgroup will not be considered.

The rsults stratified by manufacturing groups are presented in tables 8.5 to 8.7. For the plastic industry, the maximum likelihood routine had difficulty converging when the WPR variable was included in the model specification for the 1977-78 period. Hence, in table 8.7 we present the results for the plastic industry related to the first period only. Nevertheless, in order to know the possible effects of the variables selected on the locational decision of the plastic industry, several other model specifications without WPR were analyzed. The results are presented in table 8.8.

8.3.a Wages (TWAGE)

We have indicated earlier that for the sample of industries without stratifying by manufacturing groups, wages seem to exert a large influence on the location of industry. When stratifying by industry subgroups, the wage coefficient for all six industries is always subjected to a wide confidence interval. (See table 8.5 to 8.7). Except for the plastic industry, the expected negative sign is obtained. In terms of effect, wages seem to be very important for leather, non-electric machinery and textiles industries. Furthermore, for the leather and the non-electric machinery industries, the coefficients in the second period are larger, possibly implying more sensitivity to this variable during the second period.

Recalling that our hypothesis proposes that less protected industries were more concerned with locational factors and that the economic "bonanza" of the first period may have distorted the true effects of the factors of location, we may expect, in general, values for the coefficients of the

TABLE 8.5

PARAMETER ESTIMATES FOR THE TEXTILES AND THE TRANSPORTATION EQUIPMENT INDUSTRIES FOR THE TWO PERIODS

Variable	Textiles 1975-76	Textiles 1977-78	Transportation equipment 1975-76	Transportation equipment 1977-78
U1	.05 (.02)	-.09 (.02)	-2.38 (1.78)	-.33 (.16)
FI	.	.04 (.38)	.	.04 (.25)
TWAGE	-2.66 (.88)	-2.54 (.79)	-3.31 (1.78)	.14 (.13)
LIP	1.42 (1.79)	1.36 (1.54)	2.00 (3.31)	1.23 (2.36)
TEC	4.69 (1.78)	2.21 (.51)	3.54 (1.85)	-.16 (.07)
STR	-.22 (.80)	-.09 (.31)	-.55 (2.12)	-.47 (1.68)
WPR	9.73 (1.37)	20.93 (1.66)	1.22 (.72)	6.88 (1.52)
Number of firms in the sample	68	23	61	25
Sum of squared residuals	795.7	267.7	929.4	465.1
Degrees of freedom	1286	430	1153	468
Percentage correctly predicted	86.76	78.26	44.26	52.0
Likelihood ratio index	.7685	.67	.3478	.3793
Likelihood ratio statistic	313.1	92.32	127.1	56.81

TABLE 8.6

PARAMETER ESTIMATES FOR THE LEATHER AND THE NON-ELECTRIC MACHINERY INDUSTRIES FOR THE TWO PERIODS

Variable	Leather 1975-76	Leather 1977-78	Non-electric machinery 1975-76	Non-electric machinery 1977-78
U1	5.26 (2.02)	-2.26 (.67)	1.26 (1.36)	-.20 (.13)
FI	.	-.16 (.99)	.	.15 (.97)
TWAGE	-2.66 (.73)	-12.23 (1.40)	-.86 (.49)	-2.26 (.94)
LIP	.66 (.95)	1.15 (1.10)	1.03 (2.89)	.96 (2.36)
TEC	1.01 (.30)	7.77 (1.32)	.90 (.43)	2.82 (.76)
STR	-.46 (1.57)	-.48 (.54)	-.26 (.80)	.10 (.26)
WPR	10.36 (2.32)	9.71 (1.76)	1.15 (.61)	4.09 (1.22)
Number of firms in the sample	47	14	71	24
Sum of squared residuals	803.1	190.6	1364	345.2
Degrees of freedom	887	259	1343	449
Percentage correctly predicted	87.23	57.14	73.24	29.17
Likelihood ratio index	.7891	.47	.5831	.2118
Likelihood ratio statistic	222.2	39.50	248.0	30.46

TABLE 8.7

PARAMETER ESTIMATES FOR THE PLASTICS AND THE ELECTRIC MACHINERY INDUSTRIES FOR THE PERIOD 1975-1976

Variable	Plastic	Electric machinery
U1	1.87 (2.22)	-.59 (.63)
FI	•	•
TWAGE	1.09 (.74)	-.42 (.17)
LIP	.45 (1.69)	1.40 (3.61)
TEC	1.51 (1.15)	1.20 (.54)
STR	-.11 (.51)	-.27 (.72)
WPR	-.93 (.60)	.42 (.21)
Number of firms in the sample	79	51
Sum of squared residuals	1727	764.8
Degrees of freedom	1495	963
Percentage correctly predicted	74.68	52.94
Likelihood ratio index	.5889	.4428
Likelihood ratio statistic	278.7	135.3

TABLE 8.8

PARAMETER ESTIMATES FOR 1977-1978:

FOUR MODEL SPECIFICATIONS FOR THE PLASTIC INDUSTRY

Variable	Model specification A	B	C	D
U1	67.32 (2.74)	69.26 (2.65)	70.71 (2.65)	67.08 (2.66)
FI	7.30 (2.78)	8.21 (2.76)	7.11 (2.80)	7.52 (2.78)
TWAGE	1.57 (.93)	3.07 (1.45)	-1.32 (.29)	.03 (.00)
LIP	2.70 (2.52)	2.57 (2.27)	3.18 (2.31)	3.40 (1.78)
TEC	3.70 (1.07)	9.94 (2.04)	2.63 (.68)	7.81 (1.55)
STR	-1.33 (1.81)	-1.57 (1.90)	-1.32 (1.64)	-1.73 (1.51)
PHN		4.75 (1.39)		6.38 (1.15)
DOC			5.70 (.77)	7.70 (1.06)
Number of firms in the sample	23	23	23	23
Sum of squared residuals	168.1	95.92	159.8	87.13
Degrees of freedom	431	430	430	429.0
Percentage correctly predicted	60,87	52,17	60,87	52,17
Likelihood ratio index	.5736	.6055	.5793	.6150
Likelihood ratio statistic	79.04	83.44	79.83	84.75

less protected industries to be larger during the second period (expected behavior). This is to say that, during the second period, entrepeneurs of less protected industries are hypothesized to have searched more carefully for places that will give them advantages in terms of reducing costs and increasing revenues.

Table 8.9 shows the pattern of association between the protection level and the expected behavior for wages. The plastics and the electric machinery industries are not considered because of the limitations indicated earlier.

In table 8.9 as well as in the following ones, an industry subgroup is classified as having a low level of protection when its effective protection is below 80 percent, and classified as having a high level when is above 130 percent (see Fig. 4.2 as well as the World Bank[9] report, cited earlier).

TABLE 8.9

PATTERN OF ASSOCIATION BETWEEN PROTECTION LEVEL AND EXPECTED BEHAVIOR FOR WAGES

		Expected Behavior (larger TWAGE coefficients in second period): Yes	Expected Behavior (larger TWAGE coefficients in second period): No
Protection	Low	Leather Non-electric machinery	
	High		Textiles Transportation equipment

Table 8.9 indicates that less protected industries (as expected according to our hypothesis) were more sensitive to wages during the second period. It should be stressed that even if plastics and electric machinery industries are considered, these conclusions hold. This finding gives additional support to our hypothesis that protection for manufacturing activity may supress the entrepeneur's interest for locating in low wage areas.

8.3.b Access to both local inputs and markets (LIP)

The coefficients for the variable measuring access to both sources of local inputs and markets (LIP) are usually important for all the six manufacturing groups, although variations exist. (See tables 8.5 to 8.7). In the transportation equipment, plastics and electric machinery industries this variable seems to have important effects. Furthermore, coefficients for transportation equipment, non-electric machinery and electric machinery are statistically significant. This is also true for the plastic industry, especially in the light of the four model specifications that appear in table 8.8.

8.3.c Technical expertise (TEC)

When stratifying by industry subgroups, the technical expertise variable seems to exert influence on each of the six manufacturing sectors. The coefficients had a wide confidence interval (primarily during the first period) except for textiles and transportation equipment industries. From table 8.5 we can see that textiles and transportation equipment industries behave in an unexpected way, by lowering their coefficient during the second period. Table 8.6 on the other hand, indicates that leather and non-electric machinery industries have larger coefficients in the second period, i.e., shows the expected behavior.

Table 8.10 shows the pattern of association between the level of protection and the expected behavior for technical expertise.

TABLE 8.10

PATTERN OF ASSOCIATION BETWEEN PROTECTION LEVEL AND EXPECTED BEHAVIOR FOR TECHNICAL EXPERTISE

		Expected Behavior (larger TEC coefficients in second period): Yes	No
Protection	Low	Leather Non-electric machinery	
	High		Textiles Transportation equipment

Table 8.10 gives us additional evidence to support our hypothesis that less protected industries in the second period were more concerned with locational factors, i.e., the values for the coefficients of the less protected industries during the second period are larger than the values for the first period.

A possible complementary explanation as to why some industry subgroups have unexpected behavior in terms of technical expertise could be that it may be better to take the necessary technicians with the firm --and to pay whatever amount is required-- rather than to locate in places where technical expertise is available but where other locational factors are not present. This additional cost is a burden that can be absorbed by an establishment. Nevertheless, this additional expense is more easily absorbed by high profit firms which usually are highly protected.

8.3.d Labor unrest (STR)

The coefficient for the variable measuring labor unrest is usually small and subject to a wide confidence interval except in the transportation equipment industry where it is statistically significant. A possible explanation for the high significance (although low value) of the parameter STR in the transportation equipment industry may be that this sector include the assembly of motor vehicles and the specialized manufacture of motor vehicle parts. Workers in this manufacturing sector are generally better organized. The existence of labor organizations within this industry makes the transportation equipment sector more prone to be involved in labor conflicts. Locating the plants away from areas of high labor unrest may be perceived by entrepeneurs as a measure to reduce the probability of unexpected stoppages.

8.3.e Water availability (WPR)

Plastics and electrical machinery industries seem to be little affected by the proxy for water availability. The coefficient for this variable is quite large for the other four manufacturing industries studied. Furthermore, with the exception of the leather industry, for which the coefficient in the second period remains stable, the parameters for the other three industry subgroups increased drastically during the period 1977-78. Again, we may argue that this increase in importance placed on water availability as an important locational factor may be due to an awareness by second period entrepeneurs.

A possible explanation of why the coefficient for water availability remained unchanged during the second period for the leather manufacturing sector, can be found by analyzing the ISIC 323 code. This code comprises the manufacture of leather and products of leather (see table 4.12). It includes tanneries and leather finishing as well as fur dressing and dyeing industries. According to Fair and Geyer[10] high-quality water is required for this industry subgroup. Hence, water is a crucial input to their production, and it is unlikely that first period entrepeneurs would have overlooked its importance. Hence, water availability was seen as equally important to leather industrialists during both periods.

8.3.f Caracas dummy (U1)

As indicated earlier, the net effect of all attributes of Caracas which are not measured by the other variables are reflected in the dummy variable for the city of Caracas (U1). Among the attributes which are not measured by the other variables are those diseconomies related to congestion, land cost and control over location. But there are factors, such as access to the bureaucracy, which should continue to work in favor of Caracas.

According to our hypothesis, we may expect that the contribution of Caracas *per se* to the utility function of less protected firms would diminish as time passes because of increases in diseconomies. Although for highly protected industries the disadvantages of Caracas as a location also increases as time passes, this effect may be offset, for example, by the increasing fear that protection will be removed (a likely event for textiles today) or by looking for additional benefits such as those related to the local content regulation (see chapter 3), both issues makes Caracas more attractive. According to the World Bank[11] study cited earlier: "Regulations are best known in the automobile industry, which throughout Latin America has been developed under a schedule of increasing local content requirements. The Venezuelan automobile industry is no exception to this general pattern." Hence, this behavior, i.e., large negative effects in the second period can not be expected for highly protected industries since it is likely that nearness to government is an advantage that counteract the disadvantages of locating in Caracas.

Table 8.11 shows the pattern of association between the level of government protection and the expected behavior for the Caracas variable.

It may be argued that not necessarly, as time goes by, Caracas was perceived by entrepeneurs as offering larger diseconomies. It is likely that the larger negative effects observed in the second period, represent a return to the historically perceived situation which had been distorted by the sudden economic changes occurred in 1974. Unfortunately, the effect of control over location, as a diseconomy, can not be separated here from other diseconomies such as congestion or land cost.

TABLE 8.11

PATTERN OF ASSOCIATION BETWEEN THE LEVEL OF GOVERNMENT PROTECTION AND THE EXPECTED BEHAVIOR FOR THE CARACAS VARIABLE

		Expected Behavior (larger U1 negative effect in second period)	
		Yes	No
Protection	Low	Leather Non-electric machinery	
	High		Textiles Transportation equipment

8.3.g Financial incentives (FI)

From table 8.5 and table 8.6, we can see that the coefficients on the variables measuring financial incentives are sometimes negative, always very small and usually statistically insignificant. It should be noted that these results can not be extended to the electric machinery and plastic industries. As indicated earlier, the sample of firms locating within the sample location set for the electric machinery industry subgroup is composed of only nine observations. As such, it was decided that conclusions for the electric machinery industry based on this limited number of observations should not be considered.

For the plastic industry we should also recall that the maximum likelihood routine had difficulty converging with the WPR variable in the model specification for the period 1977-78. However, several other model specifications (without WPR) were analyzed for the plastic industry and the results for four of them are presented in table 8.8. A careful analysis of the coefficients for the variable FI in table 8.8 shows that for the plastic industry, the financial incentive variable enters in all four specifications --A, B, C and D-- with a large coefficient which is significant by the standard statistical criteria. From these results, we may argue that for the plastic industry, financial incentives exerted a substantial effect on locational decisions. We might also argue that one positive result may be simply a sampling accident. On the assumption that it is not, however, we may offer the following explanation for this unique pattern of responsiveness, based on interviews with entrepeneurs. The explanation in question can be found by analyzing the nature of the ISIC 356 code (see table 4.12). This code includes the moulding, extruding and fabricating of plastic articles. A typical factory has few employees, requires relatively small floor space and is composed of one or two machines which process the raw material. The basic component of the machine is the mold which determines the end product, as for example, a fork, a plate or a syringe. For each product manufactured, a different mold is usually needed. The mold comprises a high proportion of the machine cost.

The relatively ease in which a factory of plastic products is set up (disregarding quality issues) contributed to the growth of this manufacturing sector. During the first period, 79 new establishments were created, out of which 59 located in Caracas. By the second period, private financial institutions apparently become more aware of the risks involved in giving loans to this manufacturing sector due to the proliferation of many plastic factories. Furthermore, the low flexibility of the plastic machinery may have contributed even more to this perception. In other words, in case of bankruptcy, a bank would have to take over the plant and sell it; the prospective buyer would have to be interested in producing the same sort of products as the previous owner, unless additional costly investments in molds were made. Since it is possible that the earlier owner went bankrupt because of the high competition that his/her products had, the total operation seems to be a risky one. As a conseuquence, during the second period, it is likely that private financial organizations were reluctant to give loans for plastic products manufacturing plants.

