The Correspondence Between the Urban System and the Economic Base of Canada's Regions

Michel Boisvert

C COUNCIL OF CANADA

The Correspondence Between the Urban System and the Economic Base of Canada's Regions
Michel Boisvert

The Correspondence Between the Urban System and the Economic Base of Canada's Regions

MICHEL BOISVERT

The Correspondence Between the Urban System and the Economic Base of Canada's Regions

ECONOMIC COUNCIL OF CANADA

Available by mail from

Printing and Publishing
Supply and Services Canada
Hull, Quebec, Canada K1A 0S9

or through your bookseller.

Catalogue No. EC22-60/1978 Canada: $4.75
ISBN 0-660-10022-3 ✓ Other Countries: $5.70

Price subject to change without notice.

This study reflects the views of the author and not necessarily those of the Economic Council of Canada.

Table of Contents

List of Tables

List of Charts

List of Maps

Preamble

This study served as technical background material for the Economic Council of Canada's report, Living Together: A Study of Regional Disparities. Several persons contributed in one way or another to this work. First, Michel Meunier and Michel Legault identified the urban systems and collected and processed the data, with the help of Marc Blouin and Pierre Mercier as computer analysts. Joseph Chung drew up the preliminary outline for the project and suggested, in particular, the application of a logit type model for the analysis of urban growth. Neil Swan offered many comments throughout the work. Finally, Claude Sigouin produced the charts and maps, Elizabeth Morris was responsible for typing the text and Mark Villeneuve for its translation into English. Still, the author retains full responsibility for the contents.

Abstract

As a rule, there are advantages to concentrating economic activity and grouping the population of a region into large metropolitan centres. A very clear positive correlation can be observed between urban size and the growth rate of employment as well as per capita income. While the relationship with the unemployment rate is not very stable, the participation rate is also positively related to urban size. Since the degree of concentration in large centres differs between regions, it is important, for regional planning purposes, to identify the obstacles to this concentration.

This study first examines how the industrial structure of a region, particularly its economic base, imposes a number of constraints on the geographic distribution of population. Three types of regions are defined and their characteristics examined in the context of Canada's regions: resource regions, where the economy is based on the primary sector and the population is only slightly urbanized; transformation regions, which are specialized in those manufacturing industries related to raw materials and in which the regional metropolis contains a large proportion of the economic activity; fabrication regions, which possess, in addition, assembly industries geared to final demand and for which one of the geographic characteristics, besides high population density, is the emergence of satellite metropolitan agglomerations near a development pole.

Other factors capable of modifying the functioning of an urban system are also examined in turn: the biophysical characteristics of a region, differences in the behavioural patterns, traces left by successive stages of development. Finally, the study shows how certain modifications to the urban

system could influence the economic base of a region. Two approaches are used: the first one takes the existing industrial structure as given while the second one examines in a long-term perspective changes in the industrial structure.

The Correspondence Between the Urban System and the Economic Base of Canada's Regions

1 Introduction

Whereas attention during the industrial revolution period was put on the urbanization-industrialization dual phenomenon in those societies that had reached maturity in their economic development, the salient phenomenon now is metropolitanization-tertiarization. Canada is no exception to this rule.

Over the 1961-71 period (see Table 1-1) not only did urban population[1] grow at a much more rapid rate than rural or semi-urban population, but the large metropolitan-sized agglomerations (over 100,000 population) gained most from this geographic redistribution. Such demographic growth is primarily explained by the rapid growth in the demand for services, particularly the specialized services, and by the higher degree of labour intensity required in this type of activity.

All regions of Canada, however, did not experience the same pattern of growth; in British Columbia, for example, the population growth rate was not influenced as clearly by urban size and several cities whose growth was based upon the exploitation of natural resources showed remarkable performances.[2]

1 Semi-urban municipalities are defined here as those municipalities with 1,000 to 5,000 population, while rural areas are composed of those with a population of less than 1,000 and unincorporated settlements. Suburban municipalities have all been included with their urban core, based on geographic limits defined by Census Canada.

2 In addition to the rural-urban dichotomy, the metropolitan factor and the westward shift in the country's centre of gravity, two additional trends, expressed as geographic gradients, are also revealed in the analysis of local

(continued page 5)

Table 1-1

Growth Rate of Rural, Semi-Urban and Urban Population by Size and Region, 1961-71[a]

	Size Category in 1961									
Region	Rural	Semi-Urban[b]	5,000-10,000	10,000-25,000	25,000-50,000	50,000-100,000	100,000-200,000	200,000-500,000	500,000 and Over	Total
Atlantic	5.9	11.5	11.2	0.3	11.7	5.7	18.3	--	--	8.4
Quebec	0.2	-2.0	9.3	14.2	12.0	7.6	17.6	26.8	23.8	14.6
Ontario	13.5	11.5	9.3	9.6	16.6	21.5	29.0	24.3	37.0	23.5
Prairies	-9.7	33.9	13.6	14.4	4.3	32.3	23.7	28.7	--	11.4
British Columbia	41.1	30.8	27.9	44.6	39.3	--	26.7	--	31.0	34.1
Canada	4.6	11.5	11.5	16.4	14.9	15.3	23.2	26.4	30.0	18.3

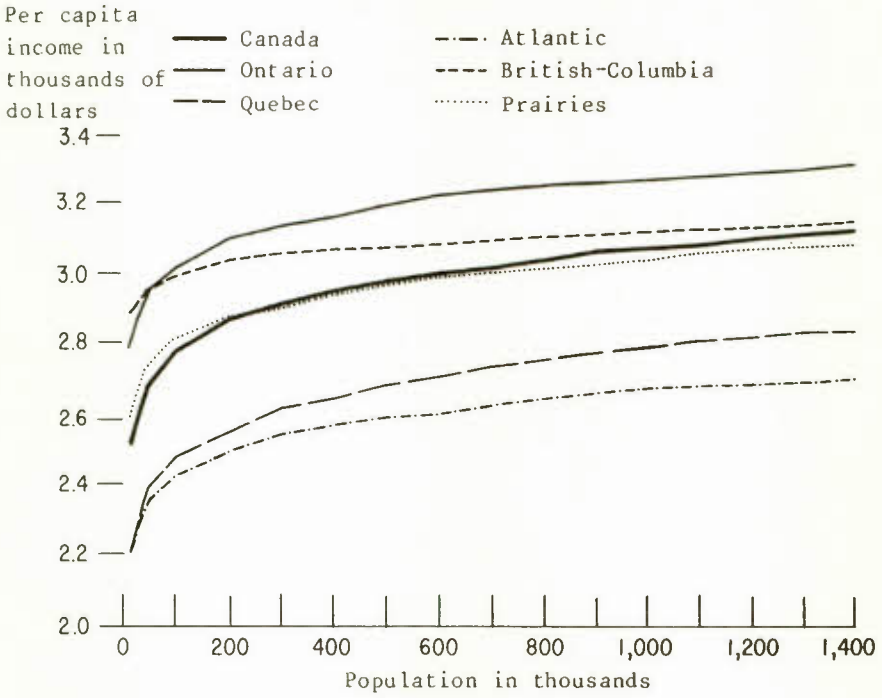
a Necessary corrections to geographic limits of urban agglomerations were made to ensure comparability of 1961 with 1971.

b Estimates based on those municipalities whose geographical limits were not altered during the ten-year period.

Sources: 1961, 1971 Census and estimates by the Economic Council of Canada.

Chart 1-1

Per Capita Income and Urban Size
by Region in Canada, 1970



Source: Results of regression analyses of a semi-logarithmic function using data from the 1971 Census.

The economic implications of the metropolitan clustering phenomenon have already given rise to much work, particularly in the area of the rela-

(conclusion footnote 2)

growth: the establishment of multinational firms in Southwestern Ontario and the English-French cultural difference. D. M. Ray and P. Y. Villeneuve, "Population Growth and Distribution in Canada: Problems, Process and Policies", in Regional Development and Planning International Perspective, ed. A. R. Kuklinski, Leyden, Netherlands: Sythoff, 1975, 91-120.

tionship between urban size and average income.[3] Chart 1-1 illustrates the rise in per capita income with urban size, for Canada as a whole and for each of the major regions.[4] While a large part of the

3 For Canada, D. M. Ray and T. N. Brewis, "The Geography of Income and its Correlates", The Canadian Geographer, 20, 1, 1976, 41-71 and M. Boisvert and M. Legault, La relation entre la taille urbaine et le revenu per capita, au Canada, Economic Council of Canada, Ottawa, Discussion Paper No. 115, April 1978.

4 The estimated statistical relationships are as follows:

y_i = per capita income, in agglomeration i;

POP_i = population size of agglomeration i.

Ontario : $y_i = 1{,}761 + 109.0 \ln POP_i$
(8.28) (5.17)
$F = 26.8 \quad \bar{R}^2 = .27 \quad n = 70$

Quebec : $y_i = 928 + 135.0 \ln POP_i$
(2.84) (4.10)
$F = 16.8 \quad \bar{R}^2 = 0.24 \quad n = 51$

Atlantic : $y_i = 1{,}174 + 109.0 \ln POP_i$
(1.73) (1.54)
$F = 2.38 \quad \bar{R}^2 = .04 \quad n = 32$

Prairies : $y_i = 1{,}690 + 97.8 \ln POP_i$
(5.10) (2.94)
$F = 8.6 \quad \bar{R}^2 = .20 \quad n = 31$

British Columbia : $y_i = 2{,}369 + 54.0 \ln POP_i$
(5.27) (1.20)
$F = 1.45 \quad \bar{R}^2 = .02 \quad n = 21$

Canada : $y_i = 1{,}357 + 124.0 \ln POP_i$
(6.28) (5.7)
$F = 32.6 \quad \bar{R}^2 = .13 \quad n = 205$

Unless otherwise indicated, throughout the study the numbers in parentheses under the estimated parameters give the Student t value used to determine whether the coefficients are significantly different from 0. In addition, F corresponds to the indicator used for the Fisher test, $\bar{R}^2$ to the corrected coefficient of determination and n to the number of observations.

phenomenon is explained by factors that at first appear to be independent of productivity -- participation rate positively related to urban size, changes in the occupational structure with a concentration in highly paid occupations, a phenomenon of accumulated wealth -- the concentration of the population in a limited area is sufficient to generate external economies, commonly called agglomeration economies. This increase in productivity arises as well from a reduction in transportation costs, a better utilization of the available labour force and an improvement in the quality of management brought about by a better accessibility to the market and to technical innovations.[5]

Thus, three of the main socio-economic welfare indicators -- growth rate of employment, per capita income and participation rate -- appear to be positively related to urban size. We may therefore question whether all Canadian regions benefit from this phenomenon by concentrating a large part of their population in metropolitan centres; the following map provides the answer.

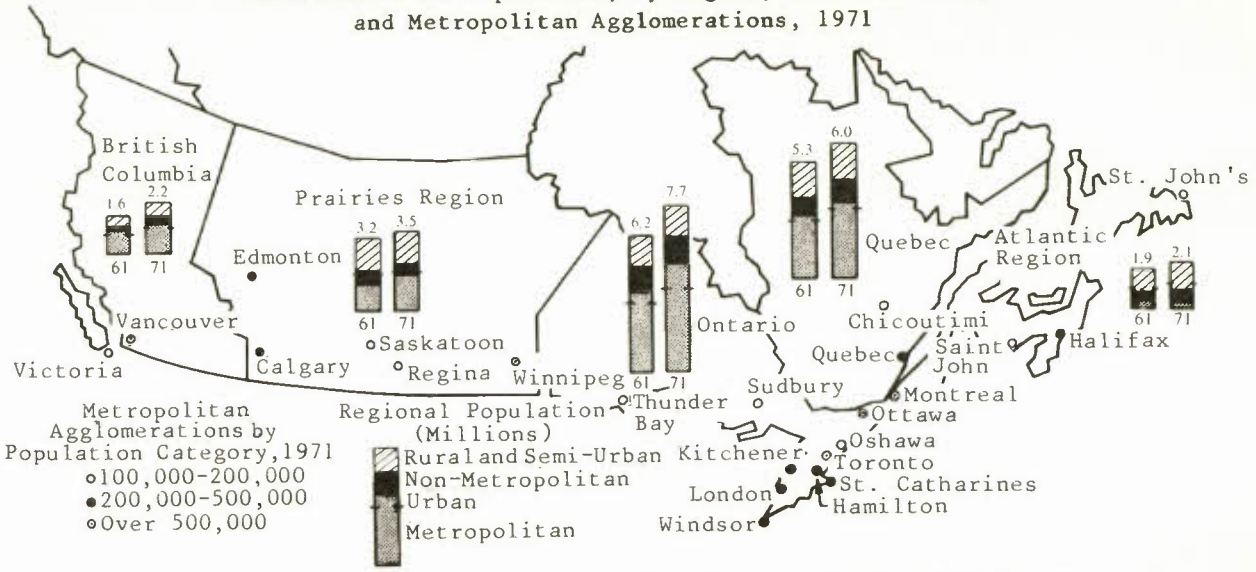
Major differences exist between the regions of Canada in both the level of urbanization and the proportion of small, medium-sized and large cities. The Atlantic region is by far the least urbanized. Moreover, its primate city, Halifax, had a population of only 222,637 in 1971, compared with 2,743,208 in Quebec, 2,628,043 in Ontario, 540,262 in the Prairies, and 1,082,352 in British Columbia. This last region is very urbanized but practically devoid of intermediate-sized cities. If we disregard Ottawa-Hull, Quebec has only three metropolitan centres while Ontario has nine.

It is possible to get an overall idea of the importance of urban structure by estimating the

5 On the one hand, it is clear that for the firms themselves part of these effects is cancelled by the cost of land in metropolitan areas; it is reasonable to believe, however, that because of the growth performances of these areas, this rent does not totally cancel the gains achieved. On the other hand, there is no doubt that agglomerating population creates problems of congestion; the field of urban planning, though, can provide, in our opinion, the necessary measures to solve these problems.

Map 1-1

Distribution of Population, by Region, 1961 and 1971, and Metropolitan Agglomerations, 1971



Source: Economic Council of Canada, Living Together: A Study of Regional Disparities, (Ottawa: Supply and Services Canada, 1977), p. 124.

value that would be obtained for each performance indicator if the geographic distribution of population in each region was the same as in Ontario, where the greatest concentration of population in metropolitan centres is found, assuming further that the performances of each geographic class in each region are maintained constant at 1971 levels. Of course, this exercise is very limited since, in order to meet the second requirement, we must assume in particular that the characteristics of rural manpower meet the requirements of urban labour markets and that the repercussions of improved labour productivity in the less urbanized regions on the competitive ability of these regions, as well as the changes in migration patterns, will be compensated for by appropriate international migrations and adjustments to the economic system, to the extent of maintaining the performances of each geographic class in each region at the observed 1971 level. Despite these limits, the exercise is interesting and easy to carry out. The results are shown in Table 1-2.

Because of the significant increase in per capita income with urban size and major interregional differences in urban structure, the range in per capita income between the regions would be under all restrictions considerably narrowed. As in the case of the other indicators, this reduction would result primarily from the Atlantic region's performances, since Quebec would be affected very little, which means that, at an interregional level, its poor performance is not closely linked to the particular features of its urban structure. However, even if performances could be improved by changing the geographic distribution of population, the practicality of such a reorganization would still have to be examined. A question could therefore be stated as follows: What are the major obstacles to a high concentration of economic activity in metropolitan centres?

We believe that the answer to this question will be found by examining the interaction between the economic base of a region and the characteristics of its urban system; the primary purpose of this study will therefore be to thoroughly scrutinize this structural correspondence. The economic

Table 1-2

Regional Performance Indicators Observed and Expected From a Geographic Distribution of Population Identical to That in Ontario[a]

Region \ Indicator	Per Capita Income 1970		Demographic Growth Rate 1961-71		Unemployment Rate in June 1971	
	Observed	Expected	Observed	Expected	Observed	Expected
Atlantic	1,948	2,379[b]	8.4	19.5[b]	8.32	7.37[b]
Quebec	2,489	2,471	14.6	16.4	10.06	9.60
Ontario	3,097	3,097	23.5	23.5	6.85	6.85
Prairies	2,453	2,684[b]	11.4	20.1[b]	6.16	6.85[b]
British Columbia	3,000	3,005[b]	34.1	30.1[b]	8.99	8.37[b]
Canada	2,700	2,783	18.3	20.6	7.89	7.74

a Computed by assuming a population distribution, among the various rural, semi-urban, and urban classes, identical to that in Ontario, but with performance indicators in each group in each region maintained constant at the level observed during the 1971 Census.

b When a class in the distribution did not exist in the region, we used as a performance indicator an estimate based on the statistical relationship observed for the country as a whole between this indicator, the urban size, and the region. The size chosen was either the median or the lower limit in the case of the residual class.

Source: Basic data from 1971 Census.

base is made up of those production activities whose market extends beyond the normal limits of a city or region's hinterland and therefore corresponds to the exporting sector of the local economy.[6] The concept of urban system covers both the geographic distribution of population (urban structure) and the various forms of interaction among the different parts of a region (spatial dynamics).

The approach we will follow is based upon a production sequence development theory whose main points can be summarized as follows. Economic development in a region usually undergoes three distinct stages: exploitation of natural resources, local transformation of these resources, and utilization of the transformed products in the fabrication of various items. Thus, the exported goods differ depending on the stage of development: raw materials, semi-finished products, finished products. Apart from the purely economic implications of such a view -- for example, on the pattern of financial flows or the location of control centres for investment decisions -- the spatial implications appear to us to be important and poorly understood.

The first part of this study will attempt to clarify the constraints imposed by the industrial structure on the functioning of urban systems. We will then examine the role played by variables other than the existing economic base, such as the biophysical characteristics of a region (density of natural resources, availability of water routes, etc.) and the traces left by the preceding development stages. Chapter 5 will examine the opposite situation, where certain transformations in urban structure or spatial dynamics can influence the industrial structure of a region either by increasing productivity and therefore the competitiveness of the existing industries or by enabling the implanting of new industries.

6 Some additional details will be provided in following chapters. On the theory of the economic base, cf. J. F. Gras, "La théorie de la base économique, son histoire, son utilisation", Revue géographique de l'Est, 11, 3, 1971, 297-317, and M. D. Thomas, "The Export Base and Development Stages Theories of Regional Economic Growth: An Appraisal", Land Economics, 15, 4, 1964, 421-432.

Economic policy considerations cannot be discussed without relating them to a well-defined context. The study is therefore constructed expressly to deal with the Canadian situation. This appears most opportune in light of the importance of the urban aspect in discussions on Regional Planning policies in Canada. To what extent could growth and productivity in the Atlantic region be enhanced by the concentration of private and public investment in a given location, such as Halifax or Moncton? Is the concentration of Quebec's economic activity in the Montreal metropolitan region as great as Ontario's in Greater Toronto? Does Montreal grow at the expense of the rest of Quebec? Should we consider a greater interdependence of urban agglomerations in the Prairie region as a necessary condition for expanding the manufacturing sector in its economy? These are only a few of the current questions urgently requiring answers. This study, will not provide definitive answers, but rather will propose an original framework for analysis that hopefully will clear the way for more detailed studies.

2 The Influence of the Economic Base on the Urban System of a Region

2.1. The Stages of Economic Development

2.1.1. Exploitation of Natural Resources

In 1963, based on the work of several historians,[1] Harold Innis in particular,[2] Melville Watkins[3] proposed an economic development theory based on the exploitation of natural resources, and thus on the export of raw materials, which was called the staples theory. His declared purpose was not to draw up a general theory of economic development nor to elaborate a specific theory for economies oriented towards foreign markets but to interpret the Canadian experience with an overall scenario designed for "new" countries characterized by an abundance of natural resources and the absence of restrictive societal mechanisms. While there is no

1 W. A. Mackintosh, "Some Aspects of a Pioneer Economy", Canadian Journal of Economics and Political Science, 2, November 1936, 457-63; D. C. North, "Location Theory and Regional Economic Growth," Journal of Political Economy, 63, 1955, 243-58; W. T. Easterbrook, "Recent Contributions to Economic History: Canada," Journal of Economic History, 19, March 1959, 76-102.

2 H. A. Innis, The Fur Trade in Canada: an Introduction to Canadian Economic History, Toronto: University of Toronto Press, 1930; The Cod Fisheries: the History of an International Economy, Toronto: idem, 1940; Essays in Canadian Economic History, Toronto: idem, 1956.

3 M. H. Watkins, "A Staple Theory of Economic Growth", Canadian Journal of Economic and Political Science, 24, 2, May 1963 , 141-58.

doubt that these characteristics alone are no longer sufficient for the study of the development of the Canadian economy, for several regions in Canada this approach still provides a reference framework that is quite appropriate. For the other regions, it provides an understanding of basic trends, particularly in the make-up of regional urban systems, as we will see later.

In a "new" country, three mechanisms are directly inferred from the original economic conditions:

1 the export of staples is the driving sector in the economy from both a quantitative point of view (growth rate of total employment and population) and a qualitative point of view (changes in social composition and economic organization);

2 it is essential to resort to imports and immigration to obtain scarce resources such as capital and labour; and

3 to maintain growth, an economy of this type must develop such a great ability to adapt that it easily transfers its productive resources from one export sector to another, thus keeping up with the disturbances in the market place (changes in supply and demand conditions in international markets) and problems of resource renewal (exhaustion of a staple).

To these mechanisms must be added the process of diversification of the economic base itself. The extension of the industrial structure of a region proceeds, as indicated by Hirschman,[4] in three directions: the backward linkages, or the establishment of industries providing equipment; the forward linkages, or the establishment of industries transforming locally these staples into semi-finished products prior to export; and the links to the final demand, or the establishment of goods and more likely service industries aimed at personal

4 A. O. Hirschman, The Strategy of Economic Development, New Haven, Conn.: Yale University Press, 1958, Chapter 6.

consumption. According to Watkins, little can be expected of the first because of the large number of barriers to entry in the machinery industry; only the establishment of a transportation infrastructure can imply major investments. The forward linkages effects obviously will depend on the region's relative profitability as a location for processing operations, for which the main factors mentioned are: the existence of tariffs in the client countries for the manufactured products; economies of scale present in the transformation process, which differ from one type of staple to another; and the region's accessibility to markets as measured by transportation costs in particular. Finally, the size of the final demand related activities will be positively influenced by the size of the domestic market, or more precisely by the volume of regional income reflected in the average level of income and the degree of inequality in the distribution of incomes.[5]

In addition to these demand conditions, some factors of local supply are also considered relevant for production growth and increases in productivity not only in the staples sector (original economic base) but also in the industries that grow from it (some of which broaden the economic base). The first is entrepreneurship, defined as the ability to identify and exploit the market's opportunities. Watkins points out that, when entrepreneurship is foreign, it runs the risk of not fully exploiting these opportunities because of those strong clustering forces present in manufacturing and because uncertainty is greater than in the country where the decision-making centres are located;[6] furthermore, the emergence of local entrepreneurship is described as "crucial" at both the public and private levels, and one of the basic determinants

5 Because the propensity to import increases with the level of individual income in this type of economy.

6 This idea was previously suggested, namely by G. Myrdal, Economic Theory and Underdeveloped Regions, London: G. Duckworth & Co., 1957, and by A. Hirschman, op. cit., 184-87. It was later put forward by many Canadian authors including K. Levitt, Silent Surrender: the Multinational Corporation in Canada, Toronto: MacMillan, 1970.

for its emergence is the actual type of staple exploited. The availability of labour and investment funds also plays a major role. Immigration will primarily be a function of relative wages offered, of the existing social structure and of the characteristics of the communications network with respect to foreign communities. Just as in the case of foreign capital, the obstacle represented by the "new" country (labelled "resource-region" here) must first be overcome before domestic savings are invested at home.[7]

As already noted several times, the type of staple has a major influence on the economic development in this type of region. For instance, the links to the outside world and the availability of capital, from foreign sources in particular, will be greater in the case of cereal production (feed grains) than in dairy production, because the former is based on larger operating units and greater capital intensity and is related to international rather than interregional or local markets. Similarly, some minerals, either because refining reduces weight considerably or because they are found in conglomerates underground, will lend themselves more to preliminary on-site transformation.

On the whole, the abundance of "rare" resources and the small native population provide immediate access to a high standard of living that can be maintained and increased provided, especially, that immigration is controlled and the tendency to overinvest in the resource sector alone[8] is countered with industrial divesification. If these conditions are not met, the risks of falling into a staple trap and resembling a traditional underdeveloped economy

7 "It is only when there are abundant opportunities in domestic markets waiting to be exploited that the amount of domestic saving will significantly determine the rate of investment", M. Watkins, op. cit., p. 148.

8 This tendency arises from a mentality found in the underdeveloped countries that could be labelled as colonial. For a theoretical treatment of this issue, see W. T. Easterbrook, "Uncertainty and Economic Change", Journal of Economic History, 14, Autumn 1954, 346-60.

are enormous. In a second stage of development, mainly identifiable by a shift in exports from the primary to the transformation sector, Watkins also notes the appearance of the following features: an increase in the natural population growth component as compared with net immigration and a substitution of local entrepreneurs for foreign control and domestic savings for imported capital.

2.1.2. The Distinction Between Transformation and Fabrication Industries

While it is useful when investigating consumption and forecasting the growth of the branches that make up the manufacturing sector to distinguish between durable and nondurable goods, it is preferable when determining the location of firms and forecasting the geographic distribution of the manufacturing sector in a given area to distinguish instead between transformation and fabrication activities.[9] A transformation activity may be defined as a productive process whose purpose is to transform a staple through refining, rolling, or stamping operations, which form part of a fairly long sequence. A fabrication activity is a productive process whose purpose is to integrate several inputs through assembly operations. Thus, the good brought to the market will be a semi-finished product in the former case and a finished product (capital or consumption good) in the latter. The production of steel is a transformation activity while the production of automobiles belongs to the fabrication category; other examples are the production of textiles on the one hand and the manufacture of clothing on the other, the refining of petroleum and the fabrication of cosmetics, the production of paper and publishing activities.

As is often the case, it is difficult to completely and unequivocally allocate an entire

9 This distinction originated primarily in the pioneering work of J. P. Fines, Analyse spatialisée des structures de production industrielle, Centre d'économie régionale, Aix-en-Provence, 1972.

Table 2-1

Classification of Manufacturing Sector Into Transformation and Fabrication Industries

Transformation Industries	Fabrication Industries
Food and beverage	Knitting mills
Tobacco	Clothing
Rubber and plastic products	Furniture and fixture
Leather	Printing, publishing and allied
Textile	Metal fabricating
Wood	Machinery
Paper and allied	Transportation equipment
Primary metal	Electrical products
Non-metallic mineral products	Chemical and chemical products
Petroleum and coal products	Miscellaneous manufacturing industries
10	10

industry within a group setting such as this one, particularly when the basic information is taken from the Standard Industrial Classification[10] into 20 major groups. In our opinion, the regrouping shown in Table 2-1 is the one best suited to the definition of each type even though the group of

10 Standard Industrial Classification Manual, revised 1970, Dominion Bureau of Statistics, Cat. No. 12-501, Ottawa, 1970.

transformation industries is fairly heterogeneous.[11] While the food and beverage industry, and to a lesser degree the textile and leather industries, actually deliver a considerable proportion of finished goods, they have been classified here as transformation industries because the number of inputs in their production processes and the operations carried out resemble transformation more than assembly.[12]

The notion of production sequence upon which this approach is based requires that we introduce as well the concept of industrial complex.[13] An industrial complex can be defined simply as a group of closely related production activities whose

11 While the Standard Industrial Classification does not make the distinction between transformation and fabrication industries, the occupational classification used in the latest Census does break down the manufacturing sector into three major groups: processing occupations; machining and related occupations; product fabricating, assembling and repairing occupations. We considered the first two groups as belonging to the transformation industries and tried to keep as close as possible to the Occupational Classification Manual, Census of Canada 1971, Ottawa: Dominion Bureau of Statistics, 1971, Cat. No. 12-536.

12 Fines distinguishes three groups within these transformation industries: complete sequence (e.g., agriculture and food); incomplete sequence (e.g., primary metal); complex and interdependent networks (e.g., petrochemical).

13 We owe this expression to W. Isard and T. Vietorisz, "Industrial Complex Analysis and Regional Development, With Particular Reference to Puerto Rico," Regional Science Association, Papers and Proceedings, 1, 1955, 1-17. The most recent works in this field, which have clear pertinence to this discussion, are those of S. Czamanski, Study of Clustering of Industries, Halifax, Dalhousie University: Institute of Public Affairs, 1974, and Study of Spatial Industrial Complexes, idem, 1976, as well as the study by the Office de planifaction et de dévelopement du Québec, Filières de production et développement régional, Collection Etudes et Recherches, Québec, 1977.

complementarity is measured by the intensity of exchanges in goods and services. To identify these industrial complexes, a Leontief input-output table must be available, and anappropriate method for tracing the contours and measuring the coefficients of intensity must be applied. Czamanski,[14] for example, using an input-output table of the 1963 U.S. economy incorporating a classification into 171 industries, identified 16 industrial complexes, four of which were in the service sector. As expected, the industries we have chosen to classify as transformation activities are found in several industrial complexes along with fabrication industries, since they generally sell their products to the latter. It is important to realize, however, that despite these links in the production sequence, there is no need for geographic juxtaposition,[15] and that each type of activity (transformation and fabrication) grows in a different manner.

The first proposition dictates that we look at the industrial location theory. The first point that can easily be established is that transformation activities are influenced more by accessibility to raw materials than fabrication industries in the selection of an appropriate location, while the latter are more dependent upon accessibility to the market. Indeed, a raw material is transformed as much by refining as by stamping and the range of semi-finished products is usually less extensive than that provided by a fabrication industry. Both characteristics favour locations near raw materials deposits since this leads to a reduction in transportation costs, which represent a much more important element in total production costs of transformation industries than fabrication industries.[16] Transportation also represents an

14 S. Czamanski, 1974, op. cit.

15 For a discussion of this matter, see F. Perroux, L'économie du XXe siècle, Paris, Presses Universitaires de France, 1964.

16 Transportation costs (direct purchases and internal operations) in transformation industries are estimated at 6.7 per cent of total cost compared with 2.7 per cent in fabrication industries. These are unweighted averages obtained from the major groups and the standard error is 4.6 in the first case and 1.01 in the second. Estimates are taken from R. Beaudry, "Une analyse de l'importance des coûts de transport au Canada", Working Paper, Economic Council of Canada, Ottawa, September 1976.

important factor in the location of fabrication industries but because of the high number of suppliers (for the assembly operations) and customers (for the finished products), it will take the form of rapid and diversified means of transportation and communications,[17] thus requiring a high volume of operations favouring geographic concentration in a metropolitan location. Since reserves of natural resources and market areas for the finished products rarely overlap geographically,[18] there is a strong probability that the two types of activities examined here will be separated by some distance.

There is also another basic difference between transformation and fabrication activities that gives rise to this geographic separation: the influence of technological innovation. Two aspects must be dealt with here. First, innovations primarily affect production techniques in the transformation industries and products themselves in the fabrication industries. Second, because inputs and outputs are more homogeneous and research and development activities specializing in production machinery are more autonomous, technological innovations will spread faster in a transformation industry regardless of geographic location.[19] On the contrary, as each fabrication firm attempts to market exclusive products, whose life expectancy will therefore be fairly short, it will frequently be forced to modify the range of its products either by establishing its own research and development section or by soliciting the services of specialized firms. In both cases, two factors will decisively influence the location of such operations: the need

17 M. J. Barloon, "The Interrelationship of the Changing Structure of American Transportation and Changes in Industrial Location," Land Economics, 41, 1965, 169-79.

18 This may even be true simply because the non-renewable character of most raw materials results in a resource frontier that moves faster than the agricultural and human settlement frontiers.

19 E. Mansfield, Industrial Research and Technological Innovation: An Econometric Analysis, New York: Norton, 1968.

to cluster all together in a single location and the requirements of the professional staff who prefer a diversified cultural environment. Consequently, the influence of technological innovation[20] also helps to demonstrate a fundamental difference in the location of transformation and fabrication industries.

The growth of fabrication industries differs from that of transformation industries in several ways. For instance, we find much more diversification in the range of products in the fabrication industries where output is directly linked to final demand. Furthermore, through the sequence leading from the transformation of raw materials to the fabrication of finished products, the range of products in each production unit is expanded. From this we may deduce that the basic factors of industrial growth will also be different; endowment in natural resources (quantity, quality and combination) and accessibility to markets as measured by transportation costs will have a determining influence on the growth of transformation industries. Accessibility to an innovation generating environment as well as the quality of the communications network will play a primary role in the growth of fabrication industries.

Finally, an important difference is also found in the utilization of labour as a factor of production. To study this matter, we have estimated for each of the manufacturing industries in Canada a CES-type production function[21] using value added in

20 A convincing discussion of the importance of innovation in explaining industrial location and eventually the formation of urban systems will be found in J. R. Lasuén, "Urbanization and Development -- The Temporal Interaction Between Geographical and Sectoral Clusters," Urban Studies, 10, 1973, 163-88.

21 Assuming the absence of residual auto-correlation, we applied the ordinary least squares method to a Taylor series expansion of the logarithmic equivalent of a CES function, in accordance with the method suggested by J. Kmenta, "On Estimation of the CES Production Function," International Economic Review, 8, 1967, 180-89 and applied in particular by P. Zarembka, "On the Empirical Relevance of the CES Production Function," Review of Economics and Statistics, February 1970, 47-53.

constant dollars as the dependent variable and the number of man/hours paid and the difference between gross and net investment (consumption of capital) in constant dollars[22] as independent variables. The estimated coefficient for the returns to scale and the elasticity of substitution coefficient computed from the parameters of the production function appear in Table 2-2.

While there is no remarkable difference between the two groups of industries in returns to scale, we find that the elasticity of substitution coefficient for all fabrication industries does not significantly differ from 1, while six of the nine transformation industries surveyed have a coefficient significantly greater than 1. This means that if the marginal productivity of capital doubles in relation to the marginal productivity of labour, we may continue to produce the same output with the same quantity of capital while decreasing the quantity of labour by half in the fabrication industries and by even more in the transformation industries. We must therefore conclude that fabrication industries will react to technical progress associated with increases in capital productivity with less intensity in terms of layoffs.

We conclude in general that the growth of transformation industries will first be influenced by the growth in demand -- a derived demand because we are dealing here with semi-finished products -- and that firms will generally seek to minimize production costs. In contrast, the growth of fabrication industries will be more influenced by supply conditions and the behaviour of the firms will in a broader way look for profit maximization, which implies in particular the determination of an

22 We have chosen capital consumption instead of capital stock so that all the variables in the production function would be flow measures, even though data on capital consumption drawn from the Statistics Canada publication Fixed Capital Flows and Stocks, Manufacturing, Canada 1926-1969, Cat. No. 13-543, are also imperfect.

Table 2-2

Parameters of the CES Production Function,
Manufacturing, Canada, 1958-69

	Coefficient of Substitution Elasticity σ	Student t Value for the Coefficient[c] $\left(\frac{\rho\upsilon\delta(1-\delta)}{2}\right)$	Returns to Scale υ	Student t Value for the Coefficient υ
Transformation industries				
Food and beverages	0.991*	2.34	0.668	1.38
Tobacco[a]	1.019*	2.42	-0.316*	3.67
Rubber	1.007*	3.07	1.387*	2.51
Leather	n.a.	n.a.	n.a.	n.a.
Textiles	1.007*	2.19	1.993*	4.40
Wood[b]	1.017	1.08	1.442*	2.18
Paper	1.018*	1.89	2.064*	1.98
Primary metal[b]	1.009*	2.25	1.377*	3.55
Non-metallic minerals	1.016*	2.05	1.337*	3.28
Coal and oil	0.979	1.28	0.821	0.34

Fabrication industries

Hosiery	1.021	0.80	2.364*	3.36
Clothing	0.995	0.71	1.429*	1.97
Furniture and fixtures	0.950	0.24	1.442*	6.87
Printing and publishing	1.026	1.07	2.107*	4.70
Metal products[b]	1.739	0.34	1.332*	10.20
Machinery[b]	0.979	1.47	1.360*	6.78
Transportation equipment	1.005	1.20	1.692*	8.20
Electrical appliances	1.008	1.03	1.526	1.42
Chemical products	0.989	2.16	1.768	0.93
Other manufacturing industries	1.012	1.02	1.568*	2.98

*Significantly different from 1 at a level of at least 90 per cent.

a The labour variable used is the number of employees in production.

b Because of modifications to industrial classification, the period covered is from 1961 to 1969.

c Since $\sigma = 1/(1-\rho)$, we conclude that σ will not be significantly different from 1 if ρ is not significantly different from 0. The null hypotheses ($\rho=0$) is tested from the Student test on the coefficient $\left(\frac{\rho\upsilon\delta\,(1-\delta)}{2}\right)$ in the estimated equation:

$$\log Q_t = \log\gamma + \upsilon\delta \log\left(\frac{K_t}{L_t}\right) + \upsilon \log L_t - \frac{\rho\upsilon\delta\,(1-\delta)}{2}\left[\log\left(\frac{K_t}{L_t}\right)\right]^2$$

Source: Data from Statistics Canada, Cat. Nos. 31-201, 31-202, 61-506 and 13-543. The classification into two groups of industries is from Table 2-1.

optimum combination of outputs and a competitive strategy including price wars.[23]

2.1.3. Three Types of Regions

If, on the one hand, a "new" country must go through a first stage of development based on the extraction of raw materials and a second stage of industrialization and if, on the other hand, there exists within the manufacturing industries a fundamental difference between transformation and fabrication industries in terms of locational factors leading to a fairly clear geographic separation, we must conclude that there are three stages of development and therefore three types of regions.[24] These will be called resource regions, transformation regions, and fabrication regions.[25] We can also infer from this production

23 These conclusions would require empirical support to actually be useful in the construction of a complete theoretical framework. Since they are only accessory to the present argument, they are mentioned here simply due to their consistency with the earlier material presented and their likelihood.

24 Many authors, from Hoover to Bell, foresee as a fourth stage the post-industrial society in which the tertiary sector would be the main basic sector. We have doubts, however, about the possibility of distinguishing between a fabrication region and a post-industrial region, in a perspective of regional differentiation. In all respects, it appears premature to us to borrow this paradigm for the study of Canadian regions. E. M. Hoover and J. Fisher, "Research in Regional Economic Growth," Problems in the Study of Economic Growth, New York: National Bureau of Economic Research, 1949, chap. 5; and D. Bell, The Coming of Post-Industrial Society: A Venture in Social Forecasting, New York: Basic Book, 1973.

25 Since the transformation stage is a period of transition, it is easy here to establish a parallel with the four types of region proposed by J. Friedmann: resource regions; transition regions, growing or declining; and core regions. The distinction between transformation activities and fabrication activities is not explicit however. J. Friedmann, Regional Development Policy, Cambridge, Mass.: M.I.T. Press, 1966.

sequence development theory that, although a region's natural growth pattern involves modification of its economic base accordingly, several conditions will have to be met to ensure this scenario.[26] Because transformation plants require vast supply areas and fabrication industries usually locate close to large population zones, the size of the market to be served presents a threshold that must be passed over before the industrial structure can be modified. The market may grow through an increase in the total volume of activity within the region or through the improvement of conditons of accessibility to export or procurement markets. In a broader perspective, economic development is also accompanied by institutional and societal adjustments facilitated by the emergence of an entrepreneurial" class able to perceive and take advantage of development opportunities as well as to provide the region with the institutions necessary for ensuring self-propelled long-term development. This last condition implies in particular the control of financial markets[27] by residents of the region.

It is also important to examine the implications of this scenario for inter-regional links. On the one hand, in a resource region and even a transformation region, within the scope of production sequence development, a large part of the decisions likely to influence regional growth will be taken outside the region. On the other hand, since the sequential development process occurs more through the addition of new industries than through the substitution of new activities for older ones, a fabrication region may be endowed with sufficient physical and human resources to ensure a large degree of autonomy. Still, because of the exhaustion of raw materials brought on by both the non-renewable character of several among these materials and the rapid increase in the needs of the fabrication regions, where absolute population expansion is greatest, the usual pattern is one of several transformation and resource regions being polarized by one fabrication region.

26 This historical dimension will be developed further in Chapter 5.

27 Jean Labasse, L'espace financier, Paris, Armand Colin, 1974, pp. 256-58.

2.2. Spatial Settlement Patterns Associated With Each Stage

It is possible to associate with each of the development stages just described a spatial settlement pattern defining a number of characteristics of the urban system.[28] These constraints, although insufficient to describe in detail the functioning of a particular urban system, do allow us nonetheless to identify some of the obstacles to the concentration of population in major metropolitan centres. Three aspects will be studied here. First, the urban structure through indicators such as the form of the urban pyramid, the level of urbanization and the degree of primate concentration.[29] Second, spatial dynamics as revealed by the intensity and direction of intra-regional flows of products, capital, individuals and information. Finally, temporal dynamics, which describe the concomitant growth of the system and its components throughout a given stage of development.

Before proceeding with this detailed examination, however, it is important to stress that we have been greatly inspired by the works of Jean-Claude Perrin and his colleagues in the Centre d'économie régionale at Aix-en-Provence[30] and of

28 Looking for an overall correspondence between the economic base and the urban system in a region has of course been attempted in the past. Population settlement in Southern Ontario for instance was examined along these lines by J. M. Gilmour, "The Dynamics of Spatial Change in the Export Region", in Locational Dynamics of Manufacturing Activity, L. Collins and D. Walker eds., New York: John Wiley, 1975, 59-82.