Under these conditions, an industrialist wishing to set up a plastic industry may well be pushed into applying for a loan to a government financial institution. According to the policy of industrial deconcentration, entrepeneurs may benefit from government loans provided they go to the designated areas. Hence, some industrialists reacted favorably to the financial incentives of the policy by locating in the areas of deconcentration. It is likely that some of these entrepeneurs selected locations in the area of deconcentration closest to Caracas (BM). By doing so, they in effect remained close to the industrial axis, i.e., did not deconcentrate.

8.4 Summary of chapter 8

This chapter describes the estimation results for the logit model described in chapter 7. After selecting the main independent variables to be tested, several model specifications were analyzed, and model specification 1 was selected. This model specification uses as independent variables the following attributes: financial incentives, total wages, accessibility to both local inputs and markets, technical expertise, labor unrest and water availability. A dummy variable for Caracas was also introduced. The parameters of the model were estimated with data for the period 1975-1976 for the six industry subgroups without stratifying by manufacturing sectors. The likelihood ratio index of .56 indicates that the overall goodness of fit is relatively good. When using the model with data for the period 1977-1978, it seems to be structurally stable.

Among the main conclusions that can be drawn from the analysis of the model (without stratifying by industry subgroups) are the following:

1) The existing financial incentives seem to have no effect on the locational decisions of manufacturing firms.
2) Wages, accessibility to both local inputs and markets, presence of technical expertise, and water availability seem to exert a large influence on the location of new manufacturing activity.
3) Labor unrest seems to be considered by entrepeneur a factor of location, although its importance is relatively limited.

As expected, when the parameters are estimated after stratifying the data by industry subgroups, the variables differ in relative importance. Table 8.12 shows which variables are important by manufacturing sector.

TABLE 8.12

IMPORTANT VARIABLES BY MANUFACTURING GROUP

	Textiles	Transport equipment	Leather	Non-electric machinery	Plastics	Electric machinery
FI					X	
WAGE	X	X*	X	X		
LIP		X			X	X
TEC	X	X*	X	X	X	X
STR						
WPR	X	X	X	X		

* Important only during the period 1975-1976.

An unexpected finding is that financial incentives seem to be an important locational factor for the plastics industry. Nevertheless, from the point of view of deconcentration, this manufacturing group remained close to the industrial axis, i.e., deconcentrated little if at all.

Our hypothesis that less protected industries are more concerned with locational factors is supported by the general pattern of results.

The development of this model is an effort to identify the locational factors that affected the locational decisions of firms. The question of alternative explanation factors, arose as a consequence of having found little or no evidence that government incentives had an effect on a firm's locational decision (see chapter 5). With this model, it was possible to test once more the insignificant weight that entrepeneurs attached to government financial incentives. The model developed in this chapter does not claim to represent accurately the complex set of locational factors that goes into the locational decision process. It only attempts to point out some of the locational factors (for which data were obtained) that decision-makers seem to consider when choosing a location. Fortunately, some of them may be subjected to control by policy-makers. It should be noted that it is likely that a lot still can be learned from examining the behavior of firms for which the percentage correctly predicted is low.

The next chapter will attempt to indicate some possible implications of these findings for policy making, as well as some recommendations for future work.

PART IV: APPRAISAL

9 Conclusions

9.1 Summary of findings

In 1974, the Venezuelan government, concious of the socio-economic problems caused by the concentration of activities in the north-central area as well as the limited amount of economic activities in the lagging areas, decided to intervene in the spatial distribution of the country's manufacturing industry. A series of presidential decrees was issued giving legal framework to the policy of industrial deconcentration. Although very little time has elapsed since the promulgation of the policy of industrial deconcentration, several reports have already been written attempting to evaluate the policy. There seems to be little or no agreement so far as to the results. A report prepared by the Ministry of the Environment (Ministerio del Ambiente,[1]) claims that the pattern of behavior of the entrepeneur is changing. On the other hand, a document prepared the same year by the National Planning Office (Cordiplan,[2]) indicates that the policy has merely accentuated existing tendencies towards concentrating manufacturing activity in Caracas and its surroundings.

This current research was initiated to address this controversial issue and to attempt an "early understanding" of the possible consequences of the policy. As indicated in chapter 2, the answer to the main question: Have government instruments (both incentives and restrictions) contributed to the deconcentration of industry? requires answers to the following more specific questions:

<u>Issue 1</u> Has deconcentration of industry indeed taken place?

<u>Issue 2</u> Is any such deconcentration a result of the policy instruments applied?

<u>Issue 3</u> What have been the other factors influencing industrial location and what has been their relative importance?

The first question is analyzed in chapter 4. Results using stratified data at three-digit level gives some evidence that the leather, non-electric machinery, as well as electric machinery manufacturing groups, have deconcentrated their locations during the period 1977-1978. The others industrial groups studied, textiles, plastics and transportation equipment, seem to have had no major changes in their relative location. It should be noted that although some deconcentration occurred, the industrial axis usually continues to be the preferred location for a large number of new industrial activities.

Question 2, discussed in chapter 5, deals with whether or not deconcentration is a result of the policy instruments applied. From the results obtained, there seems to be little or no evidence that changes in the spatial pattern of industry are related to the application of government instruments. In spite of the fact that information is generally not available on fiscal incentives, their value is probably insignificant when compared to the profits of the manufacturing industry in Venezuela. It is, therefore, unlikely that they have had any effect on location decisions. Furthermore, interviews with industrialists showed no evidence to support the opposite view.

Control over location, i.e., negative incentives, does not seem to have been applied effectively during the study period.

From the financial incentives point of view, the nearly stable trend in development region's share of credit does not support the hypothesis that these incentives influenced the location of new firms. Results obtained by econometric analysis further support this conclusions.(See chapter 8). Nevertheless, when the logit model was applied to the data stratified by industry subgroups, the plastics manufacturing sector seemed to react significantly to financial incentives. It is interesting to note that although the plastic industry reacted strongly to financial incentives, it did not deconcentrate; i.e., new plastics manufacturing plants continued to locate in or close to the industrial axis during 1977-1978 in proportions similar to those of the period 1975-1976.

Having found some evidence that a group of manufacturing industries indeed had a tendency to deconcentrate and, furthermore, since little or no evidence could be uncovered at the aggregate level to support the supposition that changes in the spatial pattern of industry were related to the application of government instruments, we asked ourselves why some deconcentration in fact occurred. In other words we addressed question 3:

What have been the other factors influencing industrial location and what has been their relative importance?

In answer to this question, it was hypothesized in chapter 6 that changes in the economy occurring in 1974 had two major effects on the Venezuelan manufacturing environment. On the one hand these changes gave rise to a large number of new manufacturing firms, most of which were more concerned with satisfying the sudden increase in demand. This resulted in a short-run, commercial or opportunistic approach, rather than a long-term approach or industrial viewpoint. On the other hand, the sudden increase in the number of manufacturing establishments further aggravated the existing problems in the industrial axis created by the already saturated and unsatisfactory physical and social infrastructure. By the second period, i.e., 1977-1978, the economy moved towards more of an equilibrium in terms of supply and demand for nationally manufactured products. As a consequence, most of the new firms created in this second period were headed by industrial-minded entrepeneurs. They were aware of the problems in the congested industrial axis and were more conscious about production costs.

Second period industrialists were more likely to carefully weigh the advantages and disadvantages of locating in the traditional industrial axis. Some less protected industries considered it more profitable to locate their new plants away from the industrial axis. Others --for example the small highly protected industries-- may have considered that closeness to the government's decision making center remained a crucial factor. They could argue that the exonerations, licences and other benefits received as incentives outweigh the disadvantages of locating in the industrial axis. Furthermore, the percentage savings that they obtain by locating outside the congested industrial axis can be very small when compared to their profit rates. So, they continue to concentrate.

Evidence to support this hypothesis was obtained from several sources, including interviews with industrialists. It was found that less protected industries seem to deconcentrate while highly protected ones do not. Furthermore, the statistical results obtained give us additional evidence, i.e., the coefficients on the variables representing the factors of location are usually found to be larger during the second period of analysis than during the first period. This is true for less protected industries, implying changes in the industrialist's sensitivity to traditional locational factors. By interviews with industrialists, anecdotal evidence to support this hypothesis was obtained.

Some researchers, for example Gilbert[3], argue that "In many ways, it may be suggested that industrial location is not a matter that is decided on the basis of detailed investigation. Most new companies, excepting some of the large foreign corporations, seem not to make studies of alternative sites and base their decisions on more subjective grounds." In a sense, the results obtained in this study show that entrepeneurs in Venezuela may be basing industrial location decisions on more investigation than is usually thought. This is especially true for less protected industries.

The results of the logit model indicates that for the sample studied (before stratifying by industry subgroups):

(1) Wages, accessibility to both local inputs and markets, presence of technical expertise and water availability seem to exert a large influence in the location of manufacturing activity.

(2) Labor unrest seems to be considered as a factor in location by entrepeneurs, although its importance is relatively small.

(3) As expected, the relative importance of the variables changes according to the manufacturing sector considered. This was determined once the sample was stratified by industrial subgroups. (See table 8.12 for details).

The findings summarized so far, should be interpreted in the light of two major limitations. On the one hand, there is a limitation imposed by the very short period that has elapsed since 1974 when the first presidential decree relating to industrial deconcentration policy was issued. On the other hand, the data base of this study cannot be accepted without the standard caveats. Therefore, the results must be considered tentative. Hence, this research attempts to make cautious conclusions on the basis of admittedly fragile ststistics as well as to indicate a methodological approach by which more accurate estimates can be done in the future. The study also shows that it is feasible to use disaggregate models in the context of some developing countries.

9.2 Policy implications

We want to stress again what was indicated at the beggining of this study, namely that in Latin American countries as well as in many other countries, policies aimed at the regional dispersal of industry have a long history. These countries have chosen deliberately to plan and promote the process of deconcentration under the expectation that industrial activity will otherwise concentrate further if left to the vagaries of the market forces. For example, the first country in Latin America to adopt financial incentives was Mexico (Gilbert,[4]) when, in the 1930's, several states bordering on the United States were granted concessions from import duties. Other countries such as Brazil, Argentina and Chile also had a long experience with policies of industrial deconcentration. (United Nations,[5]). In spite of the richness of the experiences available, it seems that too little attention has been given to learning from the mistakes of others.

In order to discuss the policy implications of the findings in this study, the following suggestions expressed by Rodwin[6] are used as a framework. Rodwin indicates that an effective urban growth strategy presupposes the existence of:

(1) a stable government;

(2) some intelligence mechanisms to analyze problems and suggest roles which the government should play;

(3) some central power over the principal incentive and control mechanisms, including those affecting the allocation of capital; and

(4) a relatively efficient civil service.

We will address each of these components in turn:

9.2.a Stable government

We may certainly assume that the first condition exists in Venezuela. Unlike most of the governments in Latin America, the Venezuelan government faces a stable situation, and there is no reason whatsoever to think that conditions will change.

9.2.b Intelligence mechanisms

In Venezuela, the responsability to formulate the guidelines for regional development is in the hands of the National Planning Office (Oficina Central de Coordinación y Planificación, Cordiplan). The task of designing policies, strategies and instruments is one of the most difficult ones. It is important at this point to stress again an important problem indicated by Rodwin[7]: "...the problem of the level of intellectual capital. It is debatable whether we know enough about urban growth strategies either to deal with them effectively or to secure the necessary understanding early enough to avoid doing more harm than good."

Two issues may be addressed here:

(1) When designing policy instruments, we tend to assume that we know how the system works, and hence, how the instruments will direct the behavior of the system toward our desired goals. But the socio-economic system is a very complex one. We know very little about how the system really operates. Hence, we should not be surprised when

our policies have not worked. For example, when designing the Venezuelan policy instruments, it was assumed that the financial and fiscal incentives given were large enough to overcome the cost disadvantage of not locating in the preferred area. This study has suggested that this assumption may be challenged. Furthermore, the system is so complex that unexpected results were obtained, such as the strong favorable reaction of the plastic industry to financial incentives which, however, did not accomplish the objective of deconcentration.

(2) In addition, the societal system is a dynamic one. It constantly tries to adapt to external and internal stimuli. This implies that when the system is affected say, by the policy instruments, the system attempts to adapt to the new stimulus, i.e., the system will try to find ways to respond to the stimulus, avoiding undesired situations. An example of this is found in those small industries which were not allowed to locate in Caracas. Those entrepeneurs affected by this policy may have camouflaged their plants as service or retail establishments to avoid this situation.

These two issues suggest that we need a proper administrative machinery within the government intelligence mechanism that could closely monitor the system that it is trying to direct. This machinery should have two important properties:

(1) capable of learning, especially from its own mistakes; and

(2) capable of reacting reasonably promptly to the ever-changing conditions.

A pre-condition for reacting is that some signal should be received and compared with the desired goals. Hence, the control mechanism should constantly monitor how the system behaves and follow very closely the consequences of policy instruments.

This study may be considered as an "early signal" as to the behavior of the system. Under the assumption that the findings of this research will contribute to the learning property of the intelligence mechanism, recomendations for immediate reaction in the following areas are suggested:

Level and type of incentives: The econometric model developed in this study allows us to explore alternative policy measures and their impact on the locational decision of firms. The model predicts the probability that an entrepeneur will select a particular city. For example, if, for firms of a particular industrial subgroup, the model indicates a probability of 0.3 that a firm will locate in city B, this implies that we can expect 3 out of 10 future new firms, to select city B. If, however, the goal is that 5 instead of 3 new firms select city B, the model will indicate the percentage saving that should be given (as financial incentives) to industrialists so as to increase to 0.5 the probability of selecting city B. Furthermore, we can study the trade-offs between subsidizing industry vs. subsidizing infrastructure. For example, it may be possible to obtain the same response from industrialists by improving the water supply system (which also benefits the city's population) as by offering direct subsidies to entrepeneurs; or by a combination of both. In any case, the model will suggest the required level of service of the locational factors considered to achieve a particular locational objective.

As indicated in chapter 8, the model developed in this research does not claim to represent accurately the complex set of locational factors that goes into the locational decision process. It only attempts to point out some of the locational factors (for which data were obtained) that decision-makers seem to consider when choosing a location and which may be subjected to control by policy-makers.

Compatibility of objectives: Almost all economic and social policies have an implicit urban impact, though many of these impacts are frequently ignored as well as unintended. It is not only a problem to recognize and identify these implicit impacts, but the problem is complicated by the fact that the spatial consequences of policies may be internally contradictory. For example, we may argue that in Venezuela, there is a conflict between the policy of industrial deconcentration (spatial policy) and the industrial development policy (economic policy). By granting high protection to spur industrial development, it is likely that the effect of traditional locational factors is distorted and that this may in fact give rise to concentration, i.e., to the opposite objective of the spatial policy. It seems that Venezuelan policy-makers, when designing the industrial deconcentration policy, guarded themselves against contradictions among explicit spatial policies but probably neglected or were unaware of the contradictions between the explicit spatial measures and the implicit economic strategies.

There is no simple solution to these problems. One necessary first step is to identify as many of the consequences as possible both explicitly and implicitly of all policies in order to ascertain whether there are contradictions between them and to determine how serious they are and whether or not they can be avoided. The important point is not to try to eliminate all the spatial implications of non-spatial policies, for that would be impossible, but to be aware of them and to avoid wasteful expenditures of resources and effort in implementing contradictory and self-defeating measures. Nevertheless, in terms of the existing policy of industrial deconcentration, it is recommended that the level of protection, as well as the means by which national industry is promoted through protection, should be revised. A useful guide for this purpose could be the World Bank[8] study cited earlier.

The spatial framework: It is recommended that the spatial framework of the policy be revised. For example, it is not clear why the area of deconcentration BM surrounding the Metropolitan Area of Caracas should receive incentives. Considerations should also be given to interrelating the spatial aspects of the policy of deconcentration (mainly the deconcentration areas) with the economic aspects of a region such as its comparative advantage. The region's comparative advantages should not only be seen in terms of inputs, such as the availability of specialized labor force or raw materials, but also in market terms, such as the possible implications of the Andean Common Market, i.e., trade with neighboring countries.

Monitoring: It is recommended that the statistical foundation for industrial policy be improved. Among the different aspects that should be considered, we suggest that inmediate steps be taken to assign a unique identification number to each manufacturing plant. Furthermore, measures should be taken to see that a copy of the industrial directories elaborated yearly, is preserved.

9.2.c Central power

This third assumption is a little more difficult to envisage. Although the political institutions may have the legal power to enforce the policy instruments, the complex relationship with the economic institutions (characteristic of a mixed-economy) lessens this legal power. This is an issue that has generally been underestimated and we want to stress again what was indicated by Gilbert[9]:

> "In several Latin American countries, political conditions have allowed governments to implement policies aimed at the regional dispersal of industry. But, in general, these policies have employed rhetoric rather than action, and only in Chile, Brazil, Cuba and Puerto Rico have any major changes been made in the regional distribution of industry. Even in these countries government action has only slowed the tide towards a highly localized spatial

distribution and not reversed it. Such a situation has not arisen because governments lacked suitable tools for dispersal, for a variety of methods have been employed. Rather, it seems as if the political will to implement these methods is the element that was lacking."

Within the realm of central power issues, an additional aspect that should be considered is related to coordination among the various government entities.

The implementation of the policy of industrial deconcentration requires the participation of many government institutions and the coordination of their activities is likely to be one of the greatest challenges that any government may face. It is extremely difficult, for example, to get financial agencies, as well as other branches of the government such as housing, health and education, to follow the priority deconcentration areas indicated by the policy and to coordinate their efforts toward the improvement of the designated growth centers.

We should note that when dealing with institutional arrangements, it is not only important to describe the administrative machinery, but also to distribute decision powers over different policy instruments. A particular guide in allocating decision powers to different levels of government is the rank of a policy instrument (United Nations,[10]). The rank of a policy instrument may be determined on the basis of:

time dimension: the longer the effective period of influence, the higher the rank of the instrument.

spatial dimension: the larger the area of influence (territorial unit), the higher the rank. Thus, those instruments that affect the nation as a whole, such as nation-wide subsidies or credits, have the highest rank.

There should be a closer correspondence between the rank of a policy instrument and the rank of the authority that controls the instrument. In practice, for example, national entities such as the Ministry of Development should not exert control on instruments such as the prohibition to locate in Caracas. This activity should be left to local authorities.

9.2.d Civil service

The final assumption,that of an efficient civil service, again deserves some consideration. Under normal circumstances, we might expect to have good professionals in both private and public sectors. But, due to the special circumstances which the country faces, there has been a "brain-drain" from the public sector into the private one. Therefore, precautions should be taken to try to equalize this imbalances in human resources. To this should be added the fact that in most LDCs, the professionals are generally concentrated in the core region, and few have received appropriate advance training.

This limitation, for example, is particularly noticeable in the number of industrial projects for which financial incentives were given but which were economically unfeasible. One possible reason projects of this sort were able to obtain government financial support may be traced to the inability of some government officials to appropriately evaluate a project.

9.3 Future work

In the immediate future, there is clearly a great need for development of scientific attitudes and growth of fundamental theory in industrial location together with a need for more and better organized data. More information about the relationships between the different elements of a firm's locational decision, as well as theoretical and model specification improvements, are necessary in order to be able to better understand industrial location issues. There are many areas where future work should be directed. Some of them are the following:

9.3.a Data issues

Updating of information.The analysis of this research covered two periods: 1975-1976 and 1977-1978. This analysis can easily be updated, i.e., the period 1979-1980 can be added. By adding this third period we can see whether the pattern of spatial distribution of industries identified in this study remains or whether changes have ocurred. This is a key task for policy purposes. This task is relatively easy because the methodology designed in this research makes it very simple to manipulate the data. The only additional piece of information needed is the 1980 industrial directory which by now is already available.

Addition of variables. We have mentioned earlier that, due to limitations of the data, variables that may be important for locational decisions, such as cost and availability of land for industrial use were left out. It is recommended that data reflecting these locational factors be gathered and its relative importance assessed. It is also recommended that data on non-traditional factors of location, such as the birth location of the principal entrepeneur, be collected and incorporated into the model. Furthermore, other non-traditional elements such as risk factors should also be introduced.

Expansion of the sample. As indicated in chapter 4, only 6 of the 27 three-digit ISIC code manufacturing activities were analyzed in this study. There is no need to study all the 27 sectors for policy analysis. Only those manufacturing sectors more prone to be affected by the policy of industrial deconcentration should be considered. We suggest that for completing the study of the eleven sectors initially chosen in chapter 4, five industry subsectors be added to the findings of this research. In so doing, we will have a better understanding of the spatial behavior of the manufacturing activity suceptible to being manipulated by policy.

Employment as an indicator. This study considers a firm or establishment as the basic unit of measure. As discussed in chapter 4, using the number of establishments as the only indicator may give an incomplete picture of reality. We should recall that one of the objectives of the policy of industrial deconcentration is to reduce the level of unemployment in the lagging areas. Hence, it is suggested that the findings presented here be complemented with employment figures. The analysis of employment figures will give additional valuable information about the pattern of spatial distribution of economic activities.

9.3.b Theoretical and model specification issues

Simultaneous decisions. The single most important improvement in theoretical and model specification aspects involves the need to represent the simultaneity of decisions made by an entrepeneur. It is likely that the decision regarding where to locate is made simultaneously with the decision of how large the plant should be and how many shifts should be operated. Hence, modelling efforts should be directed toward capturing the manufacturing firm's problem of making three interrelated choices: where to locate, how many employees to utilize and how many shifts to operate. Abusada-Salah[11],has already done an interesting study where he analyses the extent and characteristics of capacity utilization in Venezuela. Carlton[12], on the other hand, studied the joint decision on where to locate and how large to be, for branch plants in the United States.

9.3.c Evaluation and development issues

In chapter 2, we may recall that this study mainly addresses the policy-instrument relationship, i.e., the question: Is the changing pattern of industrial location a result of the policy instruments applied? We still need to address the other two questions related to the effects on the regional objectives caused by the policy or the instruments. That is, we recommend that the following two questions (already presented in chapter 2) be answered:

The first question is: Has the policy of industrial deconcentration fullfilled the regional objectives? Although the current research suggests that the policy of industrial deconcentration has had a negligible effect, it may be important to evaluate the extent to which the policy has affected the regional objectives. For example, it is probable that the proliferation and concentration of plants manufacturing plastic products are a consequence of financial incentives. In other words, we may hypothesize that some of the plastic firms created were non-competitive and the only reason they were set up was due to the policy. This proposition should be studied.

An example of similar issues in other countries may be found in Gilbert[13]. In his comments about the concentration of investment in the lagging areas of the north-east of Brazil he points out:

> "A fundamental criticism made of the scheme has been that it is creating an inefficient manufacturing sector. Rather than creating a series of industries based on the north-east's resource or labor advantages, it is claimed that it is duplicating the import-substitution process that has only recently been completed in the country as a whole. One symptom of this process has been that most of the new industries are higly dependent upon supplies from, and markets in, the south-east. Rather than creating a highly integrated industrial-complex in the north-east, industrial decentralization is merely tending to the development of inefficient plants and to the generation of inter-regional transport flows."

Gudgin[14], refering to the U.K. experience indicates:

> "It is, however, easy to argue that a new direction in policy is required after thirty years of building control, investment incentives, and other aid. These policies have achieved a great deal but in the last resort have not solved the problem, and have now reached a low ebb in which the donor regions for industrial movement are beggining to suffer and in which areas of very high unemployment are not longer restricted to the traditional problem regions. A long-term policy adopted soon after the war alongside the conventional regional measures might by now have been paying dividends."

The second question: How have policy instruments affected regional objectives? should also be addressed. As discussed in chapter 2, it is important to analyze whether, for example, subsidies to capital have encouraged capital-intensive technology which in turn has a limited effect on the creation of new employment opportunities. We suggest that future work be directed toward answering the two questions mentioned above.

Other issues that should also be addressed are related to the policy of deconcentration itself. We may ask whether the benefits involved in attracting manufacturing industries to lagging areas is worth the cost. In other words, is the policy of "moving industries to people" the most efficient and effective?

Are other approaches better? The purpose of these questions is simply to expand the horizons of possible policies or combination of them that could be used in the Venezuelan context.

A related issue is the fact that the policy of industrial deconcentration, as well as the policy of manufacturing promotion, follows very closely the process of development called "from outside", i.e., the process is based on impulses from outside the region. Growth from outside is usually stimulated in an undeveloped region by a demand for the region's natural resources. In order to mobilize these resources, transport and communication lines are established into the region to move out natural resources, while labor, capital, and technology are moved in as complementary production factors.

There is also another type of development process which may contribute to the development of a region begining at the subsistence level and developing into a modern complex economy and society. This process is based on impulses from inside the region, i.e., development from "within." This development process explains the development of a region from a subsistence economy (where local production is essentially consumed locally) towards maturity through agricultural specialization, as transport facilities become available permiting the exchange of agricultural products. With specialization, the productivity of agriculture increases and surplus is created which can pay for services such as transportation and commercialization of the agricultural surplus.

In relation to this subject matter, it is strongly recommended that future work be directed towards considering the potentialities involved in the process of development from "within" that could complement the development form "outside." This alternative is open now, since the revenues that are obtained from the oil exports could be channeled into opening up other development opportunities.

A final suggestion that could be made about future work concerns regional objectives. The objective of reducing interregional income differentials seems to assume that interpersonal disposable income differentials are automatically reduced when interregional differences are reduced. This may not be true. Future work should be directed in this direction.

APPENDIX A: INDUSTRIAL LOCATION THEORY

Industrial location theory is the rubric under which falls many attempts to establish a general theory of industrial location. These attempts all have in common the purpose of deriving the "optimum location" for the individual firm.

The major work on industrial location theory has been carried out by economists trying to provide an all-embracing system of "pure rules" of location and has been developed in the context of a free market economy. It attempts to explain why manufacturing industries locate in one place rather than another and, consequently, to account for the fact that cities of a particular kind and size are where they are instead of somewhere else.

Production involves the use of inputs --factors of production to produce outputs, whether goods or services. The location of the units of production, the firm, will obviously be determined in relation to the source of the inputs and the market for the output. The various factors of production, such as land, labor and capital, plus the market factor, constitute primary determinants of location. These factors can be refined into more specific determinants, such as the quality and quantity of labor, the geographical location of a site and the availability of the necessary infrastructure. Other determinants, such as central and local government policy and behavioral factors, can also be added.

According to Beckmann (quoted in Berry et al,[1]), the prices received by producers for their output can either be the same from place to place, or they may vary spatially. The same is true for the prices paid by the producers for their needed inputs.

If both input and output prices are uniform from place to place, the firm is locationally indifferent. If, however, output prices are uniform from place to place but input prices vary locationally, then the firm can optimize by minimizing cost.

If, on the other hand, input prices are uniform from place to place but selling prices vary locationally, the obvious strategy for the businessman is to locate where he can maximize revenues. This is the case, for example, where goods are highly complex and there is substantial product differentiation and selling price variability. Generally, such high value producers purchase semi-processed parts at input prices that vary little. In other words, the revenue maximizers will, in general, be the high value-added producers, who, in turn, seek out demand-maximizing rather than cost-minimizing location.

Finally, if both input and output prices vary locationally, the optimum location behavior --that which maximizes profit-- is to find the location that maximizes the spread between revenues and costs.

From this analysis, we can bring forth a useful framework for the study of industrial location theory. This framework can be expressed by three main approaches, which are by no means mutually exclusive:

1) The <u>least-cost approach</u>, which attempts to explain location in terms of the minimization of factor cost;
2) <u>Market-area analysis</u>, where there is more emphasis on the demand, or market factors, and the maximization of revenues is pursued;
3) The <u>profit-maximizing approach</u> --the logical outcome of the other two.

<u>The least-cost approach</u>

This approach tries to codify the relationship of production costs to plant location. It begins by recognizing that any business must go through several stages in getting its product onto the market:

1) Procurement of raw materials;
2) Processing of raw materials into finished products;
3) Distribution of products to the consumer.

The first and third of these stages involve transportation costs. The second involves the productive operations --capital inputs and scale, for example-- plus labor costs.

A variety of situations can be studied, in which plant location is affected by variations of procurement, processing and distribution costs. For example, cases can be noted where plants are very much alike in their labor requirements and scale of operations, wherever they are located, so that these costs do not vary much spatially, but these plants incur substantial transport costs that do vary considerably from one location to another. Under these conditions, plants have to minimize transport costs to maximize their competitive advantage.

This approach can be expressed as in Fig. A.1.

In 1909, Alfred Weber presented his theory of industrial location. The Weberian model produces perhaps the simplest view of manufacturing location, based principally on transports. Weber's basic principle was that a businessman would choose a location where his costs were least.

Weber made the following assumptions in his model:

* Conditions of perfect competition are implied with all firms having access to unlimited markets;
* Consideration of a single product at a time. Goods of different quality, though of similar type, are treated as different products;
* The position of sources of raw material is assumed to be known. Some natural resources, such as water, sand and clay, are ubiquitous (i.e., materials available practically everywhere and presumably at the same price everywhere). Other materials, such as mineral fuels and ores, are "sporadic" with availability limited to a number of sites;
* The position of points of consumption (i.e., concentrated at

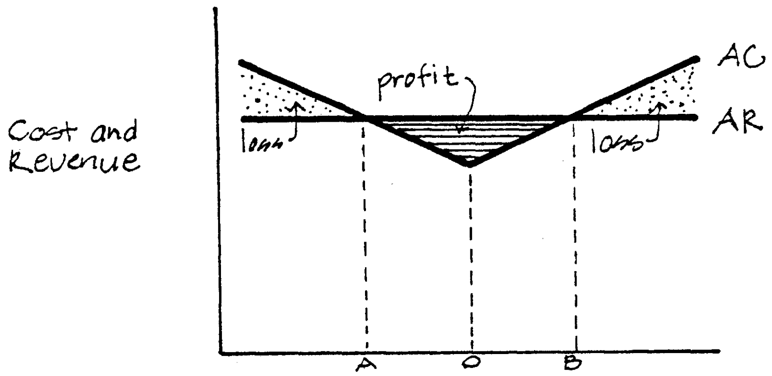


Fig A.1 LEAST COST APPROACH

AR = Average Revenue. It is assumed to be constant.

AC = Average Cost. It varies according to the location

A-B = Profitable location.