29 The proportion of the population or economic activity of a region located in its primate city or regional metropolis.

30 In particular, Le développement régional, Paris, Presses Universitaires de France, 1974 et "Les liaisons industrialisation-urbanisation et l'organisation industrielle en France," Revue d'économie appliquée, février 1975.

James Simmons in the Geography Department at the University of Toronto.[31]

2.2.1. Resource Regions

A low rate of urbanization, a small degree of primate concentration and an overall urban pyramid in the form of an upside down *T (I)* are typical of the urban structure in a resource region. These characteristics may be inferred directly from the economic conditions of a region whose economic base lies exclusively in the primary sector, as described above in the production sequence development theory.

On the one hand, the exploitation of natural resources usually requires a vast territory, whether for ecological reasons such as the low density of resources (fisheries), for economic reasons such as the increase in extraction costs that comes with deeper mining pits, or for a combination of the two, such as the exhaustion of supply areas (forestry). On the other hand, the minimum scale of operation needed for profitability frequently requires a fairly small number of workers; this is particularly the case in agriculture. Thus, at the outset there is a large number of production units, scattered accordingly over a fairly unurbanized area. Small towns will nevertheless provide the necessary transportation, trade, and personal services required primarily to satisfy daily needs.

The transformation of raw materials remains at an embryonic stage. The first consequence of this is to deprive the urban centres of an important source of urban growth and thus limit intra-regional commodity flows to a minimum by shipping output out of the region. Some centres will nonetheless take on a greater size for various reasons, for example, the need for preliminary processing of the raw material in order to refine it (sawmills, iron ore

31 Notably, Canada as an Urban System: A Conceptual Framework, Research Paper 62, May 1974 and The Canadian Urban System, Toronto: University of Toronto Press, (forthcoming).

pelletization plants) or prepare it for transportation (freezing of fish, packaging). Other reasons include the concentration of public services and the requirements of the transportation network since rail and water transportation, to be efficient, must operate from staging points. The regional metropolis, under these conditions, will be that urban agglomeration which, in addition to having the basic primary activities, will also attract one or more of these additional functions. However, the percentage of the regional population concentrated in this metropolis that is the degree of primate concentration will still remain very small.

From the standpoint of spatial dynamics, the primary characteristic of a resource region will be the strong degree of independence of the urban components, in other words, very little interaction. Therefore, the transportation network is characterized by multiple exit points. Indeed, given the little local transformation of raw materials, shipments to other regions will be much more important than intra-regional flows. Moreover, a resource region is rarely limited to a single raw material. Not only do we frequently find several primary activities side by side, such as the mining, forestry, and energy sectors but also, within a single sector such as mining, the exploitation of a mineral depends on a market that is partly independent of other mining markets. This relative independence may lead to parallel lines in the regional transportation network and a proliferation of transportation nodes. If we therefore exclude the distribution of consumer goods and services, which follows everywhere a hierarchical pattern[32] of location, and limit ourselves to the actual export-base sector, the resource region is characterized by a very low intensity of intra-regional shipments. Because of the dependence on external markets and the small absolute and relative size of the regional metropolis, we must also conclude that the flows of capital and information (particularly production control decisions) will primarily come from outside the region. Labour mobility will be fairly common and, once again, oriented more towards the other

32 A. Losch, The Economics of Location, translated by W. H. Woglom, New Haven, Conn.: Yale University Press, 1954.

regions. These relatively large migration flows will result from the very high specialization of the economic base, which reduces the possibility of industrial mobility -- without migration -- for unemployed workers, as well as from the restricted range of occupations for the young. We should also mention the frequent poverty of service facilities, resulting from the low population density in the area.

Finally, in a resource region, one should expect a large dispersion of growth rates among the urban centres, mainly because of the heterogeneous character and even independence of each centre, coming out of the specialized economic base. Furthermore, since the primary sector plays a leading role, growth should depend above all on biophysical characteristics and geographic accessibility of each urban centre: only the regional metropolis could therefore generally demonstrate a link between its growth and that of the region as a whole.

2.2.2. Transformation Regions

Compared with that of a resource region, the urban structure of a transformation region generally undergoes the following modifications: the addition of intermediate-sized urban centres, a significant increase in the size of the regional metropolis, and a much clearer relative domination of this metropolis. The level of urbanization will therefore rise and the urban pyramid will take on a much more regular form, that of a cone (*A*).

These characteristics of the urban structure result directly from the production sequence development process. First, one of the necessary conditions for increased local transformation of raw materials is a sufficient volume of primary activity which, of course, is accompanied by a major increase in employment and regional population. Two consequences of this growth phenomenon are, in our context, important: first, the multiplier effect on activities, particularly services, serving a regional market; second, the structural effect that

allows the addition of local production of semi-finished goods to the exports of raw materials. We know that, in both cases, urban size acts as a strong locational factor on these types of activities, giving rise to greater growth perspectives, first for the regional metropolis, and then for the remaining of the urban system.

Besides, most manufacturing processes present possibilities of economies of scale, further enhanced by product specialization; this implies that raw materials are transformed along stages. But factors of industrial location are not necessarily identical from one transformation stage to the next nor from one raw material type to another. This is why we must expect varying degrees of geographic dispersion and fairly different scales of operation. It is not certain that all stages in the transformation process will be carried out within the region in which the deposits of raw materials are found, but it is true that the process, and the complementarity to which it gives rise, represent a very common pattern of regional development.

This complementarity among the components of the urban system represents as a matter of fact the main spatial dynamic characteristic in a transformation region. As we have just pointed out, the stages in the transformation process will often be carried out in distinct geographic locations; consequently, the export of a semi-finished product will require the co-operation of several urban centres and thus the existence of more intense interurban interaction within the region than previously. The direction of these flows will follow the channels of the urban hierarchy simply because the basic sector in the individual urban centres will grow through the addition of new functions rather than through the replacement of former functions that would have become obsolete. In other words, the regional metropolis will dominate its region much more clearly in terms of weight and direction of flows because it will have added, rather than substituted, the entire range of transformation stages to the primary operations. However, because of the importance of vertical integration for the control of production and the necessity of locating the headquarters of large

corporations close to financial intermediaries and consulting firms, decisions will still be made primarily outside the region except for small and medium-sized firms (SMF) grouped around these industrial nodes. Labour migration to other regions should be reduced due to the complementarity existing in the urban system while the probability of the regional metropolis as place of destination should increase. On the whole, for both capital and labour mobility, the situation should get close to zero net movement, that is, an equilibrium between local savings and investment, emigration and immigration.[33]

Finally, because of the complementarity just mentioned and the elements of diversification introduced into the industrial structure, temporal dynamics should demonstrate a smaller dispersion between the region's growth and that of each of its urban components. Thus, when demand for an export product increases or decreases, a greater part of the region is affected.

2.2.3. Fabrication Regions

Fabrication activities appear in a third stage of development but actually are added to the extraction and transformation activities already present. Therefore, from the standpoint of total production they may not represent a very high percentage of the regional product. They are capable, nonetheless, of imposing a number of new features on the urban system already in operation. The most important changes to the urban structure will be as follows: a sharp rise in the rate of urbanization and a very large increase in the size

33 In an historical perspective, such as J. Friedmann's, in which the transitional characteristic of this type of region is emphasized and growing regions are distinguished from declining regions, the former should therefore obtain a greater volume of investment than the volume of savings and a net positive immigration while the latter would show the reverse. When combined, the average of the performances should nonetheless approach zero net movement. J. Friedmann, op. cit.

of the urban metropolis. The urban pyramid will therefore appear truncated to reflect this significant domination by the metropolis (λ).

Actually, in the first part of this chapter, we presented two fundamental characteristics proper to fabrication industries: the need for rapid and diversified transportation means and the frequent occurence of technological innovations. We also mentioned that the direct result of such conditions on location was proximity to a large metropolitan centre that is usually a called a "development pole."[34] These considerations are used to define the geographic limits of a fabrication region but, despite the existence of a bias in favour of location within the metropolis, they are not sufficient to reveal the pattern of intra-regional location. To do this, we must also resort to the greater dependence (than in transformation industries) on labour as a locational factor (which, in the case of a skilled labour force, leads to metropolitan concentration but, in the case of unskilled labour, leads to scattering in the hinterland), the influence of land costs (which favour suburbs and satellite cities, besides agricultural areas), and the importance of accessibility to transformation plants (located in urban areas), resulting in a high margin of indetermination. These fabrication industries are often called "footloose". But it is important to note that we are dealing here with an indetermination that only exists within the geographic limits of the fabrication region. On the whole, we can therefore state that fabrication industries will tend to locate either in large metropolitan centres

34 This expression was created in order to take into account this role of innovation promoter. However, we believe that, if a development pole does not itself generate completely original innovations (as in A. R. Pred) or play a leadership role in the adoption of innovations imported from all around the world (as in F. Martin), the development pole can and must adapt the innovations to the physical and social peculiarities of the region it dominates. A. R. Pred, The Spatial Dynamics of U.S. Urban Industrial Growth, Cambridge, Mass.: M.I.T. Press, 1966; F. Martin, La dynamique du développement urbain au Québec, Québec, Editeur officiel du Québec, 1976.

or in their immediate hinterland, but with a strong bias towards an urban site.

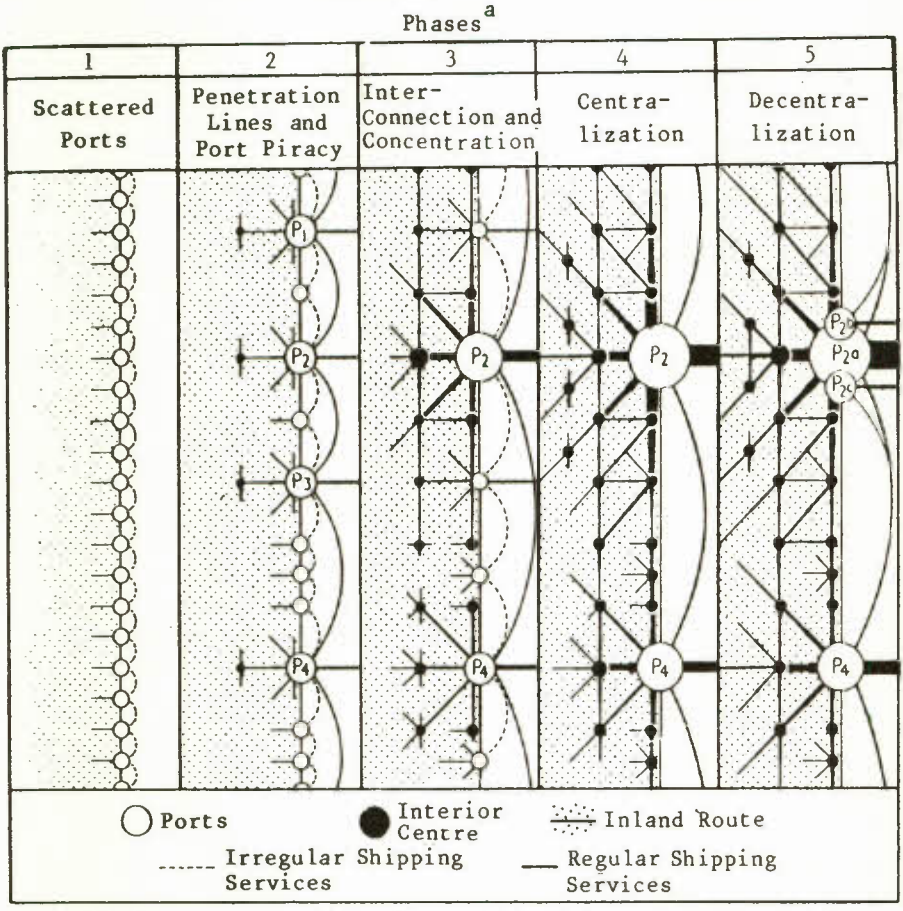
In terms of spatial dynamics, the very fact that fabrication industries are found at the end of the production sequence requires more frequent inter-industrial and therefore interurban flows; these will also be of larger size and in many more directions than in the case of urban systems specializing in transformation activities. But while there is even more complementarity, there also exists the possibility of competition between the various urban components[35] since each one possesses its own individual combination of location factors that can be adapted to the particular requirements of one or several fabrication industries at a given time. We can therefore state that, contrary to the resource regions, cities within a fabrication region will engage in frequent exchanges and that, contrary to transformation regions, these exchange flows will not be largely dominated by the hierarchical urban structure. While it is undeniable that capital and, to a lesser extent, decisions will originate primarily from the regional metropolis, it does hold true that labour mobility should resemble the flow of goods and occur in all directions. This set of characteristics thus sets in motion a polynucleation process. The growth of the transportation network from one development stage to the next is well illustrated in Chart 2-1 by the development pattern suggested by Rimmer.

The growth patterns of each systems component compared with the region as a whole should first reflect the existing complementarity by being very close to each other, except of course for the

35 Interurban competition has also been mentioned in the case of megalopolises but with a different meaning. Within a fabrication region, competition is based on the industrial location characteristics offered by each component for the establishment of new production units. There also exists lively competition between fabrication regions and particularly between their regional metropolises but this time at the level of final goods. The Great Lakes Megalopolis: From Civilization to Ecumenization, Minutes of the Great Lakes Megalopolis Symposium held in Toronto, March 1975, Ottawa: Ministry of State for Urban Affairs, 1976, particularly the text by J. Gottman, pp. 1-11.

Chart 2-1

Development of a Water Transportation Network, According to Rimmer



a Following our reasoning, Stages 1 and 2 correspond to the resource stage, 3 and 4 to the transformation stage, and 5 to the fabrication stage.

Source: P. J. Rimmer, "The Search for Spatial Regularities in the Development of Australian Seaports, 1861-1961", Georgrafiska Annaler 49 B, 1967, 42-54.

Table 2-3

Pattern of Land Settlement Associated With Each Type of Region

	Resource Region	Transformation Region	Fabrication Region
Urban structure	Nodalization	Metropolitan concentration	Peri-metropolitan diffusion
Urban pyramid	$\mathcal{L}$	Λ	λ
Level of urbanization*	low	average	high
Concentration in regional metropolis	low	high	high
Regional metropolis:			
Absolute size	low	average	high
Other caracteristics	major primary activities + transportation + refining	average transformation activities + transportation	high fabrication activities in the metropolis and its immediate hinterland
Spatial dynamics	Independence	Complimentary	Competition
Spatial interaction $\left(\frac{\text{External exchanges}}{\text{Internal exchanges}}\right)^*$	low	average	high

(continued)

Table 2-3 (concluded)

	Resource Region	Transformation Region	Fabrication Region
Output	$>\mid$	$\approx\mid$	$<\mid$
Capital	$>\mid$	$\approx\mid$	$<\mid$
Labour	$>\mid$	$\approx\mid$	$<\mid$
Decisions	$>\mid$	$>\mid$	$<\mid$
Transportation network:			
Number of nodes	multiplicity	domination of the	polynucleation
Direction of flows	parallel	metropolis based on urban hierarchy	diffuse
Temporal dynamics			
Dispersion of growth*	large	average	small
Link between regional growth and urban growth	limited to regional metropolis	more extensive	depending on urban size
Driving force of regional and urban growth	Bio-physical characteristics and accessibility	accessibility and volume of operation	intensity of communication channels and innovation

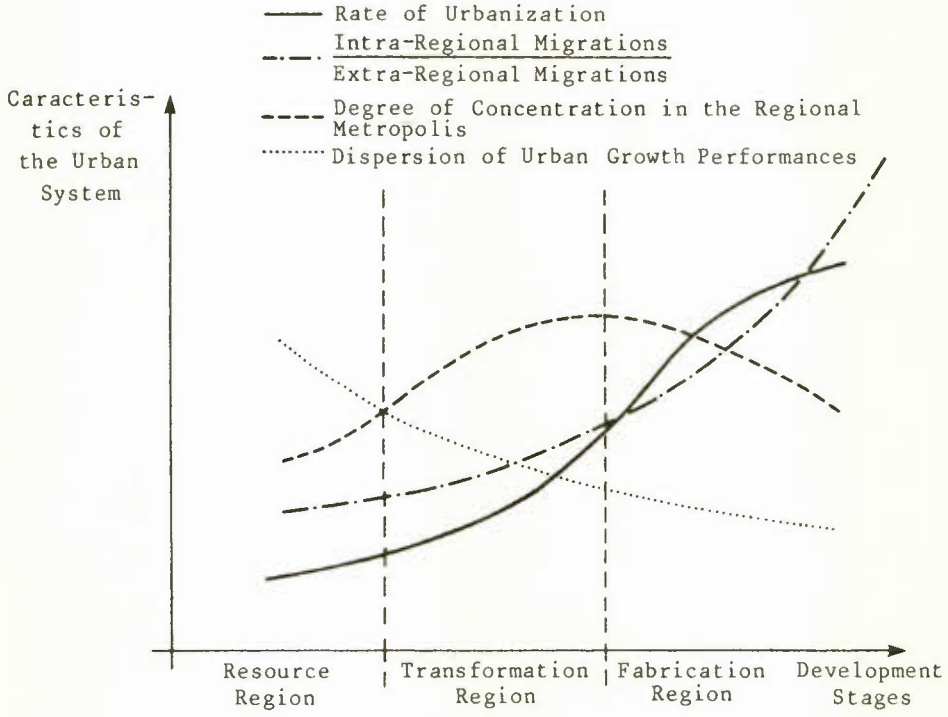
*Illustrated in Chart 2-2.

regional metropolis, which should exhibit exceptionally strong growth. Another possible exception could be the odd centre that has been able to exploit its locational advantages with more success in this context of intra-regional competition.

Table 2-3 gives a general view of the spatial settlement pattern associated with each type of region. Chart 2-2 illustrates the growth of some of these characteristics through the development stages. The empirical testing of these relationships will be made in the following chapter.

Chart 2-2

Characteristics of the Urban System Depending on the Stage of Economic Development



3 Application to Canadian Regions

3.1. Information Used

3.1.1. Regional Partitioning

Application of the developmental approach presented in the preceeding chapter requires the partitioning of Canada into distinct regions, each covering a continuous and exclusive area. Fortunately, much has already been written on methods of regionalization.[1] Boudeville[2] suggests three principles for drawing up these methods, resulting in "homogeneous", "polarized" and "planning" regions. In the first case, the desired objective is to group together those spatial units that share the greatest number of common traits, thus creating homogeneous regions and reducing total intra-regional heterogeneity. In the second case, the spatial units are put together according to interaction flows; this is a dynamic rather than static approach. It is true, however, that those spatial units subject to a high degree of interaction very often have numerous characteristics in common. Finally, the planning region is obtained by applying a principle of administrative efficiency and is aimed at dividing an area in such a way that measures of government intervention be as effective

1 For a brief presentation of these methods, cf L. King, Statistical Analysis in Geography, Englewood Cliffs, N.J.: Prentice Hall Inc., 1969, chapter 8.

2 J. R. Boudeville, "Modèle de croissance urbaine du bassin parisien", Cahiers de l'Institut de science économique appliquée, 2, 6, June 1968.

as possible; the existing administrative partitions are therefore usually borrowed upon.

The issue that interests us here, the mutual influence of the economic base and the urban system of a region, leads to the following considerations. First, the most significant spatial unit will be the urban centre. Second, it will be necessary to define polarized regions since exchanges between cities are used in the actual definition of an urban system. The search for common traits will be useful later on, however, when the regions are classified according to the three types of regions outlined in Chapter 2.

Since we are interested in the workings of the urban system and since there always exists a hierarchical structure within a system as it relates to non-basic activities,[3] we first looked for regional metropolises by limiting our choice to metropolitan areas, that is those urban agglomerations with a 1971 population of over 100,000. This criterion produced 23 possible urban systems in the country.

Whenever two metropolitan areas are very close to each other, there is a good chance that dependency links do exist between them, which can be measured by the intensity of interaction carried on between the other urban centres located in their hinterlands and between each of these metropolitan areas. Indeed, if agglomeration *A* is dependent (insofar as it belongs to an urban system of which it is not the metropolis) on agglomeration *B*, the urban centres in the hinterland will establish more intensive links with *B* than with *A*. Our second criterion for identifying Canadian urban systems was therefore the following: the distance between two regional metropolises must be at least 200 miles except when a metropolitan area that is not a primate city succeeds in attracting at least 10 per cent of the automobile traffic witnin a radius of 250 miles.[4] This criterion allowed us to establish

3 Central place theory and its applications may be mentioned here. B.J.L. Berry and A. Pred, Central Place Studies, A Bibliography of Theory and applications, Philadelphia: Regional Science Research Institute, 2nd edition, 1965.

4 The data on automobile traffic were obtained from recent studies conducted by the Canadian Transport Commission.

a separate urban system for Quebec City and Ottawa, despite their proximity to Montreal, but forced us into considering Hamilton, Ste. Catherines, Kitchener, Oshawa and London as components of the Toronto system and Victoria as part of the Vancouver system. We therefore dropped from 23 potential regional metropolises to a maximum of 17.