O = Optimum location

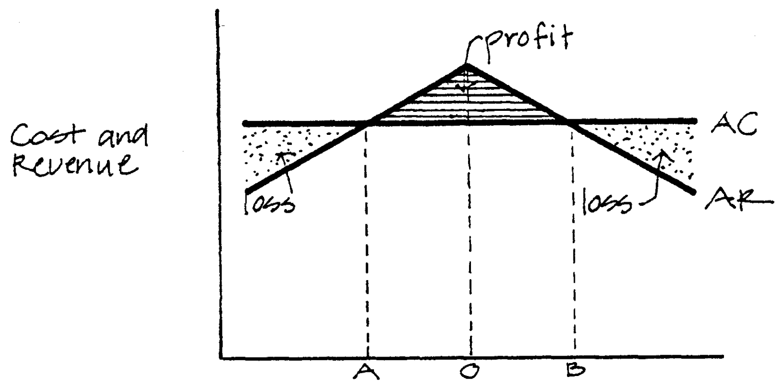


Fig. A.2 MARKET AREA ANALYSIS APPROACH

AC = Constant because no variation in factor input costs is considered.

AR = Varies according to the location and the size of the market.

A-B = Profitable location

O = Optimum location

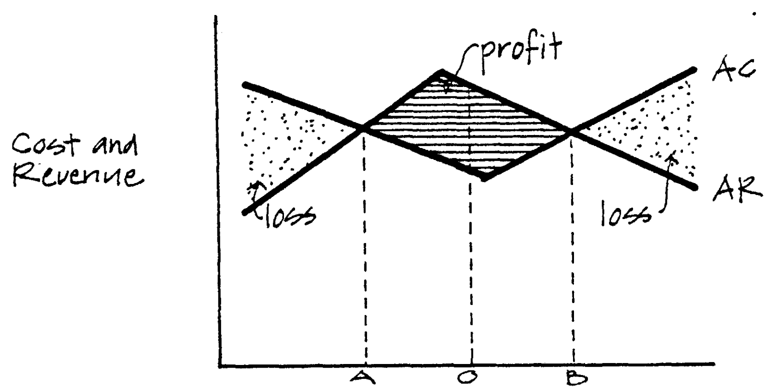


Fig. A.3. PROFIT MAXIMIZING APPROACH

AC = Variable

AR = Variable

A-B = Profitable Location

O = Optimum Location

certain given centers) is also assumed to be known;

* Labor is not ubiquitous (i.e., it is geographically fixed), with several fixed labor locations and fixed labor mobility. Weber assumes that a number of places exist where labor at definite, predetermined wages can be had in unlimited quantities.
* Transport costs are a function of weight and distance. Differences in topography are allowed for by appropriate additions to distance, and differences in transportability by additions to actual weight.

Within these assumptions, Weber believed three factors influenced industrial location:

1) Transport costs;
2) Labor costs;
3) Agglomeration factors.

The first two are general regional factors which determine the fundamental location pattern and the geographic framework; the third factor is a local one which determines the degree of dispersion within the general framework. Later on, other researchers have expanded the second factor to include othe input costs.

Under these assumptions, and holding constant everything but transport costs, the best location is quite obviously that which minimizes transport costs.

1.- Transport costs

Weber first considered the impact of transport costs, the primary location determinant, and then showed how the other two factors might modify the location, i.e., Weber derived his theory using a method of successive elimination. He assumed transport costs to be directly proportional to distance moved and weight carried. Thus, the point of least transport costs is that at which the total weight movement of assembling inputs and distributing outputs is at a minimum (locational triangle concept).

To indicate whether the optimum location was closer to the source of materials or to the market, Weber devised a material index (m.i.):

$$\text{m.i.} = \frac{\text{Weight of Local Material Inputs}}{\text{Weight of Final Products}}$$

If the index was greater than one, the firm was material-oriented; if the index was less than one, it was market-oriented.

2.- Labor costs

Other than the least-transport cost, labor costs can attract a firm to a location if the savings in labor costs per unit of output are greater than the extra transport costs per unit involved.

3.- Agglomeration factors

Having combined the effects of transport and labor costs, Weber then turned to the problem of determining how that location may be deflected within the region by the tendency of firms to agglomerate. In Weber's view, there are two main ways in which a company can gain the benefits of agglomeration. First, it may increase the concentration of production by enlarging its factory, thus obtaining savings through a larger scale of operation. Second, it may benefit by selecting a location in close association with other plants. Hence, a firm may be diverted away from both the least transport and labor cost locations if cost economies can be achieved through a third location factor of agglomeration.

The advantage of agglomeration might include the development of a pool of skilled labor and the establishment of specialist services, although, of course, there may also be diseconomies, such as rising land prices and congestion.

Production-cost and transport-cost orientation

So far, we have considered industries which find transportation costs of paramount importance in selecting a location; that is, transport-oriented industries. Typically, these are industries with a high bulk-to-value ratio for materials or products. For other industries, other considerations may be more important (Helbrun,[2]).

Industries for which geographic differentials in production cost are more important than geographic differentials in transport cost are said to be "production-cost-oriented" rather than "transport-cost oriented."

Production-cost orientation is sometimes further subdivided according to the sort of input involved. One can distinguish:

- Power orientation as, for example, aluminum refining;
- labor orientation such as textiles;

- amenity orientation: research and development laboratories;
- communication orientation: industries that need face-to-face contact with customers;
- external economy orientation: firms that take advantage of economies of agglomeration.

All of them may be seen as a way of minimizing production costs.

Criticisms of Weber's theory

The Weberian model has been criticized for some of its facets, in particular: its concern with supply, that all firms have access to unlimited demand, and its notion that the market exists as a single point. While it is reasonable to consider the pattern of inputs in analyzing location determinants, it is unreasonable to underestimate the importance of markets as areas of varying demand strength. In addition, the model has also been criticized for the assumption that transport costs and production costs remain constant, and for its disregard of institutional factors, such as government policy.

In 1948, Hoover elaborated the Weberian model, making far more realistic cost assumptions. Hoover divides costs into transport (procurement and distribution) and production, each of which is analyzed in a more detailed and realistic way. For example, transport costs may vary according to the length and direction of haul and the composition of the goods involved. Hoover also gives more emphasis to institutional factors, such as local taxes, which may have a considerable impact on locational decisions. He also mentions market areas, but only from an assumed location, and his concern is much more with cost than with demand.

Market area analysis approach

One of the fundamental weaknesses of the least-cost approach is the overemphasis on the input side (cost-minimization) and the underemphasis of the output, or demand, side, simply assuming that the firm can sell all it produces wherever it locates. But the market is variable. Buyers are scattered over a wide area and the intensity of demand varies from place to place. Firms will seek to gain access to the market and serve the greatest demand. Hence, the market may be a major location determinant and the businessman will try to locate where he can maximize his revenue.

In 1954, Lösch attempted to incorporate demand into the theory by considering the optimum size of the market. He considered a fixed individual producer --a farmer producing beer-- and attempted to determine his market area and market revenue on the basis of the following assumptions (Glasson,[3]):

- No spatial variations in the distribution of factor input --raw materials, labor and capital-- over a homogeneous plain;
- Uniform population densities and constant tastes;
- No locational interdependence between firms.

For the analysis, Lösch uses and adapt a simple demand curve. After rotating it, a "demand cone" is produced. The base of the cone represents the market area, the height represents the quantity sold at any one point, and the volume represents the total revenue from the market demand, In time, if beer production is profitable, other farmers will develop their own circular market areas, which will finally adjust into a series of hexagonal market areas covering the entire plain.

This approach is equally one-sided. For, by assuming no spatial variations in the distribution of factor inputs, Lösch eliminates spatial cost variations. Thus, while Weber neglects demand in his attempt to find the least cost location, Lösch neglects input supply and sees optimum location as primarily a function of market demand.

This approach may be represented by Fig. A.2.

Dispersive forces

In order to gain access to the market, the firm has to recognize explicitly the role of competition and other kinds of interdependence among locational units (Hoover,[4]). Therefore, to maximize its revenue, a business firm may tend to select a location where there is no nearby competition. Each firm will seek to keep its distance from others, and a pattern dominated by dispersive forces will emerge.

When an output-oriented seller is trying to find the most rewarding location in terms of access to markets, he will have to evaluate the advantage of any location on the basis of how much demand there will be within the market area that he could expect to command from that location.

Each location that he might choose entails a market area and a sale potential determined by where the buyers are and where the competition is.

The best location from this viewpoint is one where demand for his kind of output is largely relative to the nearby supply. This suggests that he will look for a "deficit area" into which the output in question is flowing. In other words, he will try to find the largest gap in the pattern of already established firms of his activity as the most promising location for himself (Hoover,[5]).

The market-area boundary between two sellers of the same good, with equal production and input costs, is a straight line midway between the sellers. If one seller has a cost advantage, the boundary will be further from him and concave toward his higher-cost competitor.

According to Alonso[6], "the theory of market areas seems to be the key to future developments. It was, in a sense, the culmination of the theory of the firm. But it was also the beginning of the theory of August Lösch in the form of central-place theory."

<u>The profit-maximizing approach</u>

In practice, both costs and revenue vary with location and the optimum location is the one which yields the greatest profit. This approach can be expressed as seen in Fig. A.3.

In this situation, the optimum profit-maximizing location may be neither the least-cost nor the maximum-revenue location.

In the 1950's, W. Isard, among others, tried to remold the approach introduced by Lösch by considering costs more closely. He has suggested a model in which the optimum location is the point which combines the lowest possible costs with the greatest possible revenue. However, there are problems in deriving the profit-maximization location. These problems are related to the limitations of the theory (Glasson,[7]). For a detailed presentation of these problems, as well as other issues related to traditional location theory, the reader may consult Smith[8], Greenhut[9] or Isard[10].

APPENDIX B: MODELS OF DISCRETE CHOICE

I Introduction[1]

B.1 Background information

The standard theory of consumer behavior has focused on decision problems in which commodities are assumed to be finely divisible. In situations where this assumption remains a valid one, choices are made over a continuum of possibilities; for example, how much to consume, to produce or to market. Demand functions, derived from the assumption of optimizing behavior by the consumer, reflect marginal adjustments by the consumer in response to changes in prices or other factors in the environment.

In many other situations, the assumption of easily-divisible goods and services is not valid, i.e., when choices are discrete. Examples can be found in the locational choice of a manufacturing firm, or in the choice of mode of travel, or in the selection of a school for the children.

In these discrete cases, the standard microeconomic theory is generally, no longer applicable, i.e., small marginal adjustments are not always feasible. For example, in the case of choice of travel mode, an increase in transportation cost (say, in a car) may either leave the patron unaffected (i.e., he will continue to use the car) or it may cause him to switch to another mode alltogether (say, bus). Nevertheless, it is possible to have some substitution along other dimensions, as for example, fuel.

Discrete decision problems are very frequently found in the public sector. Because knowledge of the determinants of discrete choices is important to the policy maker, a considerable effort has recently been devoted to the study of discrete choice decisions.

II The conceptual framework

B.2 The behavioral approach

One of the most recent approaches used to deal with the issues of discrete choice decisions has been a development from the theory of individual behavior. The modeling of discrete choice behavior is essentially a derivative of standard microeconomic choice theory. This theory follows the behavioristic approach to theory building, where it is assumed that larger groups will act in ways which can be derived from the understanding of the individual unit.

The behavioristic approach to discrete choice decisions attempts to establish the relationship between choices on the one hand and attributes of alternatives and characteristics of individual decision-makers on the other hand.

The behavioristic approach assumes that an individual has a utility function and that the observed behavior is the result of the maximization of the utility function. This approach accepts the premise that the utility which is perceived by an individual is determined by his attitudes about all the stimuli which act on him over his lifetime, but does not attempt to study the link between attitudes and behavior. Hence, the internal mechanisms which intermediate between the perceived attributes of the alternatives and the actual decisions taken are ignored by this approach. Therefore, it treats the individual as a "black box", i.e., as a system about whose structure we know nothing except that which can be deducted from its behavior. Thus, the interest is shifted from the psychological aspects of decision making such as the processes of attitude formation and modification of behavior to more observable aspects such as the discovering of statistical relationships between the inputs (attributes) and outputs (decisions) for which the theory attempts to give an explanation.

B.3 The theory of individual behavior

The theory of rational choice behavior asserts that a decision maker can rank possible alternatives in order of preference, and will always choose from available alternatives the option which he considers most desirable.

It is expected that by establishing the statistical link between the attributes of the options available to the individuals, and the actual choices made by them, it will be possible to forecast the effects of changes in the system.

In order to introduce the main ideas of the theory of individual behavior, let us suppose that we have drawn three decision makers from a population of "similar" individuals. "Similar" is defined with reference to observable characteristics of the individual themselves. For example, the three decision makers may be "similar" because they manufacture the same product, use the same technology, and employ the same number of workers. Furthermore, suppose that each of these individuals faces the same two alternative choices. Now imagine that we find that two of them --decision makers I and II-- have selected alternative 1 while one individual --decision maker III-- has chosen alternative 2. We can ask ourselves, how it is possible that similar individuals, facing the same alternatives, behave in different ways? It is precisely through answering this question that the theory of discrete choice behavior is developed.

This theory asserts that this "abnormal"finding is due to unobserved data. Recall that the estimation procedures available are based only on observed data. Only a portion of the factors that determine individual decisions are observed and measured. The theory suggests that there remain unobserved attributes of the alternatives in the choice sets available to decision makers as well as unobserved characteristics of the decision makers themselves which should be taken into account to explain the behavior of the decision maker. It is precisely the treatment of these unobserved determinants of individual decisions that are emphasized in discrete choice theory. Recall that in our example, we have assumed that the three individuals are similar only with reference to some <u>observable</u> characteristics. Hence, there is still room for unobserved characteristics to play a role in the decision process.

B.4 The conceptual model of discrete choice

Discrete choice models, as well as their continuous couterparts, assume the existence of a "representative" or "average" individual who has tastes equal to the average over all decision makers with given observed characteristics. The model assumes that this representative individual has a utility function measuring the desirability of an option. This utility function can be expressed as

$$\bar{u}_{ij} = U(X_{ij}, s_i) \tag{B.1}$$

where $\bar{u}_{ij}$ = Utility that the average individual i attaches to alternative j.

x_{ij} = Vector of the levels of relevant and observable attributes of alternative j from the perspective of individual i.

s_i = Vector of the relevant and observable characteristics of individual i.

Equation (B.1) is the deterministic functional form representing the average (e.g. mean) behavior of the individual i. In order to take into consideration deviations from this average, a nondeterministic part should be added to represent the random fluctuations observed. The stochastic utility function can be expressed as

$$u_{ij} = U_{ij}\,(x_{ij}, s_i) + \eta_{ij} \tag{B.2}$$

where η_{ij} is a random variable for individual i related to alternative j, and

$$\eta_{ij} = \eta_{ij}\,(x_{ij}, s_i) \tag{B.2.a}$$

The stochastic term η is assume to reflect the unobserved attributes of the alternatives and the unobserved characteristics of the decision maker. Hence, according to this model, the reason decision maker III of our example behaves in a "non-representative" way by choosing alternative 2, is due to the effect of unobserved data.

If we analyze more closely individual I and individual II we find that they have chosen option 1 over 2 because the utility that each gains from alternative 1 is greater than that obtained for alternative 2, i.e., because $u_{i1} > u_{i2}$.

By substitution, an equivalent expression is:

$$U_{i1}\,(x_{i1}, s_i) + \eta_{i1}\,(x_{i1}, s_i) > U_{i2}\,(x_{i2}, s_i) + \eta_{i2}\,(x_{i2}, s_i) \tag{B.3}$$

By rearrangement, we have

$$U_{i1}\,(x_{i1}, s_i) - U_{i2}\,(x_{i2}, s_i) > \eta_{i2}\,(x_{i2}, s_i) - \eta_{i1}\,(x_{i1}, s_i) \tag{B.4}$$

The common sense underlying this re-expression is easy to interpret: the decision to choose alternative 1 over alternative 2 will follow from the observable utility superiority of alternative 1, as long as the margin of superiority is greater than any countervailing effect of utility differences based on unobservable phenomena.

In general, we may say that individual i will choose alternative k if

$$U_{ik}(x_{ik},s_i) - U_{ij}(x_{ij},s_i) > \eta_{ij}(x_{ij},s_i) - \eta_{ik}(x_{ik},s_i) \qquad \text{(B.5)}$$

for $j \neq k$, $j = 1,\ldots J$

Equation (B.5) expresses the conceptual model of discrete choice: individual i will choose option k if this is the alternative which maximizes his utility, i.e., individual i will choose option k as long as the margin of superiority of the observable utility is greater for option k, than any countervailing effect of utility differences based on unobservable phenomena.

III The operational framework

B.5 General concepts

Now it is necessary to transform the conceptual model into an operational model, so that it can help us to predict the behavior of individuals not included in the original sample. It should be stressed that the model will not predict how a particular individual will behave; it will only give the probability that an individual will select a particular option. For example, if for firms of a particular industrial group, the model indicates a probability of 0.7 that they will locate in city B, this implies that we can expect that out of 10 new firms, 7 will select city B. The model will not tell us which of the 10 firms will locate in city B, only that 7 will locate there. Furthermore, the model may predict, for example, what the locational response of the industrial group will be to changes in some attributes of the city such as electricity costs or levels of subsidy or wage rates. Indeed, by explicitly stating those attributes capable of being manipulated by policy-makers, the model forecasts the effects of changes in the system.

Recall that the stochastic model of utility has been expressed as

$$u_{ij} = U_{ij}(x_{ij}, s_i) + \eta_{ij} \tag{B.2}$$

We have indicated that the first term of the right hand side of this equation is non-stochastic or determinate, while the second term is stochastic.

Now, in order to build any econometric model, we have to address two important issues:

1) How should the utility function be specified? i.e., how should the first term of the stochastic model be defined?
2) What assumptions should be made about the error term? For the second term of the stochastic model, assumptions have to be made about the structure of the errors which lead to deviations of the observed pattern of choice among observationally identical individuals.

B.5.1 Issue 1: Specification of the utility function

At the most general level, an appropriate utility function can be specified as

$$u_{ij} = \beta_o + \beta_1 z_{1i}(x_{ij},s_i) + \ldots \beta_T z_{Ti} (x_{ij},s_i) \tag{B.6}$$

This function is linear in its parameters ($\beta_0,\beta_1,\ldots \beta_T$) but its arguments ($z_1, \ldots z_T$) are themselves a series of transformations of the data. Hence, the z-variables can be logarithms, reciprocals, exponentials, etc. The z-variables may also incorporate interactions between the attributes of the alternatives and the characteristics of the individual.

Thus, a utility function could be simply a purely linear (and quite unrealistic) specification:

$$u_{ij} = \beta_o + \beta_1 x_{1j} + \ldots + \beta_g x_{gj} + \beta_{g+1} s_{1j} + \ldots \beta_T s_{Hj} \tag{B.7}$$

On the other hand, the same general specification can also encompass the translog function, which has the advantage of being additive in the first powers, squares and cross-products of the logarithms of alternatives and individual characteristics.

Since the linearization of the utility function in a set of $z°$- transformations does not appear to be very restrictive, we may consider it general enough for most applications.

To simplify the notation, equation (B.6) may be written

$$u_{ij} = \beta_o + \beta_1 z_{1ij} + \ldots + \beta_T z_{Tij} \tag{B.6.a}$$

Equation (6.a) can further be simplified in its notation:

$$u_{ij} = z_{ij} \beta \tag{B.8}$$

where z_{ij} as β are now vectors:

$$z_{ij} = [\, 1 \; z_{1ij} \; \ldots \; z_{\tau ij} \,]$$

$$\beta' = [\, \beta_0 \; \ldots \; \beta_\tau \,]$$

Hence, the stochastic model can be expressed as:

$$u_i = z_i \beta + \eta_i \tag{B.9}$$

B.5.2 Issue 2: Assumptions about the error term

The theory of individual behavior assumes that the only reason for different discrete choices by observationally -identical individuals in the same choice environment, must be the effect of unobservable attributes of the alternatives and unobservable characteristics of individuals. In any real situation, of course, there will be a huge number of such attributes and characteristics. Thus, we can define the error term in the utility function as being the sum of the contribution to utility made by a very large number of characteristics and attributes which are distributed randomly across individuals and alternatives.

As long as a fair number of these unobservable characteristics and attributes are independently distributes, it makes no difference if each distribution of random occurrences has no regular pattern. The sum of the effects of the occurrences will approximate a normal distribution, and the Central Limit Theorem guarantees that the distribution will be closer to normal, the larger the number of independently distributed unobservable characteristics. Hence, a strong argument for normality in the error-generating process can be made in discrete choice modelling.

The assumption that the error-generating process is normal has the following additional advantage: the sum or difference in repeated draws of two normally-distributed random variables is also normal. This aspect will facilitate the construction of the operational model of discrete choice, as we shall see next.

B.6 The operational model

B.6.1 The cumulative distribution function

Recall that the conceptual model of discrete choice behavior is expressed in the inequality which governs the choice between two modes:

$$u_{i1}(x_{i1}, s_i) - u_{i2}(x_{i2}, s_i) > \eta_{i2}(x_{i2}, s_i) - \eta_{i1}(x_{i1}, s_i) \qquad \text{(B.4)}$$

For convenience, we can adopt the following notation:

$$u_{i1} - u_{i2} > \eta_{i2} - \eta_{i1} \qquad \text{(B.10)}$$

Substituting for the linearized utility model, equation (8):
$u_{ij} = z_{ij}\ \beta$ we have:

$$z_{i1}\ \beta - z_{i2}\ \beta \ > \ \eta_{i2} - \eta_{i1} \tag{B.11}$$

Now, if η_{i1} and η_{i2} have been assumed to be normally-distributed, so must be their difference. If we let

$$\eta_{i2} - \eta_{i1} \ = \ \eta_i \tag{B.12}$$

the inequality can be re-written as

$$(z_{i1} - z_{i2})\ \beta \ > \ \eta_i \tag{B.13}$$

The recast conceptual model as expressed in inequality (B.13) says that alternative 1 will be chosen over alternative 2 if their utility difference is greater than the value taken on by the normally distributed variable η_i. Obviously, the greater the weighted sum of the distances between the values, the greater the probability that it will be larger than the value taken on by the associated random draw. The normality of η_i guarantees that this probability will decline very rapidly for possible values as they get further away from the mean of the distribution.

A closer look into the recast conceptual model in inequality (B.13), will show that the description of it is simply a description of a <u>cumulative distribution function</u>. In this case, because of the assumptions made, it is a <u>normal</u> cumulative function.

Hence, the probability that individual i will choose option 1 rather than option 2 is the same as:

$$\text{Prob}\left[\eta_i < (z_{i1} - z_{i2})\,\beta\right] \tag{B.14}$$

To see why this is so, recall that for any continuous random variable, η_i, the cumulative distribution function (c.d.f.) is defined as

$$F(\eta_i) = \int_{-\infty}^{\eta_i^*} f(\eta_i)\, d\eta_i \tag{B.15}$$

This is a mathematical representation of the proportion of total area under the probability density function (p.d.f.) from $-\infty$ to η_i^*. Fig. B.1 depicts the p.d.f.

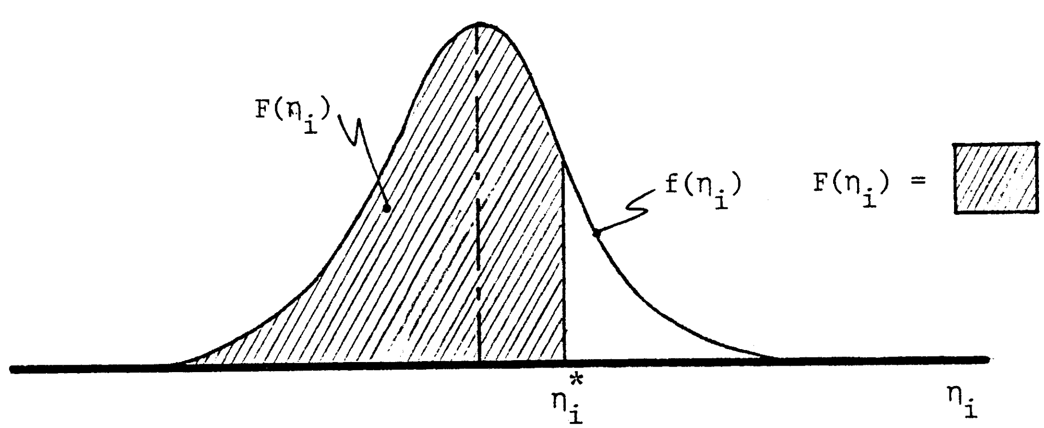


Fig. B.1: Probability density function

If we let $\eta_i^* = (z_{i1} - z_{i2})\ \beta$, the c.d.f. will give us the probability that the normal random variable, η_i , is less than a particular value, $(z_{i1} - z_{i2})\ \beta$, as can be seen in Fig. B.2.

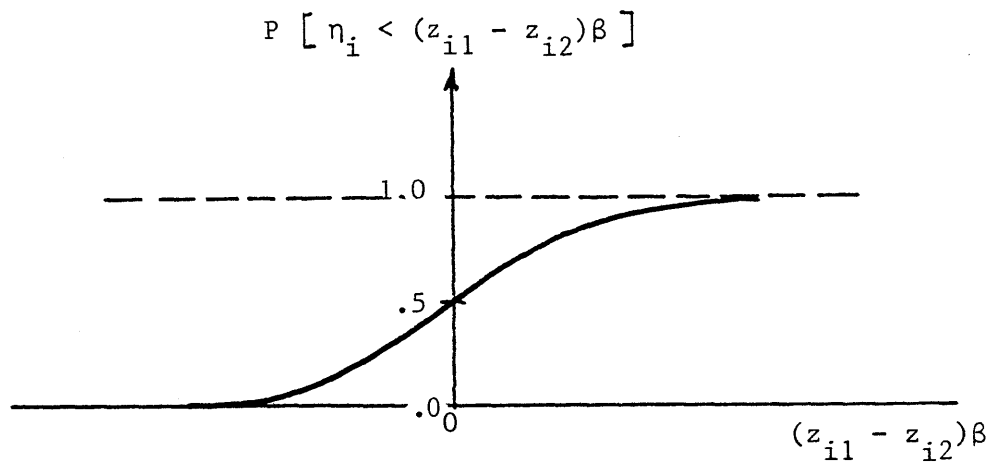


Fig. B.2: Cumulative distribution function

Thus, the normal distribution of the error term in the original model of utility leads to a nice, regular function which relates differences in the alternative valuations to the probability that option 1 will be chosen over option 2. Hence,

$$P_{i1} = \text{Prob}\ [\eta_i < (z_1 - z_2)\ \beta\ ] = \int_{-\infty}^{(z_{i1}-z_{i2})\beta} f\ (\eta_i)\ d\ \eta_i \qquad \text{(B.16)}$$

The probability that individual i will choose option 1 over option 2 can be read directly from the cumulative distribution. Note that when the utility difference is zero, the decision maker is indifferent to the two options that he faces and therefore, the probability of choosing alternative 1 can be obtained from the graph (Fig. B.2). And it is equal to 0.5.

B.6.2 The joint probability density function

Earlier, in equation (B.12) we have let $\eta_{i2}-\eta_{i1}$ be η_i, since the difference of two normally distributed random variables is also normal. Hence, η_i is a normal random variable that belongs to a joint probability density function. Now, we should take a closer look into the joint p.d.f. of the random variable η_i. For simplicity in the presentation of this important aspect, we shall drop the subscript i.

The random variable η, has to be seen as joint (difference) distribution of two equally random variables η_2 and η_1. For this purpose, three steps should be considered:

* The first step is related to the probability of drawing a particular value of η_2;

* The second step deals with the probability that the η_2-draw is greater than η_1.

* The third step is related to the combination of the two earlier steps.

To illustrate this, let us see figures B.3.a to B.3.d.

Step 1:

Each value of η_2 from $-\infty$ to $+\infty$ has a relative frequency of occurrence. This frequency can be read out of the probability density function for η_2

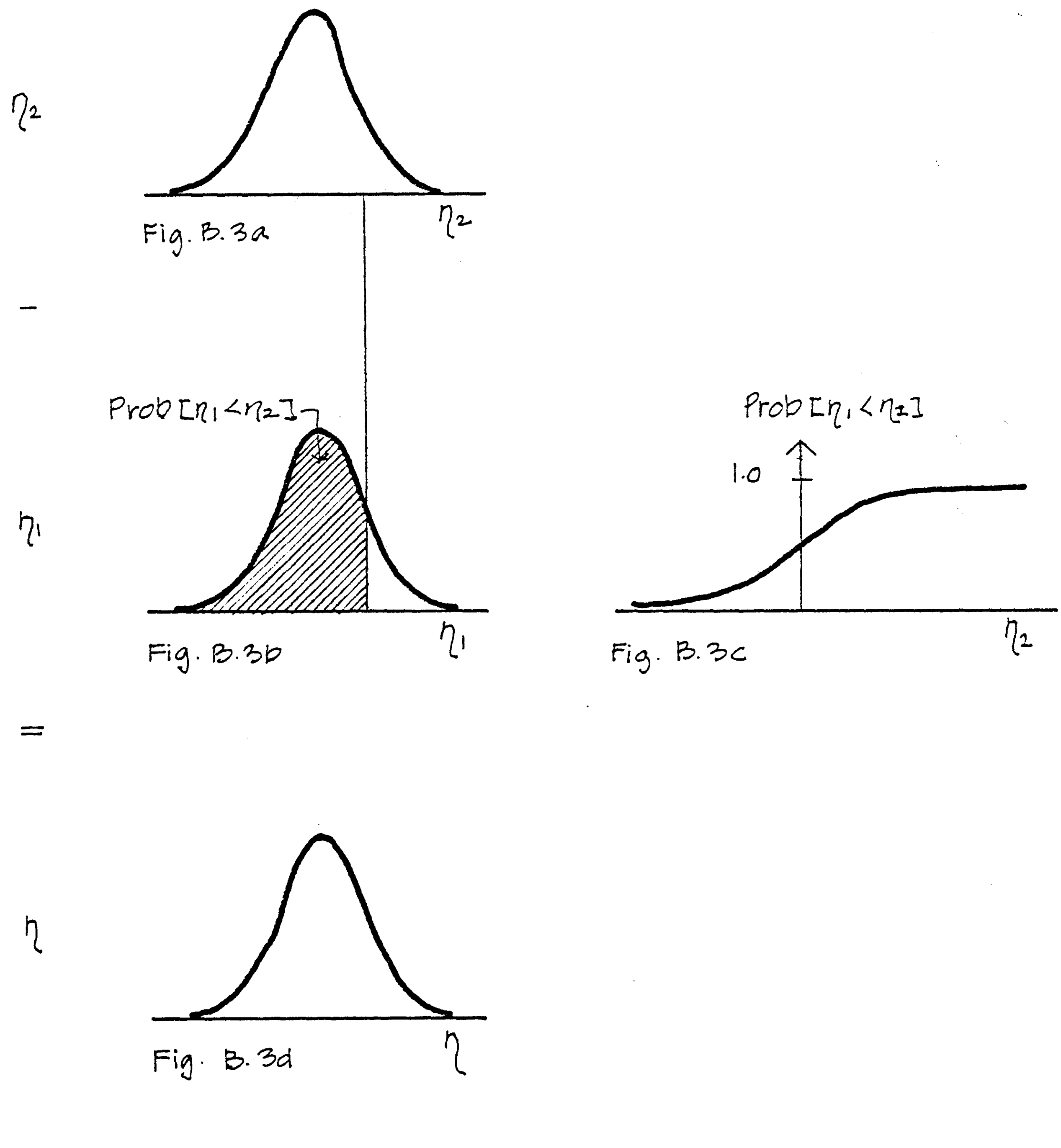


FIG B.3 THE JOINT PROBABILITY DENSITY FUNCTION in Fig. B.3.a.