We then proceeded into the assignment of each of the 204 urban agglomerations with a population over 5,000[5] to one of these 17 regional metropolises by using two criteria derived from gravity models that are widely used to represent in a simple way the intensity of links between distinct geographic units.[6] First, only those urban agglomerations located within less than 250 driving miles of a regional metropolis could be considered as part of its urban system;[7] we are actually assuming that beyond this distance the influence of the metropolis will be too weak to make it part of the urban system. As a result, 26 of the 204 urban agglomerations could not be included in an urban system because of the distance separating them from the regional metropolises.[8] Second, in all cases where the hinterlands of two regional metropolises overlapped, we assigned the urban agglomerations involved in the overlapping to the regional metropolis whose population divided by the distance

5 The 204 urban agglomerations comprise 22 census metropolitan areas, 38 census urban areas whose population is over 25,000, 5 conurbations based upon municipalities with over 5,000 population and 139 incorporated municipalities with a population over 5,000.

6 G. Olsson, "Central Place Systems, Spatial Interaction and Stochastic Processes", Papers of the Regional Science Association, 18, 1967, 13-45 and A. G. Wilson, Entropy in Urban and Regional Modelling, London: Pion, 1970.

7 Except for the St. John's urban system, for which we decided to include all the urban centres found on the Island of Newfoundland.

8 These agglomerations are obviously located on the settlement frontier. After identifying the regions endowed with urban systems, we will define within the excluded areas a certain number of rural regions.

squared gave the highest index. This criterion, as well as serving to identify the components of each urban system, led to consolidation into 13 urban systems rather than 17 as expected. First, Windsor and Thunder Bay, although meeting the criteria for metropolitan size and distance from neighbouring regional metropolises were found for all practical purposes to be alone in their own urban system; we therefore decided to assign them to the closest regional metropolis, Toronto and Winnipeg respectively. Moreover, Regina and Saskatoon on the one hand and Edmonton and Calgary on the other have almost identical populations; we decided to group them, along with the urban centres of their respective hinterland, in two bi-polar urban systems.

The 13 urban systems[9] thus identified generally correspond to the densely populated regions in eight provinces plus three regions each in Quebec and Ontario. A total of 178 out of 204 urban agglomerations were thus distributed.[10] We also considered that each urban system provides a structure for an urban region whose limits are defined by the set of census divisions required to include all components of the urban system and to form a continuous spatial area.

Still, if the partitioning is to apply to the whole country, it is necessary, because of the low rate of urbanization associated with resource regions, to introduce rural regions whose main features are a regional metropolis with a population under 100,000 and a remoteness from the 13 regional

9 Using the Canadian urban system map presented by J. Simmons, it is possible to identify nine urban sub-systems in the country. The main differences are the relative autonomy given here to five urban systems: St. John's, Saint John, Chicoutimi, Sudbury and Regina-Saskatoon and the grouping of regions dominated by Calgary and Edmonton into a single bi-polar urban system. J. W. Simmons, "Short-Term Income Growth in the Canadian Urban System", Canadian Geographer, 20, 4, 1976, 419-31.

10 A series of maps indicating the location of each agglomeration in the urban structure of each region and its level in the urban hierarchy is presented in Appendix A.

metropolises already identified, which prevented their allocation to the latter.

Two categories of rural regions were found. The first are those located to the north of the regions already defined: Labrador (which also includes two census divisions on the Island of Newfoundland); the Far North (which includes all of the Northwest Territories, northern Manitoba and Saskatchewan); and the two regions of northern and central British Columbia (whose limits are the same as those used by the Provincial Department of Economic Development). In addition to these four remote regions, we found three buffer-regions i.e., located between urban regions: Gaspesia, Northwestern Quebec and Southeastern British Columbia.[11] This gives us a total of 13 urban regions and 7 rural regions, as illustrated in Map 3-1.[12]

3.1.2. Variables Used

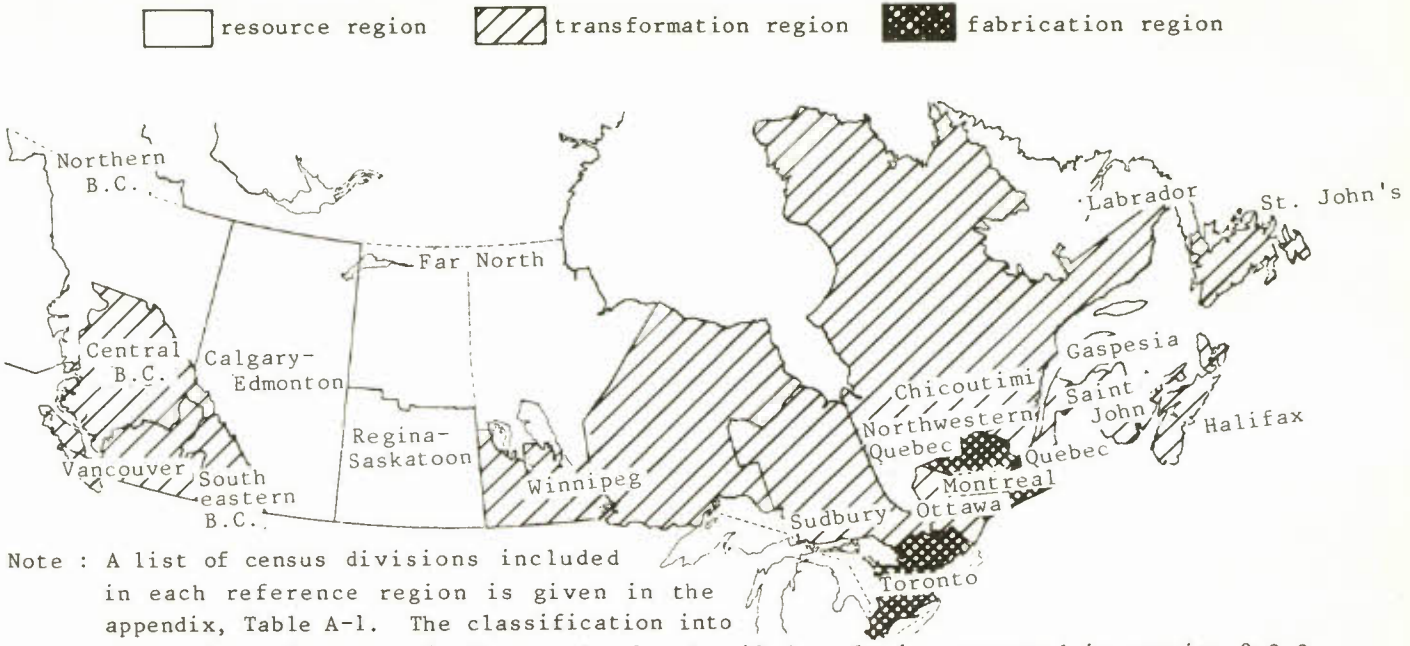
The following three tables provide the basic information used for classification into the three types of regions described in the preceding chapter. Table 3-1 gives an outline of the demographic characteristics of each region obtained from the most recent census. Strictly in terms of population size, there exists a remarkable heterogeneity among the various regions. The population of all seven rural regions is less than 225,000; at the other extreme, Montreal and Toronto are obviously in a class of their own. Looking at the other demographic characteristics, it is interesting to note that as the regional population size increases, the

11 The six census divisions found on the border between Manitoba and Saskatchewan could have been considered together as a buffer-region but, because they were less than 250 miles from Winnipeg, we chose to include them in the Winnipeg region.

12 The census divisions forming each of the reference regions as well as the urban centres located in each of the rural regions are listed in Appendix A.

Map 3-1

Partitioning of Canada Into 20 Reference Regions Based
on 1971 Census Division Boundaries



Note : A list of census divisions included in each reference region is given in the appendix, Table A-1. The classification into three types of regions is the result of a detailed analysis presented in section 3.2.2.

Table 3-1

Demographic Characteristics of Reference Regions

	Population					Age Group of Total Population, 1971		Population Aged 5 Years and Over Not Attending School Full Time With University Studies, 1971
				Annual Average Growth Rate				
	1961	1971	1976	1961-1971	1971-1976	0-14 Years	15-64 Years	
						(Per cent)		
Labrador	79,039	101,996	111,211	2.6	1.8	40.9	54.4	4.4
Northern British Columbia	87,827	123,479	129,603	3.5	1.0	36.5	60.0	8.6
Far North	90,487	125,846	139,269	3.4	2.0	42.0	55.0	7.2
Southeastern British Columbia	122,564	146,548	162,587	1.8	2.1	29.9	62.0	9.1
Northwestern Quebec	155,484	142,890	141,100	-0.8	-0.2	36.3[a]	59.1[a]	4.5[a]
Gaspesia	187,967	172,602	167,214	-0.8	-0.6	35.1	58.4	3.4
Central British Columbia	136,632	211,370	257,343	4.5	4.0	35.3	60.5	8.4
Chicoutimi	357,443	400,924	423,691	1.2	1.1	35.6[b]	61.0[b]	5.9[b]
St. John's	378,814	420,108	444,682	1.1	1.1	36.4	57.1	6.4
Sudbury	535,283	582,379	583,746	0.9	0.0	33.2	60.5	6.3
Saint John	597,936	634,557	677,250	0.6	1.3	32.0	59.4	7.2
Halifax	841,636	900,601	946,800	0.7	1.0	30.7	59.9	8.3

(continued)

Table 3-1 (concluded)

	Population			Annual Average Growth Rate		Age Group of Total Population, 1971		Population Aged 5 Years and Over Not Attending School Full Time With University Studies, 1971
	1961	1971	1976	1961-1971	1971-1976	0-14 Years	15-64 Years	
Regina-Saskatoon	904,473	904,421	897,484	0.0	-0.2	29.9	64.5	8.6
Ottawa	772,442	930,256	1,014,220	1.9	1.8	29.8	62.5	12.7
Quebec City	1,008,598	1,096,799	1,136,125	0.9	0.7	28.2	65.5	6.8
Winnipeg	1,091,428	1,143,399	1,182,070	0.3	0.7	28.8	61.5	9.2
Calgary-Edmonton	1,331,944	1,627,874	1,838,037	2.0	2.5	31.6	61.1	10.4
Vancouver	1,296,687	1.721,612	1,938,811	2.9	2.4	26.3	69.1	12.0
Montreal	3,472,274	4,105,125	4,232,313	1.7	0.6	28.9	63.6	9.7
Toronto	4,789,289	6,075,525	6,509,634	2.4	1.4	28.1	63.6	9.7
Canada	18,238,247	21,568,311	22,992,604	1.7	1.3	29.6	62.3	9.4

a Including the territories of Abitibi and Mistassini.

b Excluding the territories of Abitibi and Mistassini.

Source: Basic information taken from Census Canada 1961, 1971 and 1976.

proportion of young people in the population decreases and the percentage of the population that attended university shows a slight increase.[13] The population growth rate, one indicator of a region's economic strength, differs greatly from one region to another and significantly affects each of the above relationships.

Table 3-2 broadly presents the industrial structure in each region as established by the 1971 labour force census. If, as a first approximation, we consider all regions in which employment in the primary sector is greater than employment in the manufacturing sector[14] as resource regions, seven of the twenty regions must be considered as resource regions.[15] Most of these seven are sparsely populated, but according to our production sequence development model, the type of primary production and the accessibility to markets, in addition to the volume of operations, must enter into account to justify local transformation of natural resources. This is why on the one hand the two peripheral regions in British Columbia -- Southeastern and

13 Using the data in Table 3-1, simple correlation coefficients between population size and the proportion of young people on the one hand and the percentage of the population that attended university on the other is -.55 and .34 respectively.

14 To distinguish between semi-industrialized and industrialized countries, several authors including Balassa choose instead the proportion of manufacturing employment in all goods-producing industries, thus including construction and public utilities. Even though part of this additional industrial activity indirectly serves an extra-regional market and must therefore be considered as basic, the analysis presented in Appendix B indicates that this is indeed a very small part compared with what can be observed in the primary and manufacturing sectors. B. Balassa, "Growth Strategies in Semi-Industrial Countries", Quarterly Journal of Economics, 84, 1, February 1970, 24-47.

15 The data on value added would perhaps have been more adequate but were only available at the provincial level. According to Statistics Canada (61-202 and 31-203), four Canadian provinces have a volume of primary activity greater than the one in manufacturing: Saskatchewan, Alberta, Newfoundland, and Prince Edward Island.

Table 3-2

Industrial Structure of Reference Regions

	Percentage of the Labour Force in			Percentage of the Manufacturing Labour Force in		Location Quotient for Fabrication Industries
	Primary Industries A	Manufacturing Industries B	A/B	Transformation Industries[a]	Fabrication Industries[a]	
Labrador	29.2	7.2	4.13	--	--	--
Northern British Columbia	16.0	15.1	1.06	--[b]	--[b]	--
Far North	25.4	5.5	4.62	--	--	--
Southeastern British Columbia	15.1	19.4	.78	--[b]	--[b]	--
Northwestern Quebec	23.6	10.8	2.19	--	--	--
Gaspesia	17.2	15.6	1.10	--	--	--
Central British Columbia	15.8	20.2	.78	--[b]	--[b]	--
Chicoutimi	12.0	18.2	.66	90.5	9.5	.156
St. John's	6.6	12.9	.51	84.0	16.0	.125
Sudbury	15.9	15.9	1.00	85.4	14.6	.237
Saint John	8.5	16.3	.52	75.1	24.9	.345
Halifax	9.1	13.8	.66	67.2	32.8	.405
Regina-Saskatoon	29.4	5.4	5.44	64.9	35.1	.181

Ottawa	4.5	11.4	.39	41.3	58.7	.533
Quebec City	10.2	15.9	.64	54.0	46.0	.537
Winnipeg	12.1	14.6	.83	39.6	60.4	1.116
Calgary-Edmonton	16.8	9.1	1.85	57.7	42.3	.390
Vancouver	5.6	15.3	.37	57.9	42.1	.652
Montreal	3.3	26.4	.13	40.4	59.6	1.481
Toronto	4.4	28.2	.16	38.8	61.2	1.869
Canada	8.3	19.8	.42	47.5	52.5	--

a Since the data required to compute this distribution are only available at the provincial level and for urban agglomerations with a population of 10,000 or more, only the regions of Saint John, Halifax, Edmonton and Canada as a whole were covered 100 per cent. Some regions were covered using urban data, such as Chicoutimi (covered 51.4 per cent), Sudbury (56.2 per cent), Ottawa (68.7 per cent), Montreal (82.9 per cent) and Toronto (82.4 per cent). For two other regions, the distribution was computed from provincial data and the coefficient of coverage gave the relationship between the provincial population and the population of the intra-provincial reference regions: St. John's (124.3 per cent) and Saskatoon (102.4 per cent). Finally, in the case of regions marked with a dash, it was impossible to obtain an acceptable estimate because of the geographic limits and the low level of urbanization.

b The difference between the province of British Columbia and the set of urban agglomerations with 10,000 inhabitants or more belonging to the Vancouver system corresponds to 51,140 manufacturing jobs of which 87.1 per cent are in the transformation sector.

Source: Data from 1971 Census; the classification is taken from Table 2-1.

Central -- have a very high transformation potential relative to their population and on the other hand, the considerable population size in the Prairie resource regions -- Calgary-Edmonton and Regina-Saskatoon -- can be explained in large part by specialization on an international scale in the primary sector.

The distribution between transformation industries and fabrication industries can only be obtained at the provincial level or for urban agglomerations with 10,000 inhabitants or more because of information limitations. Thus, the population covered differs considerably between regions. However, since this distribution is to help us distinguish between transformation and fabrication regions, it is the lesser of two evils, given that the percentage of coverage is never less than 50 per cent outside rural regions and that in any case, we must expect manufacturing establishments to locate primarily in urban environments.

If we make use again of a simple rule that identifies as a fabrication region those regions other than resource regions with more jobs in fabrication than in transformation, four regions meet this criterion: Ottawa, Winnipeg, Montreal and Toronto.[16] However, since the presence of fabrication industries must also be important in absolute terms to be capable of significantly influencing the working of the urban system, it is possible that this criterion alone is not enough to distinguish fabrication regions from transformation regions. It might therefore be necessary to take into account other indicators such as the location quotient, defined as the ratio of the percentage of Canadian employment in this sector over the percentage of the

16 In a continental rather than a Canadian perspective, the Toronto region could be considered as part of a central core, characterized by the high proportion of manufacturing value added in the gross domestic product and made up of the Great Lakes megalopolis and that of the Atlantic Coast; the three other regions would then be included in the peripheral region of this core. Les orientations du développement du Québec: L'aménagement du territoire et le développement économique, Office de planification et de développement du Québec, Quebec, mai 1973.

Table 3-3

Characteristics of the Urban System in Reference Regions

	Population Density Per Square Mile	Rate of Urbanisation as a Percentage of the Population	Number of Urban Centres With 5,000 Inhabitants or More			Concentration of Population in the Regional Metropolis (Per Cent)		
			Total	That Grew at a Faster Rate Than the Region	That Experienced a Decrease in Population	1961	1971	1976
Labrador	0.91	7.5[b]	1[b]	1	0	5.0[b]	7.5[b]	10.7
Northern British Columbia	0.34	38.2	4	1	0	13.6	12.8	11.0
Far North	0.08	32.2	4	2	1	12.3	15.1	12.3
Southeastern British Columbia	4.23	27.4	4	1	2	9.7	8.2	8.2
Northwestern Quebec	1.89	44.4	5	4	2	19.4	20.0	19.2
Gaspesia	14.92	23.3	4	3	1	8.3	10.0	10.0
Central British Columbia	2.17	26.2	2	1	0	17.6	23.2	22.7
Chicoutimi	0.96[c]	57.8	7	4	0	35.8	33.3	31.7[f]
St. John's	13.30	47.4	7	5	1	28.1	31.4	31.0
Sudbury	5.24	64.7	10	5	2	23.7	26.7	26.2[f]
Saint John	22.96	45.3	9	6	2	16.4	16.8	16.2
Halifax	39.87	50.1	13	7	4	22.9	24.7	24.5[f]
Regina-Saskatoon	7.60	43.2	11	9	2	12.6[d]	15.6[d]	16.6[f]
Ottawa	45.55	74.4	11	1	2	59.2	64.8	64.1[f]

(continued)

Table 3-3 (concluded)

	Population Density Per Square Mile	Rate of Urbanisation as a Percentage of the Population	Number of Urban Centres With 5,000 Inhabitants or More			Concentration of Population in the Regional Metropolis (Per Cent)		
			Total	That Grew at a Faster Rate Than the Region	That Experienced a Decrease in Population	1961	1971	1976
Quebec	50.57	58.1	12	7	2	37.6	43.8	45.1[f]
Winnipeg	4.55[a]	65.4	10	8	0	43.7	47.3	48.3
Calgary-Edmonton	6.61	64.0	11	7	0	27.0[e]	30.5[e]	29.6[f]
Vancouver	37.46	87.2	11	4	0	63.7	62.9	58.6
Montreal	117.50	84.3	26	8	6	63.8	66.8	65.2
Toronto	186.97	84.2	42	8	1	40.1	43.3	42.3
Canada	6.06	71.5	204	92	28	--	--	--

a Excluding the following census divisions: Kenora, Rainy River and Thunder Bay.

b Even though Labrador City was not an incorporated municipality under the census definition, it is considered as such here.

c Excluding the Saguenay census division.

d Bi-polar: 23.1 per cent and 29.5 per cent.

e Bi-polar: 48.2 per cent and 55.2 per cent.

f Since the boundaries of the regional metropolis were changed for the 1976 census, this percentage was obtained by assuming a change in the metropolitan population defined according to the 1971 limits proportional to that observed following the 1976 limits.

Source: 1971 Census data.

Canadian population, located in the part of the region covered. We will use discriminatory analysis in the following section to clarify this matter.

Finally, Table 3-3 lists indicators for the functioning of the urban system in each region, particularly on the urban structure. As expected, the rate of urbanization, the population density and the density of urban centres generally increase with the regional population size;[17] the degree of concentration in the regional metropolis varies less regularly, however.

At this point, rather than list a series of simple relationships between all these indicators, let us proceed with an exercise in structural correspondence based upon the hypotheses of the model presented in Chapter 2.

3.2. Statistical Tests of Structural Correspondence

The analysis of canonical correlation lends itself well to testing for structural correspondence, such as that which interests us here, since it seeks to establish whether a significant relationship exists between two groups of variables rather than two variables. We will therefore use this method to ensure the accuracy of our approach, after which we will classify our reference regions in more rigorous fashion than in the preceding section with the help of discriminant analysis.

3.2.1. Canonical Correlation Between the Industrial Structure and the Urban Structure

In canonical correlation analysis,[18] the null hypothesis first tested (H_o) is that the industrial

17 The simple correlation coefficients are .70, .95 and .97 respectively.

18 For a technical presentation of this method, see D. F. Morrison, Multivariate Statistical Methods, New York: McGraw Hill, 1967, pp. 213-17. It should be noted that the application of this method does not require the assumption that the variables examined be distributed according to a multinormal distribution.

structure variables are not significantly related to the urban structure variables. As indicated in the first column at the bottom of Table 3-4, the value of χ^2 is high enough to reject this null hypothesis so that the contribution of the first canonical variable is cons significant. The same Bartlett test leads us, however, to consider the other two canonical variables as insignificant.