Step 2:

For each of the η_2 values, there is a definite probability that η_1 is smaller. This probability can be read out of the cumulative distribution for η_1 in Fig. B.3.c.

Step 3:

Thus, for any given pair of values, we know that the probability that η_2-draw will be greater than η_1-draw is given by:

$$\text{Prob}\left[\eta_2^i\,,\ \eta_2^i > \eta_1\right] = \text{Prob}\,(\eta_2^i)\cdot\text{Prob}\,(\eta_2^i > \eta_1) \qquad (B.17)$$

The superscript i indicates a particular value of η_2. The joint probability is the product of the individual probabilities here because the draws on η_2 and η_1 are independent of one another.

There are an infinite number of possible values for η_2 (from $-\infty$ to $+\infty$) and since equation (B.17) gives us the joint probability for only one particular value of η_2,η_2^i, we have to sum over all possible values of η_2.

To see why this is so, recall from simple probability theory that Prob (A or B) = Prob (A) + Prob (B) where A and B are draws of a random variable. Thus, if there were a finite number (M) of possible values in the distribution η_2, we would have

$$\text{Prob}\left[\eta_2^1 \text{ or } \eta_2^2 \text{ or } \ldots \text{ or } \eta_2^m\right] = \text{Prob}\,(\eta_2^1) + \ldots + \text{Prob}\,(\eta_2^m)$$

$$= \sum_{i=1}^{m} \text{Prob}\,(\eta_2^i) \qquad \text{(B.18)}$$

Similarly, we would have

$$\text{Prob}\left[(\eta_2^1, \eta_2^1 > \eta_1) \text{ or } (\eta_2^2, \eta_2^2 > \eta_1) \text{ or } \ldots \text{ or } (\eta_2^m, \eta_2^m > \eta_1)\right]$$

$$= \text{Prob}\,(\eta_2^1) \cdot \text{Prob}\,(\eta_2^1 > \eta_1) + \ldots + \text{Prob}\,(\eta_2^m) \cdot \text{Prob}\,(\eta_2^m > \eta_1)$$

$$= \sum_{i=1}^{m} \text{Prob}\,(\eta_2^i) \cdot \text{Prob}\,(\eta_2^i > \eta_1) \qquad \text{(B.19)}$$

In our case, of course, we have an infinite number of such possible draws of η_2. Recall that $f_2(\eta)$ is another way of representing the p.d.f. for η_2 and $F_1(\eta)$ is another way of representing the c.d.f. for η_1, we can therefore replace the discrete probability expression above with an analogous integral to represent summation along all values of the continuous variable η_2:

$$\text{Prob}\left[\eta_2, \eta_2 > \eta_1\right] = \int_{-\infty}^{+\infty} f_2(\eta)\, F_1(\eta)\, d\eta \qquad \text{(B.20)}$$

Note that equation (B.20) is the joint p.d.f. of the random variable η, i.e., the component $f(\eta)$ of the equation (B.16):

$$P_1 = \text{Prob}\left[\, \eta < (z_1 - z_2)\, \beta \,\right] = \int_{-\infty}^{(z_1-z_2)\beta} f(\eta)\, d\eta \qquad \text{(B.16)}$$

Substituting in equation (B.16) we have:

$$P_1 = \int_{-\infty}^{(z_1-z_2)\beta} \int_{-\infty}^{+\infty} f_2(\eta)\; F_1(\eta)\; d\eta \qquad \text{(B.16.a)}$$

Hence, equation (B.16.a) is the operational model for analyzing discrete choices.

B.7 Limitations of the normal distribution

To estimate the β-parameters,observed values of z are introduced into the operational model, where P_1 takes a dichotomous value of zero or one.

Note that the cumulative normal distribution function can only be expressed as a mathematical integral. Furthermore, all the subsequent operations which lead to econometric estimation of the β's are very complicated. These two arguments have spurred researchers to find alternatives in order to simplify the manipulation of the model. One of the alternatives most widely employed is based on the use of the Weibull distribution as a substitute for the normal.

B.8 The Weibull distribution

The shape of the Weibull distribution is fairly close to that of the normal distribution.At the same time it is generated by a function which is more convenient analytically.

The major advantage of the Weibull distribution as a characterization of the error term in the utility model emerges from the proposition that the cumulative probability function associated with the difference between two Weibull-distributed random variables is an extremely simple mathematical form called the binary logit. The basic assumption behind the binary logit model is that the disturbances are independent and identically distributed.

For a Weibull-distributed variable, the c.d.f. is

$$F(\eta) = e^{-e^{-(\eta+\alpha)}} \tag{B.21}$$

The frequency function for a Weibull-distributed variable is given by:

$$f(\eta) = F'(\eta) = e^{-(\eta+\alpha)} e^{-e^{-(\eta+\alpha)}} \tag{B.22}$$

Substituting equations B.21 and B.22 in equation B.20, and letting $\theta = [e^{-\alpha_1} + e^{-\alpha_2}]$, we have:

$$\text{Prob}\left[\eta_1,\ \eta_1 > \eta_2\right] = \int_{-\infty}^{+\infty} e^{-(\eta+\alpha_1)}\ e^{-e^{-(\eta+\alpha_1)}}\ e^{-e^{-(\eta+\alpha_2)}}\ d\eta$$

$$= \int_{-\infty}^{+\infty} e^{-(\eta+\alpha_1)}\ e^{-e^{-\eta}\left[e^{-\alpha_1} + e^{-\alpha_2}\right]}\ d\eta$$

$$= \int_{-\infty}^{+\infty} e^{-\alpha_1}\ e^{-\eta}\ e^{-\theta e^{-\eta}}\ d\eta = e^{-\alpha_1} \int_{-\infty}^{+\infty} e^{-\eta}\ e^{-\theta e^{-\eta}}\ d\eta$$

$$= e^{-\alpha_1}\ \frac{1}{\theta}\ e^{-\theta e^{-\eta}}\Bigg]_{-\infty}^{+\infty} = \frac{e^{-\alpha_1}}{e^{-\alpha_1} + e^{-\alpha_2}}\quad e^{-\theta e^{-\eta}}\Bigg]_{-\infty}^{+\infty}$$

$$= \frac{e^{-\alpha_1}}{e^{-\alpha_1} + e^{-\alpha_2}} \cdot \frac{1}{e^{\theta\left(\frac{1}{e^{\eta}}\right)}}\Bigg]_{-\infty}^{+\infty}$$

$$= \frac{e^{-\alpha_1}}{e^{-\alpha_1} + e^{-\alpha_2}}\left[\frac{1}{e^{\theta({}^{1}/_{\infty})}} - \frac{1}{e^{\theta(\infty)}}\right] = \frac{e^{-\alpha_1}}{e^{-\alpha_1} + e^{-\alpha_2}}\left[1 - 0\right]$$

$$= \frac{e^{-\alpha_1}}{e^{-\alpha_1} + e^{-\alpha_2}}$$

Hence, for two independent, Weibull-distributed variables with values α_1 and α_2, we have

$$\text{Prob}\ (\eta_1,\ \eta_1 > \eta_2) \;=\; \frac{e^{-\alpha_1}}{e^{-\alpha_1} + e^{-\alpha_2}} \;=\; \frac{1}{1 + e^{\alpha_1 - \alpha_2}} \qquad \text{(B.20.a)}$$

As can be seen in equation (B.20.a), this is a remarkable result. Although the integrals of equation B.20 look complex, the extraordinary properties of e, the natural logarithm base, make it simple.

For the estimation process of the parameters as well as other related issues, the reader may consult chapter 7 in the main text of this study.

APPENDIX C: CITY CHARACTERISTICS, MEASUREMENT AND DATA ISSUES

Most of the variables are divided by the city's population. A better approach is to use the city's total labor force instead. The latter approach was abandoned when it was realized that data on labor force was obtained by administrative regions and not by cities. Hence, additional assumptions as well as estimations would have to be made which probably would add little to the accuracy of the results.

In some cases, data by city were not available. Fortunately it was possible to obtain relevant data by administrative regions or by states. Under these circumstances, it is assumed that cities within a spatial unit have the spatial unit's value.

Variable: <u>Central place hierarchy</u>

Proxy: Wholesale employment.

Measure: Proportion of the city's wholesale employment to its population.

Source: Encuesta de Hogares, Cuadro 8, Población urbana ocupada en comercio al por mayor. OCEI, Segundo semestre, 1975 and 1977.

Spatial unit: Administrative region.

Variable: <u>Income level</u>

Proxy 1: Median household income

Measure:	The median, estimated from the urban household income distribution.
Source:	Encuesta de Hogares, cuadro 29, Ingresos totales e ingresos medios de los hogares por escala de ingreso, area urbana, OCEI, Segundo semestre, 1975 and 1977.
Spatial unit:	Administrative region.
Proxy 2:	Per capita median income
Measure:	The median income for urban households divided by the average urban household size.
Source:	Encuesta de Hogares, Cuadro 29: Ingresos totales e ingresos medios de los hogares, por escala de ingreso, area urbana. Cuadro 30: Distribución de los hogares y miembros de hogares por escala de ingreso mensual, area urbana, OCEI, Segundo semestre, 1975 and 1977.
Spatial unit:	Administrative region.
Proxy 3:	Number of private cars.
Measure:	Proportion of the city's private cars to its population.
Source:	Ministerio de Transporte y Comunicaciones, Dirección de Procesamiento de Datos, Oficina de Secretaría Técnica.
Spatial unit:	State.
Variable:	<u>Local economic conditions</u>
Proxy:	Unemployment rates.
Measure:	Deviation in a city's unemployment rate from its long-run

average, i.e., ratio of unemployment rate to the normal level of unemployment. The normal level of unemployment is measured as an average over several years.

Source: Encuesta de Hogares, cuadro 11. Población 15 años y mas desocupada, rama de actividad económica del último trabajo por sexo, area urbana. OCEI, 1970-1977.

Spatial unit: Administrative region.

Variable: Labor availability by skills

Proxy: Labor force.

Measure: Proportion of the city's two-digit ISIC code labor force to its population. The two-digit code was thought most appropriate to use because of the possibility of using the same labor category across different industries within the same two-digit ISIC code.

Source: Encuesta de Hogares, Cuadro 7. Población de 15 años y mas en la fuerza de trabajo, rama de actividad economica, area urbana. OCEI, Segundo semestre, 1975 and 1977.

Note: This source gives the urban two-digit labor force by administrative regions. It is allocated to cities within the region in proportion to the city's population.

Variable: Unemployment levels by skills

Proxy: Unemployment percentage.

Measure: Percentage of the city's unemployed labor force.

$$\text{Unemployment percentage} = \frac{\begin{pmatrix}\text{Total labor force}\\ \text{two-digit code}\end{pmatrix} - \begin{pmatrix}\text{Employment}\\ \text{two-digit code}\end{pmatrix}}{\begin{pmatrix}\text{Total labor force}\\ \text{two-digit code}\end{pmatrix}}$$

The two-digit code was thought most appropriate to use because of the possibility of using the same element of the labor force across different industries within the same two-digit ISIC code.

Source: Encuesta de Hogares, Cuadro 7: Población de 15 años y mas, en la fuerza de trabajo, rama de actividad económica, area urbana. Cuadro 8: Población de 15 años y mas ocupada, rama de actividad económica, area urbana, OCEI, Segundo semestre, 1975 and 1977.

Spatial unit: Administrative region.

Variable: <u>Technical expertise</u>

Proxy: Number of professionals, technicians and related occupations.

Measure: Proportion of the city's professionals, technicians and related occupations to its population.

Source: Encuesta de Hogares, Cuadro 14, Fuerza de trabajo: Profesionales, técnicos y personas en ocupaciones afines, área urbana. OCEI, Segundo semestre, 1975 and 1977.

Spatial unit: Administrative region.

Variable: Management potential

Proxy: Number of managers, administrators and directors.

Measure: Proportion of the city's managers, administrators and directors to its population.

Source: Encuesta de Hogares, Cuadro 14, Fuerza de trabajo urbano: Gerente, administradores, directores y otros funcionarios de categoría directiva. OCEI, Segundo semestre, 1975 and 1977.

Spatial unit: Administrative region.

Variable: Wage rate

Proxy: Bolivares paid to blue collar workers per hour worked.

Measure: The wage rate is equal to production workers' earnings divided by production manhours. That is,

$$s_i^q = \frac{S_i^q}{H_i^q}$$

where: s_i^q = average wage rate paid by industry i at point q to blue collar workers.

S_i^q = total wages paid by all industry i establishments located at point q.

H_i^q = total number of hours worked by blue collar workers in all industry i plants located at point q.

Source: 1975 and 1977 Survey tapes, OCEI.

Note: Wage rates at the three-digit ISIC code level were estimated. When the three-digit wage was unavailable for a city, the existing data for the city's region was used to estimate the relationship between the three-digit and the average manufacturing wages for the region. Knowing the average manufacturing wage for the city and assuming that the relationship in the city is the same as in the region, the three-digit wage for the city was estimated. When available, the two-digit wage was used instead of the average manufacturing wage.

Spatial unit: City.

Variable: Cost of living

Proxy: Buying power of money.

Measure: Comparative cost of living for food, drinks and tabacco.

Source: Boletines del Banco Central, Cuadro A-III-19, 1975 and 1977.

Spatial unit: City.

Variable: Labor unrest

Proxy: Working hours lost due to unexpected stoppages.

Measure: Proportion of the yearly average working hours lost (due to unexpected stoppages) to the labor force.

Source: Memoria y Cuenta del Ministerio del Trabajo, Division de Organismos Sindicales, Contratos y Conflictos de Trabajo, 1975 and 1977.

Spatial unit: State.

Variable: Facilities for training personnel

Proxy: Students enrolled in technical training courses.

Measure: Proportion of students attending technical training courses to the city's population.

Source: Memorias del Ministerio de Educación, Matrícula Estudiantil de Educación Superior, 1975 and 1977.

Spatial unit: City.

Variable: Access to financial services

Proxy: Employment in financial services.

Measure: Proportion of the city's employment in the financial sector to its population.