Table 3-4

Results of the Canonical Correlation Analysis Used to Establish Structural Correspondence

Original Variables	H_o	Coefficients of the Canonical Variables I	II	III
Industrial structure				
Per cent of labour force in manufacturing		.863	-3.239	-.857
Per cent of labour force in primary sector		-.826	-1.768	.151
Per cent of manufacturing labour force in fabrication		.877	1.0	1.0
Location quotient for fabrication		1.0	-2.627	.509
Urban structure				
Rate of urbanization		.924	-.143	1.0
Degree of concentration in regional metropolis		.911	1.0	.670
Population per square mile		1.0	-.923	-.379
Canonical correlation		.946	.761	.126
χ^2	24.73	7.05	0.13	0.0

The first canonical variable is obtained from the application of the following criterion: which of the linear combinations of the original variables in the group of industrial structure variables on

the one hand and in the group of urban structure variables on the other hand result in the largest correlation between the two variables thus formed? The second canonical variable arises from the application of the same criterion under the restriction of no correlation with the first one, and so forth. Moreover, it is common practice to modify the scale of the original variable coefficients in each canonical variable so that the highest coefficient in each group of original variables takes the value 1; since we have proceeded on the basis of the variance-covariance matrix, these coefficients give the relative importance of each original variable in each canonical variable. As a result, we observe that, for the first canonical variable, the only one that merits close study, all the original variables play a fairly equal role, in both groups; in other words, no variable can be considered as superfluous and all variables together contribute to a canonical correlation coefficient of .946. We can thus conclude that there exists indeed a strong correspondence between the industrial structure of a region and its urban structure.

3.2.2. Discriminant Analysis: Three Groups of Regions

Discriminant analysis is a classification technique whose significance is fairly restricted because, among other things, it does not attempt to determine an optimal number of classes, this information being required at the outset together with a preliminary classification of observations, and because it is based on linear discriminant functions. However, the statistical analysis to be performed has been preceded in Chapter 2 by theoretical arguments sufficiently well developed to establish our three-way classification as a null hypothesis. As for the second point, the common justification applies: it is very difficult to avoid linearity assumptions.

We used a computer program[19] with a built-in step-wise procedure using the variables best suited to classification, in decreasing order. All relevant information in Tables 3-1 to 3-3 was used from the outset. In addition, because of the above mentioned data availability problems, we were forced to apply the discriminant analysis first to all 20 regions in order to identify the resource regions and then to the 13 urban regions to distinguish further between transformation and fabrication regions.

In the first text, the preliminary classification was based upon the simple criterion already used, the ratio of labour force in the primary sector to that in the manufacturing sector with the cut-off point set at 1.0. According to the results, the only variable required to get a significant classification into two groups is the percentage of the labour force in the primary sector. The discriminant functions are as follows:[20]

(3.1) Resource region: $Z = -10.952 + .911\ PRIM$

(3.2) Transformation region: $Z = -2.508 + .383\ PRIM$

Table 3-5 gives for each region the probability of belonging to either group, based on these functions. Some regions are obviously more difficult to classify than others, particularly the British Columbia regions other than Vancouver, the Calgary-Edmonton region and the Sudbury region. For the rest of this study, we will nonetheless stick to these results, and consider seven regions out of 20 as resource regions.

Subsequently, in order to distinguish between transformation and fabrication regions, we applied the discriminant analysis to the 13 urban regions using the same variables as before -- with the added breakdown of the manufacturing sector into transformation and fabrication industries -- and carrying

19 This program is part of the BMD group (bio-medical computer programs) developped at UCLA, 1975 version.

20 A list of symbols for the variables used will be found at the end of this chapter.

Table 3-5

Results of the Discriminatory Analysis
Used to Identify Resource Regions

	Probability of a Region Belonging to the	
	Resource Group	Manufacturing Group
Labrador	.999	.001
Regina-Saskatoon	.999	.001
Far North	.993	.007
Northwestern Quebec	.982	.018
Gaspesia	.654	.346
Calgary-Edmonton	.605	.395
Northern British Columbia	.501	.499
Montreal	.001	.999
Toronto	.002	.998
Ottawa	.002	.998
Vancouver	.004	.996
St. John's	.007	.993
Saint John	.019	.981
Halifax	.026	.974
Quebec	.045	.955
Chicoutimi	.108	.892
Winnipeg	.114	.886
Southeastern British Columbia	.384	.616
Central British Columbia	.475	.525
Sudbury	.488	.512

out a preliminary classification into three groups on the basis of the percentage of the labour force in the primary sector, since this variable proved to be the determining factor in identifying resource regions; the cut-off points were fixed at 4.4 and 16.0 per cent. According to the statistical results, two variables had to be taken into consideration here, the percentage of the labour force in the manufacturing sector and the number of urban agglomerations in the region. The discriminant functions are as follows:

(3.3) Resource region: $Z = -10.708 + 1.695\ MAN + 0.630\ NOMB$

(3.4) Transformation region: $Z = -30.368 + 3.579\ MAN + 0.513\ NOMB$

(3.5) Fabrication region: $Z = -121.456 + 6.436\ MAN + 1.912\ NOMB$

Table 3-6 shows for each region the probability of belonging to either group, as computed on the basis of these functions. It is also possible to apply the canonical correlation analysis in order to determine the value of the canonical variables for each observation and each group average and thus

Table 3-6

Results of the Discriminatory Analysis Dividing the Urban Regions Into Three Groups

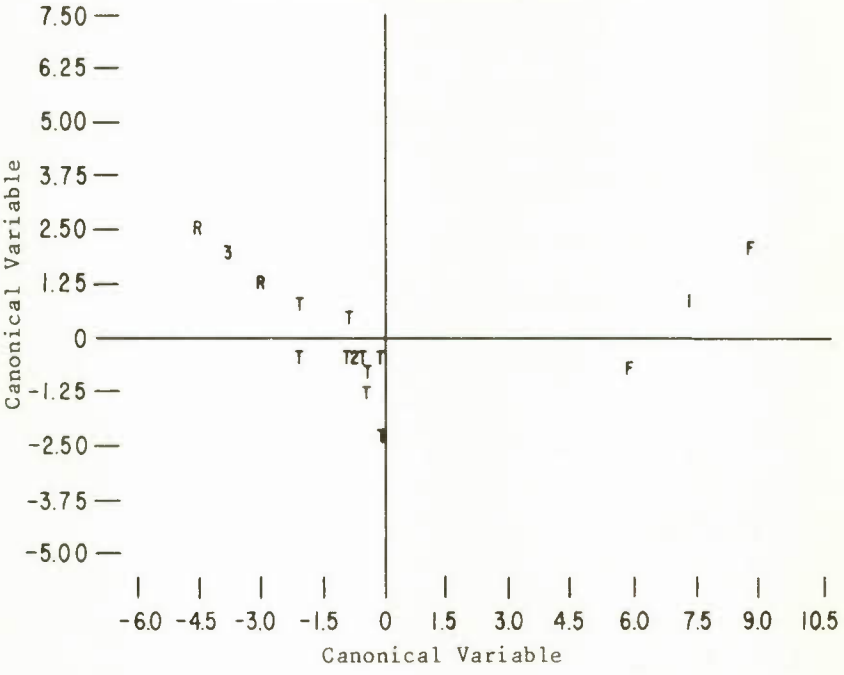
	Probability of a Region Belonging to the		
	Resource Group	Transformation Group	Fabrication Group
Regina-Saskatoon	1.0	0.0	0.0
Calgary-Edmonton	0.978	.022	0.0
Chicoutimi	0.0	1.0	0.0
Sudbury	0.0	1.0	0.0
Saint John	0.0	1.0	0.0
Quebec	0.0	1.0	0.0
Vancouver	0.0	1.0	0.0
Winnipeg	.001	.999	0.0
Halifax	.008	.992	0.0
St-John's	.021	.979	0.0
Ottawa	.370	.630	0.0
Montreal	0.0	0.0	1.0
Toronto	0.0	0.0	1.0

provide a geometric representation of the classification obtained[21] (see Chart 3-1). Interestingly enough, only the Regina-Saskatoon and Calgary-Edmonton regions should be considered as resource

21 Each canonical variable is a linear combination based on two groups of variables: one contains the original variables used for classification and the other is made up of dummy variables indicating the group in which each observation was classified.

Chart 3-1

Position of Each Urban Region in the Space of Canonical Variables Obtained From the Discriminatory Analysis



regions, which confirms the results of the preceding exercise. On the whole, these last results are very clear since for all practical purposes eight regions out of 13 can be classified with no doubt whatsoever.

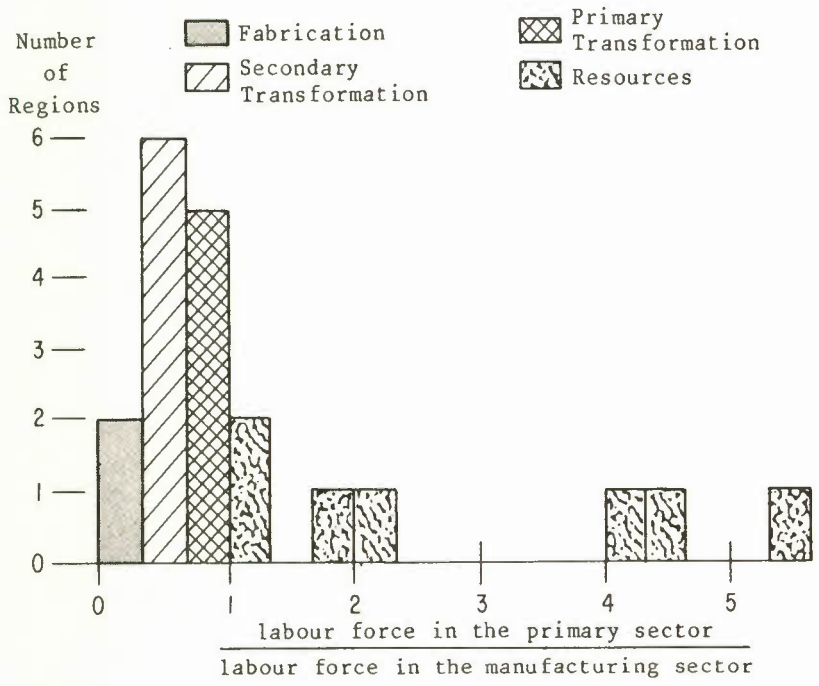
The discriminant analysis therefore clearly divides our set of 20 Canadian regions into seven resource regions (of which two have metropolitan agglomerations), 11 transformation regions (of which two have no metropolitan agglomeration) and two fabrication regions, Montreal and Toronto. This classification thus modifies that developed previously using simpler criteria.

Now that we have an acceptable classification from a statistical point of view, it is interesting to observe, as illustrated in the accompanying histogram, that a criterion as simple as the ratio

of the labour force in the primary sector to the manufacturing labour force is sufficient to produce the same result, provided, of course, that the cut-off points are carefully chosen.

Chart 3-2

Histogram Based on the Ratio of the Regional Labour Force in the Primary Sector to the Manufacturing Sector, in 1971, for 20 Canadian Regions



3.3. Multiple Regression Analysis: the Influence of the Economic Base on the Urban System Indicators

We suggested that, as the industrial structure of a region changes in accordance with a production sequence development process, population growth was accompanied by a certain number of changes in the operation of the urban system. We will now check, using our 20 regions, the accuracy of our suggestions by examining in turn the urban structure,

the spatial and the temporal dynamics of an urban system. Cross-sectional multiple regression analysis will be used in order to explain the changes in each indicator by first the change in the size of the regional population, then by certain characteristics of the industrial structure, directly or through the utilization of dummy variables standing for the three types of regions. Special attention will be given in each case to the outlier observations so that these may be referred to in the following chapter when the influence of some factors of distorsion is examined.

3.3.1. Urban Structure

As equation (3.6) indicates, when the population of a region increases, a phenomenon of nodalization occurs with an increase in the rate of urbanization; in other words, an increasing proportion of the population gets thus concentrated in urban centres. However, given the existence in Canada of small transformation regions together with large resource regions whose size is out of proportion to their population, we believe that the industrial structure characteristics of a region will have an even sharper influence on the rate of urbanization.

(3.6) $URB = 40.137 + 0.0103\ POPREG$
$\qquad\qquad (8.908) \quad (4.148)$

$SEE = 16.19 \qquad \bar{R}^2 = .46 \qquad n = 20$

This is indicated by equation (3.7): as the importance of the primary sector in the overall industrial structure decreases, an urbanization process develops. When, in addition, the fabrication activities also reach a significant proportion, the rate of urbanization registers a new increase.

(3.7) $URB = 78.766 - 1.959\ PRIM$
$\qquad\qquad (10.77) \quad (4.304)$

$SEE = 15.89 \qquad \bar{R}^2 = .480 \qquad n = 20$

$$(3.8)\quad URB = \underset{(6.798)}{59.362} - \underset{(1.132)}{0.574}\ PRIM + \underset{(2.522)}{16.671}\ QUOTFAB$$

$$SEE = 10.871 \qquad \bar{R}^2 = .492 \qquad n = 13$$

A strong correlation therefore exists between the size of the regional population and the percentage of primary employment *(R = -.52)* as well as the location quotient for fabrication employment *(R = .93)*. Moreover, in order to check whether the rate of urbanization grows steadily or in a discrete fashion (by stages) we introduced into equation (3.6) two dummy variables to take into account our classification into three types of regions.

$$(3.9)\quad URB = \underset{(7.0)}{40.601} + \underset{(3.510)}{0.000019}\ POPREG - \underset{(1.952)}{13.271}\ RESS - \underset{(2.082)}{54.191}\ FAB$$

$$SEE = 13.68 \qquad \bar{R}^2 = .615 \qquad n = 20$$

The results obtained from equation (3.9) give support to the suggestion that if two regions were of identical size but one specialized in the primary sector and the other in transformation activities, the former would get a lower rate of urbanization: 36.8 per cent as compared to 50.1 per cent for a regional population of 500,000 in both instances. This statistical relationship also corroborates the point that even though a fabrication region usually has a large population base located in a more urban environment the growth in the rate of urbanization slows down when the region moves from the transformation to the fabrication stage. Consequently, it is appropriate to estimate a logistic type function such as that suggested in Chapter 2. The results from equation (3.10) are very conclusive.

$$(3.10)\quad \ln URB = \underset{(39.281)}{4.3054} - \underset{(6.167)}{151{,}204} \times POPREG^{-1}$$

$$SEE = .336 \qquad \bar{R}^2 = .66 \qquad n = 20$$

The coefficients of determination $(\bar{R}^2)$ obtained in all our estimates are relatively high but still leave part of the variability unexplained. The most erratic observations are Labrador, whose rate of

urbanization is lower than expected and the Ottawa and Vancouver regions, whose rates are higher than expected.

The degree of concentration in the regional metropolis varies roughly in the same way as the rate of urbanization; as a matter of fact, the correlation coefficient between the two is .88.

$$(3.11)\quad DOMPR = -143.235 + 13.283 \ln POPREG$$
$$\qquad (4.99) \qquad (6.136)$$
$$SEE = 11.317 \qquad \bar{R}^2 = .66 \qquad n = 20$$

$$(3.12)\quad DOMPR = 76.392 - 2.034\ PRIM - 1.056\ MAN$$
$$\qquad (3.968) \qquad (3.357) \qquad (1.300)$$
$$SEE = 15.364 \qquad \bar{R}^2 = .371 \qquad n = 20$$

$$(3.13)\quad DOMPR = -168.366 + 15.276 \ln POPREG - 0.063\ RESS - 12.204\ FAB$$
$$\qquad (3.941) \qquad (4.772) \qquad (0.010) \qquad (1.090)$$
$$SEE = 11.578 \qquad \bar{R}^2 = .643 \qquad n = 20$$

$$(3.14)\quad \ln DOMPR = 2.513 + 0.00123\ POPREG - (0.1734 \times 10^{-12})\ POPREG^2$$
$$\qquad (16.97) \qquad (5.82) \qquad (4.801)$$
$$SEE = .392 \qquad \bar{R}^2 = .67 \qquad n = 20$$

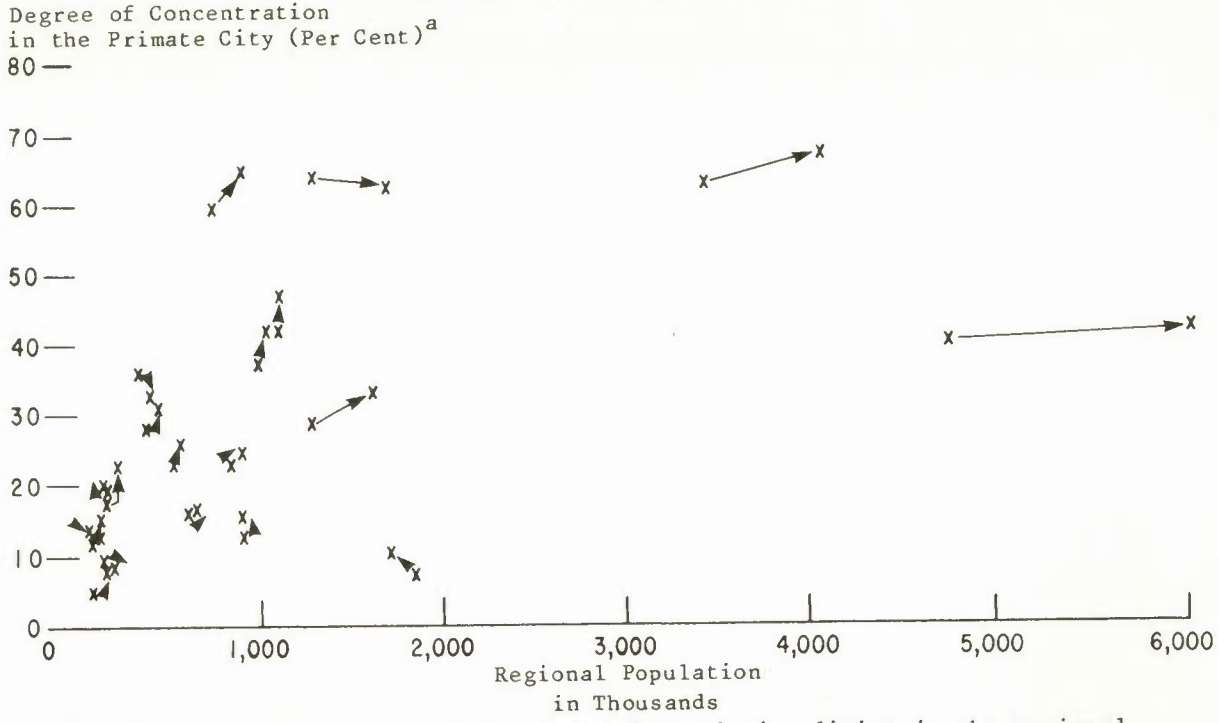
The main difference is that the nonlinear relationship that gives the best results is quadratic (see Chart 3-3).[22] It is also important to note in equation (3.13) that the variable *FAB* has a negative coefficient;[23] even though it is only significant to about 80 per cent, this finding gives some support to the existence of a tendency in fabrication regions to deconcentrate population growth around the regional metropolis. Tying this result to the continuous increase in the rate of urbanization, as suggested by equation (3.10), we can conclude that

22 Even though their degree of concentration was the highest on average in 1961 and 1971, the transformation regions did not experience the greatest increase over this period since they showed an average of 2.33 percentage points compared to 3.96 points for the resource regions and 3.1 for the fabrication regions.

23 The simple correlation coefficient between *FAB* and *QUOTFAB* is .69.

Chart 3-3

Degree of Concentration in the Regional Metropolis and Regional Population Size, 1961 and 1971, 20 Canadian Regions



a Measured as the percentage of the regional population living in the regional metropolis, or primate city.

Source: Table 3-3.

this deconcentration primarily involves the urban agglomerations found in the hinterland.

The most exceptional regions in terms of a degree of concentration smaller than expected are Southeastern British Columbia, Toronto, Labrador, Gaspesia and St John's; it is the other way around for Montreal and Ottawa. We will re-examine these exceptions in the next chapter, but it is important to note already that the "excessive" rate of urbanization obtained in the Ottawa region arises primarily from the size of the regional metropolis while in the case of Vancouver, whose region does not show an exceptionally high degree of concentration in the regional metropolis, the explanation rests more with a ratio of non-metropolitan urban population to rural and semi-urban population that is higher than average.

The relationship between population density and the size of the regional population is logarithmic and, while the signs of the coefficients for the dummy variables are those expected, the distinction between a transformation and a fabrication region does not appear to be significant. Still it is interesting to note that the coefficient of the population variable is greater than 1, which means that, as the regional population increases, the area decreases; in other words, a transformation region emerges as a densely populated sub-region in a vast resource region, just as a fabrication region comes out of a large transformation region.[24]

$$(3.15)\quad \ln DENST = \underset{(2.66)}{-12.164} + \underset{(3.193)}{1.093}\ \ln POPREG - \underset{(1.349)}{0.904}\ RESS + \underset{(0.254)}{0.304}\ FAB$$

$$SEE = 1.238 \qquad \bar{R}^2 = .613 \qquad n = 20$$

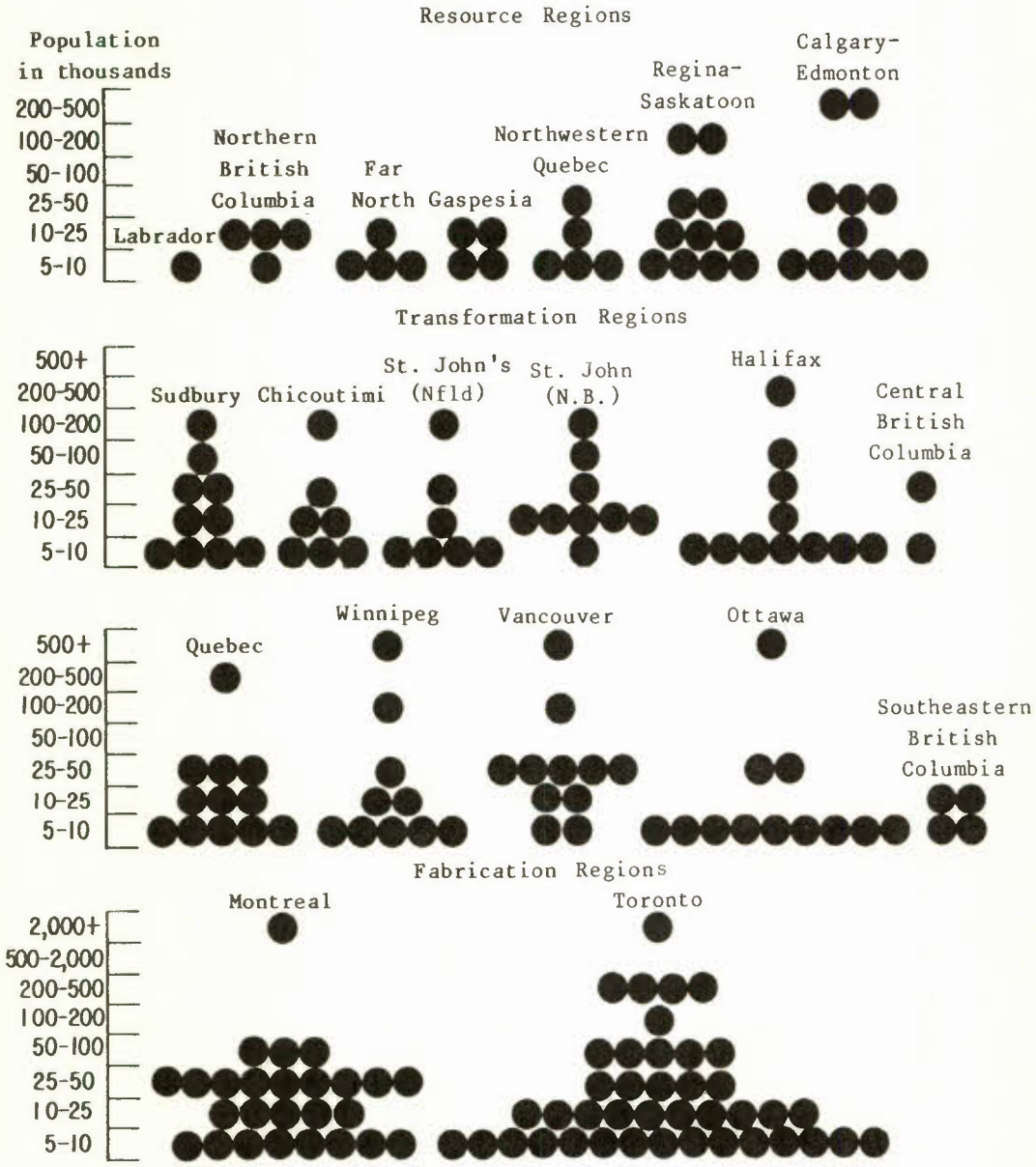
Before leaving the urban structure, we shall look at the form of the urban pyramid in each region, as this summarizes to a large extent the indicators examined up to now. Chart 3-4 gives the distribution of urban centres by size category.

In resource regions, the expected upside-down *T* (*I*) is more or less visible and a sharper feature

24 The average area of a resource region is 351,568 square miles compared to 98,904 and 33,716 square miles respectively for transformation and fabrication regions.

Chart 3-4

The Pyramidal Form of Urban Structure, 1971, 20 Canadian Regions



is the absence of a single regional metropolis whose domination would be clear-cut; indeed for both Prairie regions, there is clearly bi-polarization. In transformation regions, on the other hand, a much larger regional metropolis emerges and the general outline of the urban pyramid is more regular, particularly in the eastern part of the country since, in British Columbia, the Vancouver region and its two peripheral regions show fairly irregular profiles. The Ottawa region is undoubtedly the most exceptional and one may wonder whether, without the federal government, this region would still make up a separate urban region or instead be included in the Montreal region. Finally, the two fabrication regions are each endowed with a very dense urban structure whose pyramidal profile is truncated at the top to take into account the much larger absolute size of the regional metropolis.

The absence of an upper-intermediate urban structure in the Montreal region will be examined in detail in the next chapter when we examine the traces of previous development stages as well as the role of uncertainty in the location decisions of firms and migrants.

3.3.2. Spatial Dynamics

Spatial dynamics in a region is measured by the intensity and direction of interaction flows. The intensity may be assessed by comparing the volume of intra-regional flows in various regions or by comparing this volume with that of exchanges with other regions. In Chapter 2, we attempted to infer certain propositions concerning spatial dynamics in a way that, by imposing our regional typology, we would be in a position to better characterize its operation. In brief, we claimed that, because of the small population, the variety of natural resources, and the predominance of the primary sector in the industrial structure, a resource region would typically show a higher volume of interaction with other regions than within the region itself resulting in a low spatial-interaction index, a multiplicity of exit points and parallel routes in the transportation network. In contrast,

because of its large population and high density of settlement, its industrial diversity and importance given to industries serving final demand, a fabrication region would typically show a smaller volume of inter-regional interaction than intra-regional one resulting in a high spatial-interaction index plus a tendency towards polynucleation and wider diffusion of interaction as measured by the number of direction flows. Finally, the transformation region, while getting an in-between position in terms of the intensity of interaction would show a high degree of concentration in the regional metropolis and a transportation and communications network structure with direction flows moving along the urban hierarchy.

It is very difficult to test the accuracy of these statements in the present-day Canadian situation because of the almost total lack of information on intra-regional interaction. In the financial field, the data even at the regional level, remains incomplete and has only been compiled in the past few years. The location of head offices is an increasing concern, if only because of the publicity it got in recent political debates, but there still exists no exhaustive study on this matter. With few exceptions, the same observation applies to intra-regional trade. Only migration flows and the utilization of means of transportation[25] have now received sustained attention, although much additional work is still needed to meet the requirements for research in this field.

Some indicators of the relative importance of interaction with other regions have been assembled in Table 3-7; admittedly the regional partitioning is very crude and uses up different spatial units from one indicator to the next, but our intention is to present all that is readily available. The information in the second column of Table 3-7 shows that the intra-provincial market is much more important in a fabrication region than in a transformation region, the latter being more

25 Notably, the works of John Vanderkamp on the one hand and those of the Canadian Transport Commission on the other.

Table 3-7

Flow of Interaction with Other Regions, by Type of Region in Canada

	Value of Manufacturing Shipments in 1974[b]		Head Offices of Large Firms as a Per Cent of the Canadian Total[c]		Total Labour Force as a Per Cent of the Canadian Total[d]		Average Migration Rate 1968-69[e]	
	Per Cent of Canadian Total	Sold on the Intra-Provincial Market in Per Cent of Provincial Total, on Average	Mines	Manufacturing	Mines	Manufacturing	Immigration	Emigration
Resource regions[a]	8.6	58.8	22.9	5.1	29.9	4.9	5.99	7.22
Transformation regions[a]	14.0	44.8	23.5	23.3	57.9	25.8	5.04	5.11
Fabrication regions[a]	77.4	56.6	53.6	71.6	12.2	69.3	3.98	4.15
Canada	100.0	55.1	100.0	100.0	100.0	100.0	--	--

a The Prairies region is considered as a resource region, the Atlantic and British Columbia regions as transformation regions and Quebec and Ontario as fabrication regions.

b Source: Interprovincial Trade Flows, Employment and the Tariff in Canada, supplementary material to the 1977 Ontario Budget, April 1977, Tables 1 and 2.

c Overall, 408 manufacturing firms, 196 mining firms (metals) and 255 petroleum firms (oil and natural gas) were surveyed in 1975 and 1976; the last two subsectors were weighted according to their importance in the Canadian mining sector. Sources: Financial Post, Survey of Industrials, Survey of Mines and Survey of Oils.

d Basic information taken from the 1971 Census.

e Rates derived from a study based on a division of Canada into 44 distinct regions in which migratory flows correspond to migration out of the region on an annual basis. These 44 spatial units were distributed among our 20 reference regions and the basic information weighted accordingly. Source: E. K. Grant and J. Vanderkamp, The Economic Causes and Effects of Migration: Canada, 1965-71, Economic Council of Canada, Ottawa, 1976.

oriented toward external markets.[26] The data concerning the location of head offices indicate that the difference in geographic distribution between the labour force and decision centres is apparently much larger in the primary sector than in the manufacturing sector; since all head offices are given here equal weight regardless of the value of shipments or the number of employees, and since large corporations favour large metropolises located in fabrication regions, this observed difference should be interpreted as a minimum. Migration rates are defined as the proportion of the total population that moved to another region[27] during 1968 or 1969, on average. Of course within each type, some regions are in decline while others are growing; as illustrated in Chart 3-5, a westward gradient is undoubtedly a major dimension of population settlement in Canada. However, according to the weighted figures of Table 3-7, it is difficult to reject the general hypothesis that interregional geographic mobility is more common in resource regions than in transformation regions and in transformation regions than in fabrication regions.

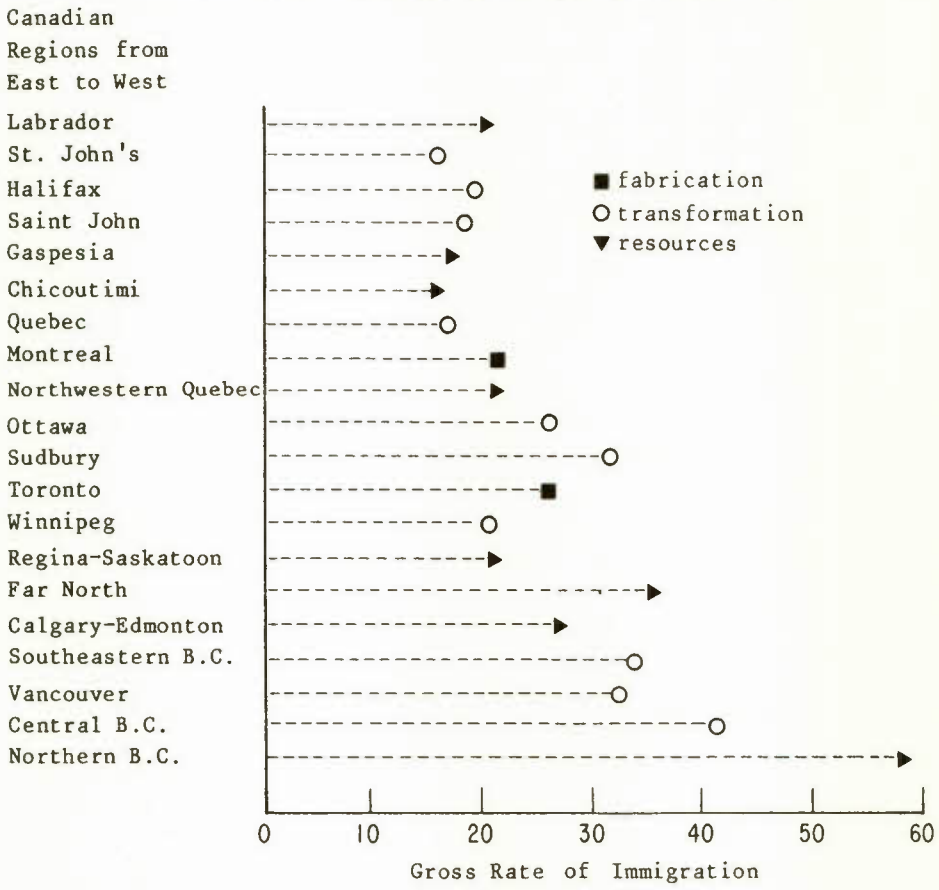
Some indicators of intra-regional interaction are presented in Table 3-8. The greater the proportion of urban agglomerations in a region serving extra-regional markets in the transportation industry, the greater the chances that the links with other regions will be more important than those within the region. The first column of the table shows, in this respect, a basic difference between fabrication regions and both resource and transformation regions. In the same way, the index of

26 In a resource region, the embryo of manufacturing industries is made up in large part of non-basic activities in the food and beverage, printing and publishing and metal products groups.

27 Canada was divided, for the purpose of the study from which these data were taken, into 44 distinct regions and the rates reported here are weighted averages. It is surprising to find that in all three types of regions immigration rates exceed emigration rates; part of the explanation comes from the exclusion of international immigration in addition to the fact that these data bear only upon two years.

Chart 3-5

Gross Rate of Immigration, by Region, 1966-71



Source: Estimates from 1971 Census data.

spatial interaction constructed from the intra-regional distribution of population gives a very clear idea of the much greater intensity of intra-regional interaction in a fabrication region. The data on immigration indicate a slightly higher concentration in the regional metropolis for transformation regions.

Table 3-8

Indicators of Intra-Regional Interaction by Type of Region in Canada

	Urban Agglomerations Wigh Basic Employment in Transportation and Warehousing as a Percentage of the Total Number Agglomerations[a]	Index of Average Spatial Interaction, Weighted by 1971 Population[b]	Percentage of Immigrants (1966-71) Located in the Regional Metropolis Coming From the Same Province	
			Without Quebec	With Quebec
Resource regions	23.1	4.26	44.9	46.3
Transformation regions	20.8	20.15	46.4	52.3
Fabrication regions	1.5	127.43	40.8	53.2
Canada	14.6	--	--	--

a The method for determining the basic employment is presented in Appendix B, at the end of the study.

b Computed on the basis of the gravity potential of each urban agglomeration as a function of the population masses and the interurban distances in each urban system. This index increases with the number and size of agglomerations but decreases with distance; the precise definition of the index is provided on page 76.

Source: Estimates based on the 1971 Census data.

3.3.3. Temporal Dynamics

In Chapter 2, we also stated that the characteristics of independence, complementarity, and competition associated respectively with resource, transformation, and fabrication regions would have implications on the growth of each urban component in relation to the region as a whole. More specifically, we suggested, firstly, that the correlation between the percentage variation in population of an urban centre and that of the region in which it is located would be greater in transformation regions, secondly, that the regional metropolis would be favoured in this process of urban growth and, thirdly, that the dispersion in growth performances would be greatest in a resource region and smallest in fabrication regions.

Using simply the percentage variation of population between 1961 and 1971 derived from the census at the level of individual urban agglomerations (presented in Table 3-1 by region), we estimated the correlation coefficient between urban and regional growth at .36 for resource regions, .52 for transformation regions, and .33 for fabrication regions. One way to test how distinct is the growth pattern of regional metropolises is to introduce into the regression analysis a dummy variable equal to 1 if the urban centre in question is the regional metropolis and 0 otherwise. The results are as follows:

(3.16) Resource regions:

$$\begin{array}{lllll} ACURB = & 4.237 & + 1.653\ ACREG & + 55.67\ METRO \\ & (0.324) & (2.637) & & (1.931) \end{array}$$

$$\bar{R}^2 = .16 \qquad n = 49$$

(3.17) Transformation regions:

$$\begin{array}{lllll} ACURB = & -0.081 & + 1.120\ ACREG & + 12.930\ METRO \\ & (0.022) & (5.374) & & (1.823) \end{array}$$

$$\bar{R}^2 = .28 \qquad n = 86$$

(3.18) Fabrication regions:

$$ACURB = -10.537 + 1.099\ ACREG - 2.948\ METRO$$
$$(1.125) \quad (2.814) \quad (0.302)$$
$$\bar{R}^2 = .08 \qquad n = 68$$

We thus find that for fabrication regions, the coefficient of the dummy variable does not differ significantly from 0. Furthermore, if the metropolis of the Far North region (Thompson) is excluded from the sample, on the grounds that it experienced an utterly exceptional 455 per cent growth in population between 1961 and 1971, the *METRO* coefficient becomes larger for transformation regions than for resource regions, as expected.[28]

The third hypothesis is also confirmed by the fact that the average unweighted coefficient of variation, which gives the ratio of standard error to the mean performances, equals 2.41 in resource regions, 1.23 in transformation regions, and 1.04 in fabrication regions.

The influence exerted by the industrial and urban structures of a region on the growth of individual urban centres can be estimated by replacing the rate of population increase by the probability of rapid growth for any agglomeration in a region as dependent variable. Careful examination of population growth among the urban agglomerations in Canada during the 1960s, leads to the identification of two modes with the median equal to 14.9 per cent. It can thus be considered that an agglomeration has experienced rapid growth if its population growth was greater than 14.9 per cent. The observed probability of an agglomeration in a given region growing rapidly would be calculated as the proportion of the agglomerations in the region that succeeded in showing this performance. The regional characteristics whose influence we wish to measure fall into two types: the level of industrial integration which indicates to what extent

28 The coefficients of determination ($\bar{R}^2$) nonetheless remain fairly small, so that a large part of the variance of the dependent variable remains unexplained; however, the purpose of this test is not to explain in detail the urban growth mechanism, but only to determine the influence of urban structure.

all the agglomerations in a given urban system participate in the same industrial complexes; the level of spatial interaction which indicates to what extent the agglomerations in a given urban system carry on intense and requent interaction. The first characteristic can be measured by using a modified Gini coefficient calculated for each of the industries in which the region in question specializes, relatively to the Canadian industrial structure,[29] as in (3.19). The second characteristic can be measured by an index of gravity potential based on the distance and demographic weight of each urban agglomeration relative to the other components in its urban system (as in 3.20).

$$(3.19)\quad I_j^J = 1 - 1/2 \sum_{i=1}^{N} (X_i - X_{i-1})(Y_i + Y_{i-1})$$

where

I_j^J = index of industrial integration for industry j and urban system J which contains N agglomerations;

X_i = cumulative percentage of the labour force in the industry, beginning with the urban agglomeration having the largest proportion;

Y_i = cumulative percentage of the total labour force, based on the order imposed by the iterations of variable X_i.

$$(3.20)\quad S^J = \frac{1}{100} \cdot \frac{1}{P} \cdot \sum_{k=1}^{K} \sum_{\ell=1}^{n_k} \frac{P_{k\ell} \cdot P_j}{d_{\ell j}}$$

29 Specialization was determined on the basis of the largest positive differences in the percentage distribution of manpower between the region and Canada as a whole, with the available industrial structure including 26 major groups. In some cases, several industries were taken into consideration to include at least 15 per cent of the regional manpower.

where

S^J = index of spatial interaction in urban system J;

P = total population of the urban system;

$P_{k\ell}$ = the population of a city ℓ that belongs to the kth level in the urban hierarchy (P_{K_1} = population of the regional metropolis);

n_k = number of cities of the kth level in the hierarchy;

P_j = population of city j, which is that city of a higher hierarchical level nearest to city ℓ;

$d_{\ell j}$ = road distance in miles between ℓ cities and j.

These indices were computed for each of the 13 Canadian urban regions. Since they provided an order of magnitude more than an exact measure of a phenomenon, we decided to use an ordinal rather than a cardinal approach. The *LOGIT* [30] model is recommended in cases where the dependent variable is a probability coefficient and where the independent variables are all dummy variables. The classification of the regions according to the value of the indices described above is presented in Table 3-9, as well as the probability of rapid growth observed (P_1) and estimated (P_2) by this method. The following probability function is obtained:[31]

30 This method is described by Theil, among others, in Principles of Econometrics, New York: John Wiley & Sons, 1971, pp. 628-31.