Source: Encuesta de Hogares por Muestreo, Cuadro 8, Población urbana ocupada en establecimientos financieros. OCEI, Segundo Semestre, 1975 and 1977.

Spatial unit: Administrative region.

Variable: Access to industrial services

Proxy: Employment in services for establishments.

Measure: Proportion of the city's employment in services for establishments, to its population.

Source: Encuesta de Hogares por Muestreo, Cuadro 8, Población urbana ocuapda en seguros y servicios prestados a las empresas incluyendo alquiler y arrendamiento de equipo.

OCEI, Segundo semestre, 1975 and 1977.

Spatial unit: Administrative region.

Variable: <u>Access to research services</u>

Proxy: Employment in research institutes.

Measure: Proportion of the city's employment in research institutes to its population.

Source: Boletin Estadístico, Oficina de Planificación Universitaria, Consejo Nacional de Universidades, 1975 and 1977.

Spatial unit: City.

Variable: <u>Water availability</u>

Proxy 1: Cubic meters of water consumed per inhabitant.

Measure: Proportion of the city's consumption of water to its population.

Source: INOS, Dirección de Planificación de Desarrollo, OCEI, Proyecciones de Población, 1974.

Spatial unit: City.

Proxy 2: Percentage of population serviced with water.

Measure: Percentage of the city's population serviced with water.

Source: INOS, División de Planificación de Desarrollo, INOS, Proyecciones de Población, 1972.

Spatial unit: City.

Variable: <u>Water cost</u>

Proxy: Water cost.

Measure: The industrial rate taken from the "higher usage" schedule of the city.

Source: INOS. Gaceta Oficial No. 2077 Extraordinaria del 15/8/77.

Spatial unit: City.

Variable: <u>Availability of Communication Facilities</u>

Proxy 1: Telephone services

Measure: Number of telephone lines (installed capacity) per thousand inhabitants.

Source: CANTV, Division de Planificación, Anexos Estadísticos, 1975 and 1977.

Spatial unit: City.

Proxy 2: Telex services.

Measure: Number of telex lines (installed capacity) per thousand inhabitants.

Source: CANTV, Division de Planificación, Anexos Estadísticos, 1975 and 1977.

Spatial unit: City.

Variable: <u>Health services</u>

Proxy 1: Available medical doctors.

Measure: Number of inhabitants per doctor

Source: Ministerio de Sanidad y Asistencia Social, Departamento de Estadisticas Vitales.

Spatial unit: State.

Proxy 2: Available hospital beds.

Measure: Number of beds per thousand inhabitants.

Source: Ministerio de Sanidad, Divisiõn de Sistemas Estadísticos y Computaciõn, Secciõn de Estadisticas de Salud.

Spatial unit: City.

Variable: Educational provision

Proxy 1: Children per classroom.

Measure: Number of 5-14 year old children per classroom.

Source: Encuesta de Hogares, Cuadro 1, Poblaciõn total por grupos de edad. OCEI, Segundo semestre, 1975 and 1977.
Memorias del Ministerio de Educaciõn, Educaciõn Preescolar y Primaria, Anexos Estadísticos 1975 and 1977.

Spatial unit: Administrative region.

Proxy 2: Teenagers per classroom.

Measure: Number of 15-19 year old teenagers per classroom

Source: Encuesta de Hogares, Cuadro 1, Poblaciõn total por grupos de edad. OCEI, Segundo semestre, 1975 and 1977.
Memorias del Ministerio de Educaciõn, Educaciõn Media, Anexos Estadísticos 1975 and 1977.

Spatial unit: Administrative region.

Proxy 3:	Teachers per classroom in primary school.
Measure:	Number of teachers per classroom.
Source:	Memorias del Ministerio de Educación, Educación Preescolar y Primaria, Anexos Estadísticos 1975 and 1977.
Spatial unit:	State.

Proxy 4:	Teachers per classroom in High School.
Measure:	Number of teachers per classroom.
Source:	Memorias del Ministerio de Educación, Educación Media, Anexos Estadísticos, 1975 and 1977.
Spatial unit:	State.

Proxy 5:	Students per classroom in primary school.
Measure:	Number of registered students per classroom.
Source:	Memorias del Ministerio de Educación, Educación Preescolar y Primaria, Anexos Estadísticos, 1975 and 1977.
Spatial unit:	State.

Proxy 6:	Students per classroom in high school.
Measure:	Number of registered students per classroom.
Source:	Memorias del Ministerio de Educación, Educación Media, Anexos Estadísticos, 1975 and 1977.
Spatial unit:	State.

Variable:	<u>Shopping facilities</u>
Proxy:	Retail employment.

Measure: Proportion of the city's retail employment to its population.

Source: Encuesta de hogares, Cuadro 8, Población urbana ocupada en comercio al por menor. OCEI, Segundo semestre, 1975 and 1977.

Spatial unit: Administrative region.

Variable: Hotel and meeting facilities

Proxy 1: Employment in restaurants and hotels.

Measure: Proportion of the city's employment in restaurants and hotels, to its population.

Source: Encuesta de Hogares, Cuadro 8, Población urbana ocupada en restaurantes y hoteles. OCEI, Segundo semestre, 1975 and 1977.

Spatial unit: Administrative region.

Variable: Entertainment and cultural provision

Proxy: Those employed in entertaining and cultural services.

Measure: Proportion of the city's employment in entertainment services to its population.

Source: Encuesta de Hogares, Cuadro 8, Población urbana ocupada en servicios de diversión y esparcimiento. OCEI, Segundo semestre, 1975 and 1977.

Spatial unit: Administrative region.

Variable: Local transportation facilities

Proxy 1: Employment in transportation.

Measure: Proportion of the city's employment in transportation to its population.

Source: Encuesta de Hogares, Cuadro 8: Población ocupada en transporte y almacenamiento. OCEI, Segundo semestre, 1975 and 1977.

Spatial unit: Administrative region.

Proxy 2: Public transportation units.

Measure: Number of public transportation vehicles per thousand inhabitants.

Source: Ministerio de Communicaciones, Dirección de Transporte.

Spatial unit: State.

Variable: Personal safety

Proxy: Delinquent index.

Measure: Number of registered cases per thousand inhabitants.

Source: Anuario Estadístico, Cuadro II-5-4, Indice delictivo, OCEI, 1977.

Spatial unit: State.

Variable: Financial incentives

Proxy: Percentage savings in present value terms.

Spatial unit: Area of deconcentration.

Measure: In order to determine how much savings an entrepeneur could have made by locating in an area of deconcentration, a single indicator for the level of subsidy in each area was needed. This indicator had to combine into one measure subsidized interest rates, a market interest rate, a loan period and a grace period, but these aspects varied with the use of the money: whether for land and construction, machinery and equipment, or for working capital. After studying several approaches, the one chosen was based on the concept of net present value. This approach reflected the percentage savings in present value terms obtained by an entrepeneur locating in each of the areas of deconcentration. For each of the components of the loan, e.g., machinery, working capital, etc., the present discounted value of the series of payments was calculated at the actual rate of interest. This discounting procedure allowed us to combine both subsidized and market interest rates, as well as grace and loan periods. It should be noted that when the subsidized and market rates were the same, the percentage savings was zero.

From the information available, it was possible to determine what proportion of a loan was for working capital, for machinery, etc. The following are the average percentages for the loans given by Corpoindustria:

Land and construction	30%
Machinery and equipment	60%
Working capital	10%

By multiplying the percentage savings for each use by the proportion of its corresponding participation and summing the three uses, a single indicator of the percentage savings in present value terms was obtained for each deconcentration area.

The following example will help to clarify the process used. Suppose an entrepeneur is considering borrowing Bs. 100. Furthermore, suppose that if he goes to a designated area, the following loan conditions are offered to him by the government financial institutions:

loan period:	3 years
grace period:	1 year
interest:	8%

Otherwise, he would have to pay the outgoing market rate of, say, 12%.

The entrepeneur may want to know what the current value is, i.e., Present Discount Value (PDV), for the sum of a series of future payments, a, over the period t=1 through t=4, when the market interest rate is 12%. This can be estimated by

$$PDV = \sum_{t=1}^{4} \left(\frac{a}{(1+.12)^t} \right) \tag{C.1}$$

The value of the constant stream, a, when the subsidized interest rate is 8% is given by

$$a = \frac{(.08)\ I\ (1+.08)^n}{(1+.08)^n - 1} \tag{C.2}$$

where n is the number of periods during which payments are made. In our example n=3, since during the first year no payment are made (grace period). Since the interest for the grace period, i.e., Bs. 8, is not paid but added to the amount borrowed, the value of I at the end of the grace period is 100+8=108. Hence the debt service using equation C.2 is:

$$a = \frac{(.08)(108)(1.08)^3}{(1.08)^3 - 1} = 41.91 \qquad \text{(C.2.a)}$$

This implies that from years 2 to 4, our entrepeneur will pay Bs. 41.91 each year. To determine how much these "future payments" are worth to him today, we substitute this value for a in equation C.1. This gives us

$$PDV = 0 + 33.41 + 29.83 + 26.63 = 89.87 \qquad \text{(C.1.a)}$$

For our entrepeneur, paying back three installments of Bs. 41.91 to the government in the future is worth Bs. 89.87 to him today. Furthermore, by getting Bs. 100 today from the government as a loan, he is making a profit of Bs. 10.13 (100.00-89.87). In other words, by going to the designated area, our entrepeneur is saving 10.13%.

Now suppose that the percentage savings for our entrepeneur on the following items is:

Land and construction	10%
Machinery and equipment	15%
Working capital	20%

To obtain a single indicator, we multiply the percentage savings for each use by its corresponding participation and then sum over the uses:

Percentage savings	Participation proportion	
10	(.30)	= 3
15	(.60)	= 9
20	(.10)	= 2
Total percentage savings		14%

APPENDIX D: AGGLOMERATION POTENTIAL MODEL

D.1 Flow characteristics

Flow characteristics are those attributes of a point which reflect the interaction that takes place between a particular city's activity and the activity and geographic location of neighboring cities. For the purpose of this study, the city's activity will be expressed mainly in terms of the manufacturing sector of the economy. Hence, flow characteristics take into account the spatial structure of the manufacturing system.

When the flow characteristics of a city offer locational advantages, it is generally said to have localization economies, i.e., economies external to the firm but internal to a group of firms in a particular location. For example, localization economies may arise from similar plants clustered together and obtaining benefits from joint use of subsidiary facilities, or they may arise by a firm being near to its sources of input and/or market for its output.

A simple classification of the interaction of manufacturing activities may be helpful here. Following Hoover's terminology (Hoover,[1]) we have:

1.- Vertical relationships

2.- Horizontal relationships

3.- Complementary relationships

D.1.1 Vertical relationships

Vertical relationships occur when the outputs of one industry are inputs to another industry. In terms of location it generally implies mutual attraction due to the reduction of transfer costs. Localization advantages obtained by this type of relationship, i.e., from the juxtaposition of several industries linked by trade or production factors, are defined as "industrial complex economies" (Isard and Schooler,[2]). Rarely however, is such attraction equal in both directions. We can distinguish between cases where the linkage is predominantly backward or forward.

Backward linkage:

In the backward linked industrial complex, linkages exist between a firm in industry j and its suppliers in various other industries or sources i.

Because of the incipient conditions of the manufacturing industry in Venezuela, there is a high proportion of inputs which are imported. Hence, it will be useful to separate the attractiveness of the ports and international airports, as sources of imported material, from the local sources.

We will need two different models to measure the attractiveness of backward linkages:

1.- Agglomeration potential associated with local inputs;

2.- Agglomeration potential associated with foreign inputs (imports).

Forward linkage:

In the forward linked industrial complex, linkages exist between a firm in industry i and purchasers of its output in many other industries j. Because the purchasers may be other industrial sectors, (final consumers as well as foreign countries), it will be useful to separate the locational effects that each of the markets have on an industry. Hence, we need a model to represent each of these cases:

3.- Agglomeration potential associated with intermediate markets;

4.- Agglomeration potential associated with foreign markets (exports);

5.- Agglomeration potential associated with domestic final consumers.

D.1.2 Horizontal and complementary relationships

Horizontal relationships involve the competition of firms for either markets or inputs. While the localization effect of horizontal relationships is basically one of mutual repulsion, the localizational effect of complementary relationships is mutual attraction, i.e., an increase of one activity in a city encourages the growth of a complementary activity. This is due to the localizational economies obtained from joint use of subsidiary facilities.

Hence, we need a model to measure these relationships:

6.- Agglomeration potential (negative or positive) associated with the presence of manufacturing activity of the same industrial sector.

D.2 Description of the agglomeration potential model

It has been stated earlier that the attractiveness of a point in space to new manufacturing activity is assumed to also be based upon the flow (or inter-city related) characteristics of the point. This implies that the level of existing activity at that point and points in the vicinity has to be considered, i.e., to be based upon the existing spatial structure of manufacturing.

The model that will be used to measure the agglomeration potential of a point will be based on a spatial interaction model of the potential type. The "potential" concept may be thought of as a measure indicating the intensity of the possibility of interaction. The basic principles underlying potential models can be formulated as follows (Carrothers,[3]):

At a given location p, the potential influence, or possibility of interaction with respect to an individual at p, which is generated by the attractiveness of any given point q, will be greater as the attractiveness of q is larger and will be smaller as the distance between p and q increases. Then according to this formulation, the accessibility of an origin point p to attractions in the destination point q, can be expressed by the basic equation:

$$V^{pq} = \frac{KW^{q}}{T_{pq}^{\alpha}} \qquad \text{(D.1)}$$

where: V^{pq} = Potential at point p generated by the attractiveness of (or activity at) point q.

W^q = Attractiveness of (or level of activity at) point q.

T_{pq} = Transfer cost between point p and q.

α = Transfer cost exponent. We have used α=2. (See further details in the section below, D.4.3, dealing with measuring the proximity to activities).

In our case the constant K is a scale factor which will depend on the industry subgroup being analized.

The potential model can also be formulated as a constrained gravity model (production constrained case). The gravity model is developed by analogy with Newton's Law of Gravitation expressed by the formula

$$F = G \frac{M_1 M_2}{d^2} \tag{D.2}$$

where F = Force with which each mass pulls the other

M_1, M_2 = Size of masses concerned

d = Distance between them

G = Universal constant, the pull of gravity

When the potential model is formulated as a production constrained case of the gravity model, the single constant K in equation D.1 is replaced by a set of proportionality constants $K^{(1)}$ so that the constraint can be satisfied. For a comprehensive review and detailed presentation of spatial interaction models see Reif[4].

Since we are interested in the agglomeration potential of a point p taking into account the activity that takes place in all the points q that are part of the manufacturing spatial structure, we can generalize equation (D.1) by summing over all points q:

$$V^p = \sum_q \left(\frac{K\ W^q}{T^{\alpha}_{pq}} \right) \tag{D.3}$$

Equation D.3 may be identified as the generic potential model that will be used in this study to determine the attractiveness of a location based on the flow chatacteristics. In order to simplify the notation, the superscript p will be dropped, since the potential will always be referred to a particular point p.

D.3 Development of the models

We have identified earlier, the need to develop six different agglomeration potential models to measure the attractiveness of a point for a particular industry. Based on the generic potential model, (equation D.3) we shall develop each of these.