31 Admittedly, the number of observations is very small here but the Student and Fisher Tests apply and are sufficiently robust to be conclusive. It should also be noted that the number of observations does not depend on the number of urban systems nor the number of urban agglomerations in each category but on the number of categories.

$$(3.21)\quad ln\left(\frac{p}{1-p}\right) = \underset{(0.256)}{0.049} - \underset{(3.698)}{0.790}\,\beta_1 + \underset{(2.240)}{0.479}\,\beta_2 - \underset{(1.715)}{0.367}\,\gamma_1 - \underset{(0.930)}{0.238}\,\gamma_2$$

$$F = 7.84 \quad R^2 = .94 \quad \bar{R}^2 = .82 \quad n = 7$$

Table 3-9

Results of the *LOGIT* Analysis Based on Spatial Interaction and Industrial Integration in Canadian Urban Regions

Spatial Interaction	Industrial Integration: Weak	Average (γ_1)	Strong (γ_2)
Weak	St. John's Sudbury $p_1 = .529$ $p_2 = .512$	Chicoutimi Saint John $p_1 = .375$ $p_2 = .579$	Winnipeg Regina-Saskatoon Calgary-Edmonton $p_1 = .484$ $p_2 = .547$
Average (β_1)	Halifax $p_1 = .308$ $p_2 = .677$	Quebec Ottawa $p_1 = .261$ $p_2 = .248$	$p_2 = .727$
Strong (β_2)	$p_2 = .629$	Toronto $p_1 = .571$ $p_2 = .540$	Vancouver Montreal $p_1 = .541$ $p_2 = .572$

p_1 = Proportion of urban centres with rapid growth in the region(s).

p_2 = Estimated probability of rapid growth.

Because the coefficient of determination is high, the Fisher test conclusive, and all the coefficients of the equation significantly different from 0 at a level of at least 90 per cent, except for the coefficient γ_2, we can use these results to

conclude that, in general, spatial interaction[32] and industrial integration both play a positive role in the probability of rapid growth at the level of urban agglomerations.[33] Although the results in Table 3-9 are difficult to interpret, we find, firstly, that a greater proportion of the urban agglomerations in a region grow rapidly if the regional urban system reveals strong industrial integration and average spatial interaction. These correspond to a very homogeneous region in terms of the economic base but this region would have a fairly low population density and no large regional metropolis. We also find that it is preferable to disclose low industrial integration but average or strong spatial interaction than the opposite.

Of all the urban systems, the one with the most erratic behaviour is found in the Halifax region where only one agglomeration out of three -- rather than two out of three, as predicted by the model -- experienced a rate of growth higher than 14.9 per cent. No doubt that part of the explanation lies in the growth outlooks at the regional level. The same technique can thus be used to study, not the effect of a higher regional economic integration, but the impact of unfavourable regional conditions.

The "shift and share"[34] method allows us to compute the growth of employment in a region that

32 Golant concludes in his analysis that between 20 and 25 per cent of urban growth is explained by the spatial structure as measured by the number of highways crossing the agglomeration, the number of urban centres in a radius of 50 miles or the size of this urban population. S. M. Golant, "Regression Models of Urban Growth in Ontario and Quebec", in L. S. Bourne and R. D. MacKinnon (eds.), op. cit., 117-31.

33 This positive influence is established not from the sign of the coefficients in equation (3-21) since the dependent variable is not p, but by consulting the estimates reproduced in Table 3-9.

34 Presented in Growth Patterns in Manufacturing Employment by Counties and Census Divisions, 1961-1970, Statistics Canada, Ottawa, Cat. No. 31-518, 1972, and discussed by R. Beaudry in an appendix to F. Martin, Regional Aspects of the Evolution of Canadian Employment, Ottawa: Economic Council of Canada, 1975, pp. 55-68.

Table 3-10

Variables Used and Results of the *LOGIT* Analysis Based on the Spatial Interaction and Regional Employment Conditions in Canadian Urban Regions

Spatial Interaction	Regional Employment Conditions[a] Unfavourable	Average (δ_1)	Favourable (δ_2)
Weak	St. John's (-2,289) Chicoutimi (-2,447) p_1 = .571 p_2 = .735	Saint John (-1,299) Sudbury (-3,297) Winnipeg (-2,070) p_1 = .310 p_2 = .596	Regina-Saskatoon (+1,688) Calgary-Edmonton (+12,531) p_1 = .591 p_2 = .990
Average (β_1)	Quebec (-8,531) Halifax (-7,781) p_1 = .360 p_2 = .714	Ottawa (-2,453) p_1 = .091 p_2 = .570	p_2 = .988
Strong (β_2)	Montreal (-56,306) p_1 = .346 p_2 = .963	Toronto (+7,293) p_1 = .571 p_2 = .835	Vancouver (+16,704) p_1 = .999 p_2 = .999

p_1 = The proportion of urban centres with rapid growth in the region(s).

p_2 = Estimated probability of rapid growth.

a The numbers in brackets give the variation in employment between 1961 and 1971 in the mining and manufacturing sectors (nine major groups in total) above or below the potential represented by the industrial structure existing in 1961 in each urban system.

would have taken place if each of the existing industries had experienced a rate of growth identical to the one observed for the same industry in the country as a whole. The difference between the observed employment variation and the variation expected from average performances may therefore be attributed to more or less favourable regional conditions. For this second application of the *LOGIT* model, we classified the Canadian urban regions in terms of these regional conditions and in terms of the index of spatial interaction (see Table 3-10). The results of the estimation follow:

$$(3.22)\quad \ln\left(\frac{p}{1-p}\right) = \underset{(0.581)}{1.018} - \underset{(0.048)}{0.105}\,\beta_1 + \underset{(1.192)}{2.234}\,\beta_2 - \underset{(0.336)}{0.630}\,\delta_1 + \underset{(1.610)}{3.539}\,\delta_2$$

$$F = 1.77 \qquad R^2 = .70 \qquad \bar{R}^2 = .31 \qquad n = 8$$

In this case, the coefficient of determination is much lower and the Fisher and Student tests for the entire relationship and each of the coefficients respectively are not very conclusive. The results from Table 3-10 indicate nonetheless that, when regional employment conditions are very favourable and/or when the level of spatial interaction is very high, we can expect pervasive rapid urban growth. The most obvious cases of concentration of urban growth are Ottawa and Montreal.

Glossary

URB = percentage of a region's population living in an urban agglomeration of at least 5,000 population.

POPREG = total population of the region.

QUOTFAB = location quotient for fabrication industries, defined as the ratio of the percentage of Canadian jobs in fabrication located in a region to the percentage of the Canadian population residing in the region in 1971.

PRIM = percentage of the regional labour force in the primary sector, in 1971.

MAN = percentage of the regional labour force in the manufacturing sector in 1971.

RESS = dummy variable:
1 = resource region
0 = otherwise

FAB = dummy variable
1 = fabrication region
0 = otherwise

DOMPR = degree of concentration in the regional metropolis defined as the percentage of the regional population living in the most populous city (regional metropolis).

DENST = regional population density defined as the regional population divided by the area of the region in square miles, 1971.

NOMB = number of urban agglomeration in the region in 1971.

ACURB = percentage variation of the population in an urban centre between 1961 and 1971.

ACREG = percentage variation of the regional population between 1961 and 1971.

METRO = dummy variable:
1 = the regional metropolis
0 = otherwise.

4 Factors of Distortion

The industrial structure imposes several constraints on the characteristics of a region's urban structure and spatial dynamics and on the relative growth of each component in the urban system; this produces three basic types of region. However, to explain the remaining differences between regions of the same type, other factors must be introduced. Some are largely independent of the decision making power of the economic agents involved and arise mainly from each region's biophysical aspects natural endowments. Other factors are the result of the decision makers' behaviour, particularly in the face of uncertainty. Finally, it is very important to put the analysis in a dynamic perspective because each development period leaves traces in a region, which, particularly in the case of urban structure and transportation networks, have a much greater degree of permanence than the production activities that created them. In this chapter, we will briefly explain each factor and look for its influence on Canada's regions.

4.1. Biophysical Characteristics of a Region

The staples theory of economic development claims that the quantity and quality of natural resources as well as the accessibility to markets have a decisive influence on the growth of a resource region; in addition, we suggest here that the density and variety of these raw materials will have a determining influence on the functioning of its urban system. Furthermore, the adaptation of the transportation network to the conditions of each

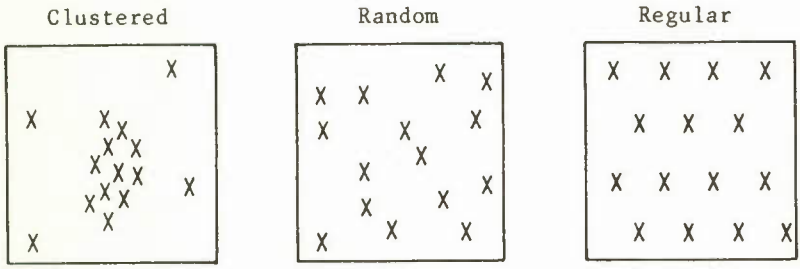
physical environment will affect not only the spatial dynamics but also the urban structure.

4.1.1. Density of Resources

Stochastic processes of geographic location produce three basic types of distribution: clustered; random; and regular (see Chart 4-1).[1]

Chart 4-1

Three Types of Spatial Distribution of a Resource



Each of the 15 points represents an equal quantity of resources of equal quality.

In the field of mining, it is common knowledge that asbestos, nickel, and coal are usually found clustered in a small geographic area. On the other hand, metals such as copper, zinc, and gold are found in aggregate form and are distributed fairly randomly over space. Finally, iron, petroleum, and natural gas are distributed in a continuous pattern over a larger area with much less variation in density, thus showing a more regular distribution.

1 Examples are the processes derived from the negative binomial law, the law of Poisson and a uniform allocation based on equidistance, respectively.

Spatial settlement in a resource region will adapt to these basic conditions. When the mineral is clustered, expansion of the extraction sector will obviously occur through the growth of a single urban agglomeration; this partly explains Sudbury's size and degree of domination over its whole urban system. When a mineral is randomly distributed, the expected spatial settlement pattern is much more chaotic, made up of successes and failures and resulting less from the desires of a monopoly than from the action of a large number of competitors; for this reason, the remainder of the Sudbury region, Northwestern Quebec, Southeastern British Columbia, and Northern British Columbia have fairly low rates of urbanization and degrees of concentration in the regional metropolis. Finally, in an area where the mineral is almost uniformly distributed, we expect the resource frontier to move out at about the same speed at which deposits are being exhausted, thus leaving behind small population units but encouraging the emergence of a limited number of large agglomerations to provide the continuance of operations. The network of central places, developed for agriculture and already applied with success in Saskatchewan,[2] could then also apply where the characteristic of a non-renewable resource is introduced.[3]

In the case of forest resources, which are more easily subject to on-site transformation (lumber, pulpwood, paper), a greater density of resources should lead to, firstly, the establishment of larger plants because of economies of scale in the production process and, secondly, to the location of several processing operations in a single urban

2 Royal Commission on Agriculture and Rural Life, Service Centres, Report No. 12, Queen's Printer: Regina, 1957 and G. Hodge, "The Prediction of Trade Center Viability in the Great Plains", Geographical Approaches to Canadian Problems, Englewood Cliffs, New Jersey, Prentice Hall, 1971, pp. 176-196.

3 A discussion of this matter can be found in M. Boisvert, Industrial Spatio-Dynamics: A Generalization of Central Place Theory to Space-Dominated Activities, unpublished Ph.D. dissertation, Philadelphia: University of Pennsylvania, 1976.

centre due to lower investment costs in the transportation infrastructure. These propositions could be tested empirically by comparing the region dominated by Vancouver with those other transformation regions in the country, particularly Quebec City and Ottawa, that also specialize in forestry.[4] Indeed, it is important to explain the differences in the form of the urban pyramid: in the Vancouver region, 65.5 per cent of the population not living in the regional metropolis is located in an urban centre of at least 5,000 population while the corresponding percentage is 27.3 in the Ottawa region and 25.5 in the Quebec City region. However, because of the difficulty in obtaining data on forest density based on our regional partitioning, we used the information available on a provincial basis.

Table 4-1 shows that the density of raw materials differs widely from one province to another except between the island of Newfoundland and Nova Scotia, and that the average size of plants also varies greatly between provinces. To fully understand the relationships existing between these various indicators, it is first necessary to recall that there are major interprovincial differences in the combination of species of wood, as reflected in the relative importance of the lumber and paper industries in each province. For instance, of the seven provinces for which we have complete information, Nova Scotia ranks third in forest density, second in average size of plants in the paper industry but seventh under that indicator in the lumber industry; indeed value added in this latter industry represents less than 40 per cent of that for the entire paper industry. A comparison of the most important regions reveals that the differences in forest density (over three times greater in British Columbia than in Quebec) are accompanied, as expected, by large differences in the average size of plants in both the lumber and paper industries. This illustrates well how the density of raw materials can influence patterns of spatial settlement.

4 The proportion of urban agglomerations specializing in the forestry, lumber and paper industries is 100 per cent in the Vancouver urban system, 63.6 per cent in the Ottawa region and 61.6 per cent in the Quebec City region.

Table 4-1

Forest Density and Average Size of Plants in the Lumber and Paper Industries, by Province

	Mature Marketable Standing Timber (1)	Unreserved Forested Land (2)	Density (1)/(2)	Value Added in 1972			
				Lumber Industry		Paper Industry	
				Total	Plant Average	Total	Plant Average
	(in millions of cubic feet)	(in thousands of acres)		(in thousands of dollars)			
Newfoundland[a]	7,991	9,271	.861	2,989	42.1	n.a.	n.a.
Prince Edward Island	16	615	.026	480	17.8	n.a.	n.a.
Nova Scotia	8,955	10,506	.852	19,201	118.5	49,660	4,514.5
New Brunswick	4,554	15,281	.298	34,152	273.5	77,332	3,866.1
Quebec	109,732	171,757	.638	250,936	260.8	658,193	3,179.7
Ontario	149,659	106,288	1.408	218,661	298.3	664,425	2,214.8
Manitoba	6,192	32,591	.189	15,940	183.2	30,809	1,232.4
Saskatchewan	9,568	30,221	.316	23,984	314.4	n.a.	n.a.
Alberta	12,190	62,705	.194	76,446	371.1	29,736	1,351.6
British Columbia	267,599	130,336	2.053	754,293	1,197.3	369,260	6,478.2

n.a.: non available.

a Density on the Island of Newfoundland only.

Source: Statistics Canada, 25-202 and 31-203, 1972 and 1973.

4.1.2. Variety of Resources

In our opinion, however, the variety in the eco-system of a region is related more to the degree of interdependence that should be shown by the different components of an urban system in a resource region. It should first be stated again that this lower degree of interdependence has two causes. First, because the transformation of raw materials remains embryonic, we expect very little intra-regional trade in the basic sector, which generally implies that each urban centre will have closer links with an extra-regional market than with the regional economy. Second, since a resource region usually has more than one basic resource, demand fluctuations in international markets are not very closely correlated and conditions also differ from one market to another, we should expect urban growth performances to be more dispersed when the variety of natural resources exploited is large.

Let us examine Table 4-2 in this respect. In general, dispersion around the mean clearly decreases from resource regions to transformation regions and fabrication regions; this is true of both the urban unemployment rate and the percentage variation of the population during the 1961-71 period. If we take a closer look at the coefficients of variation for resource regions, two regions stand out from the rest of the group, Northwestern Quebec and Gaspesia. These are the only regions that registered a decline in population, with one third of their agglomerations following this trend. It is true, nonetheless, that the variety of natural resources is not at issue here, but rather the capacity for some agglomerations of compensating for unfavourable employment conditions in their basic sector by further developing their tertiary sector. Two transformation regions show peculiar behaviour: Southeastern British Columbia, which has just emerged from the resource region stage, and the St. John's region. In the latter case, the very large standard deviation results from Wabana's exceptional performances, with a 50 per cent decrease in population between 1961 and 1971, while the weighted average growth rate of urban centres in

Table 4-2

Percentage Variation of Urban Population 1961-71, and the Urban Unemployment Rate in June 1971, by Urban System

	Percentage Variation of Urban Population 1961-71			Urban Unemployment Rate, June 1971		
	Unweighted Average	Standard Deviation	Coefficient of Variation	Unweighted Average	Standard Deviation	Coefficient of Variation
Resource regions						
Labrador[a]	27.7	45.5	1.64	n.a.	n.a.	n.a.
Northern British Columbia	31.0	23.0	.74	9.2	2.1	.23
Far North	139.4	215.0	1.54	10.5	10.4	.99
Northwestern Quebec	4.6	20.5	4.46	13.7	3.3	.24
Gaspesia	2.0	12.0	6.00	18.8	6.6	.35
Regina-Saskatoon	16.2	13.4	.83	7.1	1.1	.15
Calgary-Edmonton	51.0	86.4	1.69	7.2	1.4	.19
Unweighted average	38.8	59.4	2.41	11.1	4.2	.36
Transformation regions						
Southeastern British Columbia	15.6	34.5	2.21	8.6	0.4	.05

(continued)

Table 4-2 (concluded)

	Percentage Variation of Urban Population 1961-71			Urban Unemployment Rate, June 1971		
	Unweighted Average	Standard Deviation	Coefficient of Variation	Unweighted Average	Standard Deviation	Coefficient of Variation
Central						
British Columbia	69.1	40.9	.59	9.4	0.1	.01
Chicoutimi	31.0	34.2	1.10	12.2	3.1	.25
St. John's	11.3	28.4	2.51	11.4	7.5	.66
Sudbury	10.2	10.0	.98	8.2	2.2	.27
Saint John	10.7	11.9	1.11	8.3	1.1	.13
Halifax	8.2	11.3	1.38	8.9	2.7	.30
Ottawa	7.0	9.0	1.29	7.8	2.8	.36
Quebec	10.9	12.9	1.18	10.6	1.8	.17
Winnipeg	10.6	6.4	.60	6.9	1.3	.19
Vancouver	46.5	27.8	.60	9.2	1.5	.16
Unweighted average	27.7	20.7	1.23	9.2	2.2	.23
Fabrication regions						
Montreal	9.4	12.6	1.34	11.2	2.2	.20
Toronto	19.0	14.1	.74	7.1	1.1	.15
Unweighted average	14.2	13.4	1.04	9.2	1.7	.18

n.a.: non available.

a Computed from semi-urban centres.

Source: Basic data from 1961 and 1971 Census.

the region was 11.3 per cent. Wabana is a mining town specializing in iron ore and, as such, is unique in the St. John's system.

4.1.3. Topographic Constraints

Apart from the density and variety of natural resources, another biophysical characteristic has an important influence on the workings of a regional urban system: the availability of water routes to ensure each urban centre with a direct link to external markets. Thus, when as in the Atlantic region the gateways to the outside are primarily maritime and the entire coast is well adapted to port installations (which, incidentally, is not true of the Pacific Coast), we can expect concentration in the regional metropolis to be fairly low. In the opposite situation, as in the Prairies, where railways provide the link with the outside, transportation efficiency requires a smaller number of staging points. In other words, since the technological and economic conditions affecting maritime transportation allow a higher number of transportation nodes[5] than is the case with rail transportation, the pressure to increase the urbanization rate will be weaker.

This statement can be empirically established by looking at the concentration of the transportation industry in both the Atlantic provinces and Manitoba and Saskatchewan. The total population to be served is very similar: 2,057,262 in 1971 in the former and 1,914,489 in the latter. The total number of employees in the transportation and warehousing industries is also quite close: 46,554 and 48,508 respectively.[6] However, 51.0 per cent of

5 It is nonetheless true that the appearance of the container has abruptly changed this flexibility although the container, being better adapted to the transportation of general merchandise, has more influence on import than export flows.

6 A certain difference remains however even when those employed strictly in warehousing are eliminated, since they number only 600 in the Atlantic region and 4,910 in Manitoba and Saskatchewan. Unfortunately, as the data at the urban level do not distinguish between warehousing and transportation, the two industries cannot be separated.

this labour force lived in an urban agglomeration in the Atlantic region while the corresponding number was 64.8 per cent in the two Prairie provinces; furthermore, the primate city in each region concentrated 9.7 per cent of this labour force in the first case (Halifax) where the population represented 10.8 per cent of the regional population compared with 38.8 and 28.2 per cent respectively in the second case (Winnipeg).

Because of the heterogeneity of the transportation services in which a large part of the activity must be considered as non-basic, it may be advisable to consider only basic employment rather than total employment. The number of basic jobs computed at the level of individual urban centres in the transportation and warehousing industries is estimated[7] at 3,067 in the Atlantic region, and at 3,631 in the Prairies. This total is divided among six urban agglomerations in the former, with Moncton[8] getting the greatest percentage (59.4 per cent), while in the second case, only four urban agglomerations specialize in the industry, with Winnipeg taking the lion's share (88.5 per cent). Chart 4-2 illustrates the higher concentration in the Prairie region with Lorenz curves.

It is worth adding that this greater concentration of population, caused in part by the operating conditions of the transportation network which are determined by particular geographic characteristics, can definitely play a role in the passage from the extraction-of-resources stage to the transformation stage. In fact, it has been recognized that the region polarized by Winnipeg had the usual economic and urban characteristics of a transformation region, while the diagnosis was much less clear in the Atlantic sub-regions.