Model 1: Agglomeration potential associated with local inputs

a) Level of activity:

In this model, the "level of activity" i at point q (W^q_i) can be expressed by the proportion of the national production of sector i that takes place at point q. Hence

$$W_i^q = \frac{X_i^q}{X_i} \tag{D.4}$$

where X_i^q = the level of production of sector i at point q.

X_i = the national level of production of sector i.

b) Interaction factor:

Since we are interested in backward linkages, we shall use as interaction factors, the Leontieff input-output technical coefficients. These coefficients are estimated as follows:

$$a_{ij} = \frac{X_{ij}}{X_j} \tag{D.5}$$

where a_{ij} = amount of inputs that industry j must purchase from industry i to produce one unit of its output.

X_{ij} = production of sector i sold to sector j.

X_j = total production of sector j.

In order to distribute the input requirements among the various sources, we shall assume that sector j can potentially purchase a certain amount from each point q and that other things being equal, the amount purchased might be proportional to the production of i in point q. Hence, in order to compute the purchases of input i, that sector j makes at point q, we have

$$M_{ij}^{q} = a_{ij} W_{i}^{q} \quad (D.6)$$

For the production of sector j, inputs are needed from various sectors i, which may have part of their production in the same point q. Hence

$$M_{j}^{q} = \sum_{i} a_{ij} W_{i}^{q} \quad (D.7)$$

where M_j^q = amount of inputs that sector j purchases at point q.

c) Proximity to local sources:

Since we assume that as the distance from point p to the source q increases, the attractiveness of source q decreases, the probability of an actual purchase may be inversely related to the travel function, as expressed in equation D.1. To estimate the attractiveness (probability of actual purchases) to sector j of point p, due to inputs located at point q, we have:

$$V_{j}^{q} = \frac{\sum_{i} a_{ij} W_{i}^{q}}{T_{pq}^{\alpha}} \quad (D.8)$$

Hence, to estimate the attractiveness of point p to industry j, due to inputs located at all points q, we compute

$$V_{j}^{(1)} = \sum_{q} \left(\frac{\sum_{i} a_{ij} W_{i}^{q}}{T_{pq}^{\alpha}} \right) \quad (D.9)$$

The superscript (1) refers to model 1: Agglomeration potential associated with local inputs.

A problem with the index of agglomeration potential associated with local inputs may arise when the industry itself happens to be major supplier of its own inputs, making interpretation of the agglomeration potential index difficult. A large value could indicate not only the great attractiveness of locational input advantages, but could also indicate a large number of potential competitors at that point. In these cases, the interpretation should be done together with model 6 (explained later on) which will pick up this competition effect.

The technical coefficients, a_{ij}, tell us the relative importance in money value terms of the various industries i which are sources to industry j. These belong not only to the processing sector but to the payment sector as well; for example, payment of wages and taxes. Since our concern in this model is with the relative purchases that industry j makes from the various industries i belonging to the processing sector, we may neglect the factor payment sector and use only purchased goods and services. The purchase coefficients can be derived from the technical coefficients in the following way:

$$a^*_{ij} = \frac{a_{ij}}{\sum_i a_{ij}} \quad \text{for} \quad i = 1,2,\ldots k \qquad \text{(D.5.a)}$$

where a^*_{ij} = purchase coefficient.

k = number of industries in the processing sector.

In doing so, we will be able to compare not only the attractiveness, to industry j, of one geographical point against another point (which is the subject matter of the agglomeration potential model), but to compare also the attractiveness of point p to industry i compared to industry j.

Equation D.9 should be rewritten as:

$$V_j^{(1)} = \sum_q \left(\frac{\sum_i a_{ij}^* W_i^q}{T_{pq}^{\alpha}} \right) \tag{D.9.1}$$

<u>Model 2: Agglomeration potential associated with foreign inputs</u>

Level of activity:

For this model, the "level of activity" at a point q reflects the proportion of the production of sector j, that is imported via point q, where q is an international gate (such as a port or airport).

The coefficient for imports, i.e., the amount of inputs per unit of output that sector j imports, m_j, can be computed as:

$$m_j = \frac{I_j}{X_j} \tag{D.10}$$

where I_j = amount of inputs imported by sector j.

X_j = national level of production of sector j.

If we assume for a particular point p that the components of sector j will be imported through the nearest international port, q, then $m_j = m_j^q$.

Hence, the attractiveness of point p to industry j can be expressed as

$$V_j^{(2)} = \frac{m_j^q}{T_{pq}^{\alpha}} \qquad \text{(D.11)}$$

The superscript (2) refers to model 2: Agglomeration potential associated with imports.

Model 3: <u>Agglomeration potential associated with intermediate markets</u>

a) Level of activity:

The "level of activity" j at point q (W_j^q) can be expressed as the proportion of the production of sector j that takes place at point q:

$$W_j^q = \frac{X_j^q}{X_j} \qquad \text{(D.12)}$$

where X_j^q = the level of production of sector j at point q.

X_j = the national level of production of sector j.

b) Interaction factor:

Since we are interested in forward linkages, we shall use as interaction factors the input-output delivery (usually sales) coefficients. These coefficients are estimated as follows:

$$b_{ij} = \frac{X_{ij}}{X_i} \qquad \text{(D.13)}$$

where b_{ij} = amount of dollars of output demanded by industry j for every dollar produced by industry i.

X_{ij} = production of sector i demanded by sector j.

X_i = total production of sector i.

In order to distribute the output of sector i among the various markets, we assume that sector i potentially can sell a certain amount to each point q and that this amount is proportional to the production of j at point q. Hence, in order to compute the potential sales that industry i might make to sector j at point q, we have

$$N_{ij}^q = b_{ij} W_j^q \qquad (D.14)$$

where N_{ij}^q = the proportion of the production of sector i that is sold at point q to sector j.

At point q, industry i sells not only to sector j, but to other sectors as well. Hence, the total sales that industry i makes to all industries located at point q is computed by:

$$N_i^q = \sum_j b_{ij} W_j^q \qquad (D.15)$$

c) Proximity to the intermediate markets:

Since we assume that, as the distance from point p to market points increases, the attractiveness of market q decreases, we will want to divide by the travel function as expressed by equation D.1. To estimate the attractiveness of point p to industry i, due to purchases made by industrial sectors located at point q, can be expressed as:

$$V_i^q = \frac{\sum_j b_{ij} W_j^q}{T_{pq}^{\alpha}} \qquad \text{(D.16)}$$

Hence, a measure of the probability of sales from industry i, located at point p to intermediate markets located at all points q, can be expressed as:

$$V_i^{(3)} = \sum_q \left(\frac{\sum_j b_{ij} W_j^q}{T_{pq}^{\alpha}} \right) \qquad \text{(D.17)}$$

The superscript (3) refers to model 3: Agglomeration potential associated with intermediate markets.

A problem with the index of agglomeration potential associated with intermediate markets may arise when the industry itself happens to be a major consumer of its own products. This problem makes the interpretation of the agglomeration potential index difficult. A large value could indicate not only the great attractiveness of locational market advantages, but could also indicate a large number of potential competitors at that point. In these cases, the interpretation should be done together with model 6 (explained later on) which will pick up this competition effect.

Model 4: Agglomeration potential associated to foreign markets

For this model, the level of activity at point q reflects the proportion of the production of sector i that is exported via point q, where q is an international gate (such as port or airport).

The coefficient for exports of industry i, e_i, can be obtained as:

$$e_i = \frac{E_i}{X_i} \tag{D.18}$$

where E_i = amount of output exported by sector i.

X_i = national level of production of sector i.

If we assume that, for a particular point p, the products of sector i will be exported through the nearest international port, then $e_i = e_i^q$. Hence, the attractiveness of point q to industry i can be expressed as:

$$V_i^{(4)} = \frac{e_i^q}{T_{pq}^{\alpha}} \tag{D.19}$$

The superscript (4) refers to model 4: Agglomeration potential associated with exports.

Model 5: Agglomeration potential associated with domestic final consumers

We may identify two basic domestic final sectors:

1.- Private consumption

2.- Government consumption

Hence, we will need a model for each of them.

Model 5.1: Private consumption ·

a) Level of activity:

For the purpose of this model, the "level of activity" at point q, y^q, reflects the purchasing power of the population in that and neighboring, settlements (catchment area).

To determine the purchasing power of point q, y^q, we assume that this value is proportional to the share of the national income generated at point q. This value is computed by:

$$y^q = \frac{Y^q}{Y} \tag{D.20}$$

where Y^q = Income generated at point q and its catchment area.

Y = National Income.

b) Interaction factor:

The coefficient of final private consumption, c_i, may be estimated as follows:

$$c_i = \frac{X_{ic}}{X_i} \tag{D.20.a}$$

where c_i = Amount of dollars of output demanded by the private consumption sector for every dollar produced by industry i.

X_{ic} = Production of sector i demanded by the private consumption sector.

X_i = Total production of sector i.

In order to distribute the output of sector i among the various points of final private consumption, we assume that private consumption is distributed in the geographical space in the same way as the purchasing power. Hence, the sales to private consumers that industry i makes, F_i^q, at point q, is computed by:

$$F_i^q = c_i y^q \qquad \text{(D.21)}$$

c) Proximity to the final consumer:

Since we assume that, as the distance from point p to the points of final consumption increases, the attractiveness of the market q decreases, we have to take into account the deterrence function, T, as expressed by equation D.1. To estimate the attractiveness of point p to industry i, as a result of the purchases made by the final consumers located at point q, we have:

$$V_i^q = \frac{F_i^q}{T_{pq}^{\alpha}} = \frac{c_i\, y^q}{T_{pq}^{\alpha}} \qquad \text{(D.22)}$$

Hence, the attractiveness of point p to industry i due to the location of final consumers at all points q, can be expressed as:

$$V_i^{(5.1)} = \sum_q \left(\frac{c_i\, y^q}{T_{pq}^{\alpha}} \right) \qquad \text{(D.23)}$$

The superscript (5.1) refers to model 5.1: Agglomeration potential associated with national private final consumers.

Model 5.2: Government consumption

a) Level of activity:

For the purpose of this model, the "level of activity" at point q, g^q, reflects the purchasing power of the government sector in that locale.

To determine the government purchasing power at point q, g^q, we assume that this value is a proportion of the city's government operational expenditures to the national government operational expenditures. This value is computed by

$$g^q = \frac{G^q}{G} \qquad \text{(D.20.1)}$$

where G^q = local government operational expenditure.

G = national government operational expenditure.

b) Interaction factor:

To estimate the coefficient of final government consumption, r_i, we estimate how much the local government spends in each sector i. When data for local government distribution of purchases is not available, we may use the national values and assume that local governments spend their operational budgets in the same way.

When data problems arise in determining the values of the interaction factors c_i and r_i, we may not be able to separate the national final onsumers into private and government. Under this condition we will be able to estimate only one coefficient of final consumption, c_i, in the following way:

$$c_i = \frac{C_i}{X_i} \tag{D.24}$$

where C_i = production of sector i demanded by the sector of final consumers, both private and public and also including net changes in inventories.

X_i = total production of sector i.

The value of the production of sector i demanded by the final consumers, C_i, can be computed as a residual if necessary. Since we know that

$$X_i + I_i = N_i + C_i + E_i \tag{D.25}$$

where X_i = total production of sector i.

I_i = total imports of sector i.

N_i = total sales of sector i to intermediate markets.

C_i = total sales of sector i to final consumers.

E_i = total exports of sector i.

We can easily obtain the value of C_i from equation D.25.

Model 6: <u>Agglomeration potential associated with the presence of manufacturing industry of the same industrial sector</u>

a) Level of activity:

For the purpose of this model, the "level of activity" i at point q, W_i^q, is obtained by the proportion of the total production of i that takes place at point q:

$$W_i^q = \frac{X_i^q}{X_i} \tag{D.4}$$

where X_i^q = production of sector i at point q.

X_i = national production of sector i.

b) Interaction factor:

Since we are interested in the effects due to the presence of the manufacturing industry of the same industrial sector, we only need to consider the purchase coefficients that relate to the same sector and we can disregard all others. Hence,

$$a_{ij}^* = \begin{cases} 0 & \text{for } i \neq j \\ a_{ij}^* & \text{for } i = j \end{cases}$$

c) Proximity to the same industrial sector:

Since we assume that as the distance from point p to the points where the production of the same sector is located increases, the attractiveness (negative or positive) of the point q decreases, we have to take into account the deterrence function, T.

To estimate the attractiveness of point p to industry i as a result of the presence of the same sector i at point q, we have:

$$V_i^q = \frac{W_i^q}{T_{pq}^{\alpha}} \qquad (D.26)$$

Hence, to estimate the attractiveness of point p to industry i, due solely to the presence of industry i at all points q, we compute:

$$V_i^{(6)} = \sum_q \left(\frac{W_i^q}{T_{pq}^{\alpha}} \right) \qquad (D.27)$$

The superscript (6) refers to model 6: Agglomeration potential associated with the presence of the same industrial sector.

D.4 Measuring and data issues

D.4.1 Measuring the level of economic activity

X_i^q = level of production of sector i at point q measured by the bolivares value of output.

Source: Survey tapes for 1975 and 1977.

m_j = amount of inputs per unit of output that sector j imports

e_i = coefficient for exports of industry i.

Source: Input-output table for the Venezuelan economy, Conavial, 1972.

Y^q = income in bolivares generated at point q and its surroundings.

Source: Encuesta de Hogares, Cuadro 29, Ingresos totales e ingresos medios de los hogares por escala de ingreso mensual y area. OCEI, Segundo semestre 1975 and 1977.

G^q = local government operational expenditure.

Source: Presupuesto de las Entidades Federales, Programas Ordinarios de Administración en Inversión. Clasificación Económica de los Gastos Acordados para 1975 and 1977. Adquisición de Bienes y Servicios por Entidades Federales (Partida A-21-Gastos Corrientes).

D.4.2 Measuring the interaction between activities

a_{ij} = bolivares of input that industry j must purchase from industry i to produce one bolivar of its output. (Technical coefficients).

b_{ij} = amount of bolivares of output demanded by industry j for every bolivar produced by industry i.

c_i = bolivares of production of sector i demanded by the sector of private final consumers.

r_i = bolivares of production of sector i demanded by the sector of government final consumption.

Source: Input-output table for the Venezuelan economy, Conavial, 1971.

Since the input-output table give us the technical coefficients (a_{ij}) which are by "columns", the "row" coefficients may be estimated as follows:

We know that

$$b_{ij} = \frac{X_{ij}}{X_i}$$

and:

$$a_{ij} = \frac{X_{ij}}{X_j} \quad ; \quad X_{ij} = a_{ij} X_j$$

then, substituting we have

$$b_{ij} = \frac{a_{ij} X_j}{X_i}$$

D.4.3 Measuring the proximity to the activities

T_{pq} = Transfer cost between point p and point q.

Several variables are suitable for measuring distance: straight line mileage, road mileage, transport costs, etc. Due to data availability, travel time is used.

Source: Tiempos entre centroides, Ministerio de Communicaciones.

α = Transfer cost exponent. Due to data limitations, it was not possible to calibrate this exponent for the Venezuelan environment. Nevertheless, most of the studies done in other countries have used values which range between 1.5 and 2.5. (See for example Blair[5]). Ablas and Azzoni[6] use α=1 in their study of Brazil. For our purposes it was selected α=2.

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Appendix B

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