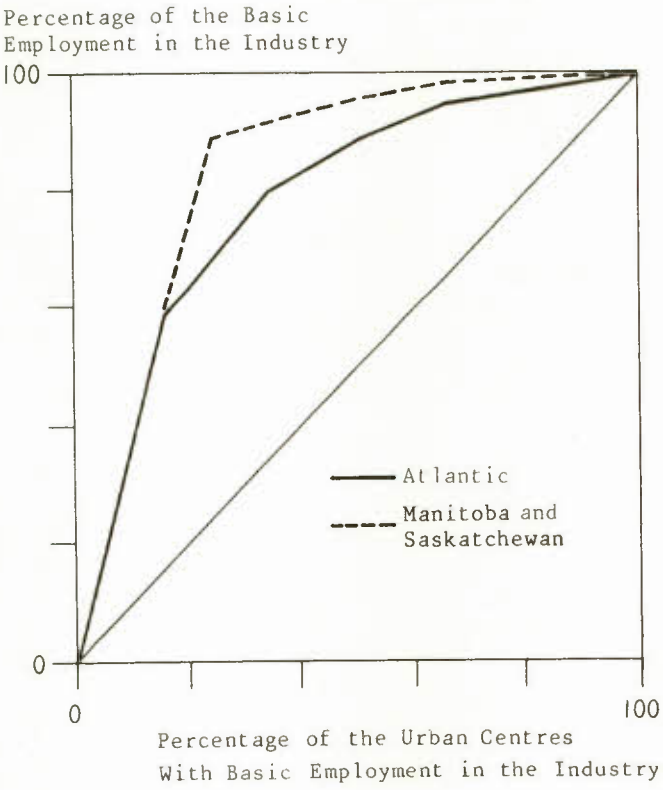
We can also introduce biophysical constraints when comparing the Montreal and Toronto regions.

7 Some methodological details are provided in Appendix B.

8 It is important to stress that Moncton has only limited port activity and that rail transportation accounted for almost all of these jobs; thus, the geographic coincidence between maritime transportation nodes (Halifax, St. John's and Saint John) and rail transport nodes (Moncton) is not ensured.

Chart 4-2

Lorenz Curves Applied to Basic Employment in the Transportation and Warehousing Industries, Atlantic Provinces, Manitoba and Saskatchewan



Because of its position in the St. Lawrence plain, Montreal dominates its hinterland in all directions (360°) while Toronto faces Lake Ontario, a true inland sea, and thus cannot exert its influence in all directions (between 180° and 270° only). Since, as we have suggested, fabrication activities seek an urban location with easy access to the metropolitan pole and may benefit from agglomeration economies, this geophysical constraint alone can explain part of the difference in the size of the intermediate

urban agglomerations in each of these urban structures. While this factor is probably minor, it is not negligeable.[9]

4.2. Behavioral Differences

Economic behaviour may differ from region to region, with the result that different locational decisions will have important implications for the urban structure and the functioning of the urban system in general. As this difference in attitude may be linked to the actual characteristics of the economic environment, we will examine how uncertainty can give rise to various attitudes particularly in relation with the attraction exerted by a large city over its hinterland. This difference may also originate from particular socio-cultural characteristics, the most obvious example being the Quebec society in the Canadian setting.

4.2.1. Individual Attitudes Under Uncertainty

In their day-to-day dealings, individuals never have complete information on all the variables required to make their economic decisions. Furthermore, when expectations about the future intervene, a margin of error must be introduced. It is therefore necessary to account for a certain amount of uncertainty. This will have a major influence on the location of firms as well as of individuals and public services, an influence that generally will increase the concentration of population in the large urban agglomerations.

9 It would be inappropriate to attempt an estimate of the importance of this factor since the sole purpose of this chapter is to list some of the factors indisputably influencing the workings of an urban system once the influence of the region's industrial sector has been accounted for.

Webber[10] proposes the following reasoning at the firm level. Three variables appear to be of crucial importance in the selection of a site for a new plant: the costs imposed by distance, the occurence of external economies or diseconomies and the possibility of economies of scale in the production process. As a rule, these three factors will be modified in a situation of uncertainty as indicated above, that is in favour of concentration in a metropolis rather than dissemination in the periphery. The costs imposed by distance will be higher in an uncertain situation for two reasons: the variability of prices received by the producer, once transportation costs are paid, increases with distance from the market and this variability is even greater in the presence of uncertainty.[11] Consequently, producers will seek to minimize risks by locating close to the market. This choice will also hold down communications costs which also increase with distance.[12] Moreover, agglomeration economies should be higher in the presence of uncertainty; in particular, new firms will tend to guard themselves against the risks inherent in setting up a new activity by seeking a metropolitan location.[13]

Finally, uncertainty also leads to a reduction in the size of firms because, according to Webber, it decreases the share of profits that will be

10 Michael J. Webber, Impact of Uncertainty on Location, Cambridge, Mass.: M.I.T. Press, 1972, particularly pp. 273-79.

11 Ibid, pp. 192-93.

12 However, when the distance to raw materials rather than the distance to the market is important (as is the case for primary industries compared to fabrication industries) uncertainty will favor the proliferation of the extracting units over the entire area.

13 This idea was also put forward by S. Czamanski, "Examen des disparités inter-régionales et critères de choix des politiques de développement" in Vers une problématique globale du développement de la région de Montréal, P. P. Proulx (ed.), Centre de recherches en développement économique, Montreal, No. 12, 1976.

reinvested rather than held in reserve or redistributed in the form of dividends, and thus leads to an industry-wide proliferation of production units rather than expansion of existing sites. Two consequences are foreseeable: if this reduction in the size of production units lowers productivity, it will produce a much lower urbanization rate through relatively lower wages, since the high income elasticity of demand for services and the urban location of these activities represent the most important source of urban growth. On the other hand, through less extensive vertical integration, the reduction in the size of firms will increase reliance on more frequent and intense inter-industrial shipments, which will be less costly in large urban agglomerations.

The textile and clothing industries can be referred to in order to test the influence of this factor on the firm's behaviour. There is no doubt that, over the past 15 years, these two industries have grown in a climate of uncertainty, particularly with respect to Canadian commercial policy in the face of growing imports. This group also experienced the lowest growth rate in employment between 1961 and 1971 among all manufacturing industries (6 per cent compared with 21.5 per cent on average).[14] Table 4-3 shows these variations in detail for each urban system, as well as the geographical distribution between the regional metropolis and the rest of the urban system. The figures for the smallest regions are so small that, for all practical purposes, they can be ignored. Among the seven other regions, four experienced more rapid expansion in the regional metropolis than in the rest of the urban system, particularly the Montreal region where the metropolis showed an increase of approximately 4,000 jobs while the hinterland suffered a loss of over 5,200 workers. Since over half of the labour force employed in these industries in Canada in 1971

14 As the standard classification of industries was revised in 1970, the comparison between the two census years is difficult; we have therefore combined the textile and clothing industries. Because of the relatively small numbers still affected by the changes after this combining and because of the lack of more accurate data, we have nonetheless assumed perfect comparability.

Table 4-3

Labour Force in the Textile and Clothing Industry
in 1961 and 1971, by Urban System, Canadian Urban Regions

Urban System	1961	1971	Variation Between 1961 and 1971			
			In Number of Jobs	In Per Cent	In the Regional Metropolis	In the Urban Hinterland
St. John's	213	70	-143	-67.1	-140	+3
Chicoutimi	85	180	+95	111.8	+70	+25
Sudbury	134	160	+26	19.4	-7	+33
Regina-Saskatoon	436	480	+44	10.1	-122	+166
Saint John	461	400	-61	-13.2	-32	-29
Halifax	761	705	-56	-7.4	-56	0
Calgary-Edmonton	1,627	2,525	+898	55.2	+848	+50
Quebec City	6,385	5,990	-395	-6.2	-968	+573
Ottawa	1,327	1,625	+298	22.5	+104	+194
Winnipeg	6,383	6,995	+612	9.6	+485	+127
Vancouver	2,970	3,985	+1,015	34.2	+879	+136
Montreal	87,510	86,230	-1,280	-1.5	+4,004	-5,284
Toronto	44,640	44,035	-605	-1.4	-1,697	+1,092
Total	152,932	153,380	+448	2.9	3,368	-2,916
Canada	154,180	163,480	+9,300	6.0	--	--

Source: Basic data from 1961 and 1971 Census.

was located in this region, it is not surprising to find this pattern reflected in the figures for all urban systems combined as well. The growth of employment in the Quebec City and Toronto urban systems also demonstrates the lead imposed here by the regional metropolis in the shrinking of employment. In contrast to the Montreal region, these industries are indeed little represented in the economic base of these two regions and uncertainty thus caused some of these activities to be abandoned, in the regional metropolis to begin with.

Uncertainty can also result from incomplete information, as illustrated with the labour market. A commutershed can be identified for each major urban agglomeration, with limits defined by the frequency of daily commuting. Within each zone thus established, we can assume that workers will use industrial or occupational mobility before resorting to geographic mobility when faced with unemployment or underemployment problems. But when these mechanisms fail to solve the problem of unemployment or to meet a worker's wage requirements, emigration must be considered. This decision implies an important quantity of information not only on many key variables (differential in the wage rate and the cost of living, vacancy rate, stability of employment, etc.) but also for a considerable number of destinations. The hypothesis put forth here is that the information available on labour market conditions in large urban agglomerations is much more complete and thus reduces uncertainty to the extent of favouring more so than under equilibrium conditions the selection of these centres as migrant destinations.

We know, for example, that, even though Toronto, Montreal, and Vancouver represented only 29.0 per cent of Canada's population in 1966 and 29.9 per cent in 1971, over 51.9 per cent of those who immigrated to Canada between 1966 and 1971 chose to reside in these cities.[15] Obviously the expected growth rate in the job market must be added to the size of the market as a decision variable, and as a

15 Taken from the study by R. W. Crowley, Population Distribution Perspectives and Policies, Ottawa: Ministry of State for Urban Affairs, 1974.

matter of fact this growth generally proved to be proportional to the size of urban agglomerations over the medium term.[16] While population growth under normal conditions is a consequence of the increase in the supply of jobs, we believe that the inverse relationship is true of large metropolitan centres, in other words, the increase in population triggers an increase in the supply of jobs, with the difficulties of adjustment reflected in the level of urban unemployment rates. Although the unemployed form only a part of all migrants, it has been shown that they are more geographically mobile than those who hold a job;[17] it is thus valid to refer to geographic mobility as an effective adjustment process. To test the hypothesis on the impact of uncertainty presented above, we will check for the following two statements: because of a migrant's bias toward large agglomerations, the relationship between the unemployment rate and urban size, instead of being negative, is *U*-shaped, and, secondly, in urban systems where unemployment is high, the degree of concentration in the regional metropolis is relatively higher.

Let us consider each type of unemployment in relation to the characteristics usually associated with urban size. Frictional unemployment should be lower where the number of contacts possible between suppliers and demanders of labour is high. Seasonal unemployment is more concentrated in some industries, particularly the construction and the primary sectors; while the spatial distribution of the construction industry is distributed geographically roughly in proportion with the population,[18] the various extraction industries are located more in rural and semi-urban environments or small cities. Consequently, a worker in a large agglomeration runs less risk of suffering periodical work stoppages.

It is widely held that cyclical unemployment affects all industries and all regions although in varying degrees, particularly because of differences in income elasticity and in labour/output ratios

16 Consult Chapter 1.

17 E. K. Grant and J. Vanderkamp, op. cit., p. 23.

18 Consult Appendix B.

across industries and, to a lesser extent, across regions. However, after a careful survey of the literature on this subject, we reach the conclusion that there is no clear relationship between cyclical unemployment and urban size. Finally, it is customary[19] to associate structural unemployment either with a mismatching of the occupational characteristics of the available labour force and the demand for labour or with the exhaustion of natural resources; the former applies primarily to transformation regions and the latter to resource regions. In both instances, structural unemployment should be less serious in large urban agglomerations.[20] To summarize, we expect labour market conditions to vary with urban size and in particular, the unemployment rate to fall steadily, as illustrated in Chart 4-3.

The only published empirical data available on urban agglomerations are those from the census; as a result, we were limited to a precise point in time, June 1971.[21] We were also forced to eliminate the heteroscedasticity present in the sample since, as suggested above for cyclical and structural unemployment, the dispersion in unemployment rates is inversely related to urban size.[22] The following equation was estimated for all 205 Canadian urban agglomerations:

$$(4\text{-}1)\quad U = \underset{(34.93)}{7.76} - \underset{(4.13)}{(0.241 \times 10^{-5})}\, POP + \underset{(4.10)}{(0.797 \times 10^{-12})}\, POP^2 + \underset{(1.04)}{0.405}\, ATL$$
$$+ \underset{(28.1)}{2.175}\, QUE + \underset{(3.86)}{0.655}\, PRA + \underset{(13.49)}{3.232}\, COL$$
$$F = 14{,}757 \qquad \bar{R}^2 = .99$$

19 Thirsk, W. Regional Dimensions of Inflation and Unemployment, Ottawa: Prices and Incomes Commission, 1973.

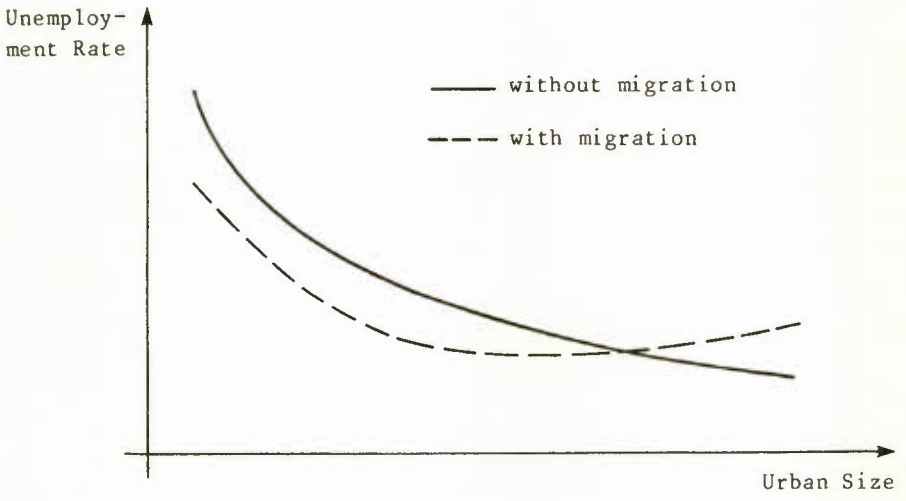
20 Some even hold that beyond a certain threshold, such as 250,000 people, an urban agglomeration possesses all the potential necessary to ensure permanent industrial reconversion. W. Thompson, A Preface to Urban Economics, Baltimore: John Hopkins Press, 1965, pp. 21-24.

21 Although the parameters differ, the observations that follow are just as true for the 1961 Census.

22 The identification and correction procedures for heteroscedasticity are presented in Appendix C.

Chart 4-3

The Relationship Between Urban Size and Unemployment Rate With and Without the Migration Process



The coefficient of determination obtained is very high and each coefficient, except for the dummy variable indicating the Atlantic region, proves to be significant in this non-linear equation. Since, in particular, the coefficient of the variable "population squared" is positive, we must conclude that beyond a certain point[23] (1,414,741 in this case), the unemployment rate increases with urban size. This phenomenon must be attributed to

23 Since only the constant here differs from one region to another, the urban size corresponding to the minimum unemployment rate is the same in all cases; the value of the dependent variable varies however, so that for a metropolis of 2 million inhabitants, the expected unemployment rate based on 1971 data is 6.13 per cent in Ontario, 8.30 per cent in Quebec and 9.36 per cent in British Columbia while the minimum possible rate is 5.94 per cent, 8.11 per cent and 9.17 per cent respectively.

migration, more precisely to the agglomeration bias present in the behaviour of the migrants.[24]

Turning now to the second point, assuming that an unemployed worker would first try to find work in his own region before considering outmigration to one of the country's large metropolitan centres, we suggested that the role of intervening opportunity be played by the regional metropolis so that a high regional unemployment rate be accompanied by a high degree of concentration in the regional metropolis. As indicated in Tables 4-2 and 3-3, the urban systems whose unemployment rate is clearly different from that obtained in other regions of the same type are Chicoutimi, Vancouver, and Montreal, where indeed population concentration in the regional metropolis is very high.

4.2.2. Location of Public Facilities

Concerning governments, the major source of uncertainty is certainly the voters intentions. In a resource region, where there is only an embryo of intermediate urban hierarchy and where urban growth often occurs independently, it is tempting to scatter public facilities throughout the area with a learning institution here, a hospital there, and administrative offices everywhere. This type of behaviour is easy to recognize in regions such as Northwestern Quebec and Gaspesia,[25] not to mention

24 While it is true that the functioning of the labour market in very large centres is clearly distinguished here from that observed in the rest of the urban structure, the simple relationship between unemployment rate and urban size is not very significant, even when heteroscedasticity is eliminated. The general conclusion of the work carried out on this matter is that a low unemployment rate in the large urban agglomerations cannot be counted among the advantages of large cities. H. Richardson, The Economics of Urban Size, Lexington, Mass.: Lexington Books, 1973, pp. 60-65.

25 One of the main recommendations is the plan drawn up from the work of the BAEQ (Bureau d'Aménagement de l'Est du Québec) consisted precisely in changing this state of

(cont'd next page)

the Maritime provinces as a whole. At the other extreme, a fabrication region with a high degree of concentration in the regional metropolis and characterized by more intense intra-regional interaction will show a strong tendency to concentrate installations in the regional metropolis. Uncertainty here therefore amplifies the differences between the various types of regions.

Much importance must also be attributed to the distortions caused by the location of federal and provincial capitals. The selection of a site for a capital is in large part arbitrary. However, for the centres chosen, public administration usually belongs to the basic sector and in addition represents a considerable industry in terms of employment, as shown in the figures of Table 4-4. It is also interesting to note that eight of the eleven capitals are regional metropolises and that two of the three other capitals have the lowest concentration of employment in provincial public service (31.2 per cent in Victoria and 33.3 per cent in Fredericton) precisely because of the regional metropolis' competition. Table 4-4 also shows the number of jobs that should be considered as indisputably basic, that is, serving an extra-regional population. As indicated in Appendix B, the ratio of employment to population very often varies from one urban class to another precisely because of the larger hinterland of cities in the upper levels of the urban hierarchy. For this reason, the 66,890 jobs in public administration in Toronto do not appear excessive, because of Toronto's domination over Ontario; for the same reason, Quebec City has 15,908 basic jobs while employment in public administration within Montreal is lower than expected for an agglomeration of its

(conclusion footnote 25)

affairs by favouring greater concentration, that is the implementation of a nodalization process. A similar recommendation is found in the work of the Royal Commission on Agriculture and Rural Life created by the Saskatchewan government at the end of the 1950s.

Table 4-4

Impact of the Location of Federal and Provincial Capitals on Urban Size

Capital	Employment in Federal or Provincial Public Administration		Total Number of Jobs in Public Administration	Number of Jobs in Public Administration Considered as Basic	1971 Population	
	Number	In Percentage of Federal or Provincial Total			Observed	Corrected[b]
Ottawa-Hull	71,955[a]	21.9[a]	78,555	59,909	602,510	178,993
St. John's	2,585	63.8	5,280	1,215	131,814	119,642
Charlottetown	790	53.6	1,645	477	25,253	22,172
Halifax	2,550	51.4	21,565	14,695	222,637	170,709
Fredericton	1,755	33.3	3,400	1,652	37,684	26,353
Quebec City	17,960	41.4	30,725	15,910	480,502	225,909
Toronto	25,425	44.9	66,890	0	2,628,043	2,628,043
Winnipeg	5,340	65.4	20,010	3,350	540,262	504,132
Regina	3,785	46.6	8,540	4,201	140,734	105,739
Edmonton	9,075	58.9	22,820	7,534	495,702	409,450
Victoria	4,010	31.2	15,235	9,192	195,800	119,033

a If we exclude National Defence, the numbers are 56,785 and 30.0 per cent respectively.

b Population of the agglomeration in the absence of all basic employment in public administration. The procedure used is described at the end of Appendix B.

Source: Basic data from 1971 Census.

size.[26] Finally, it is worth noting that other cities in the Atlantic and Prairie regions, in contrast to other regions, have basic jobs in this industry (Moncton and Calgary), and this appears to be still another indicator of the fractioning typical of these regions.

4.2.3. Impact of Cultural Differences

The most obvious cultural difference in Canada is certainly language spoken. Since 84 per cent of all French Canadians in 1971 resided in Quebec where they formed a majority of 80.7 per cent of the population, this cultural difference could result in spatial differentiation. If we make the assumption that French-speaking Québécois forced to change their place of residence would agree to choose a destination outside Quebec only under conditions of unemployment and/or wage differentials higher than the thresholds observed for other Canadians,[27] we can expect that migration flows in Quebec will be very different from those in the other provinces.[28]

Over the past hundred years, Quebec has experienced two important economic crises, in

26 It should be emphasized that, according to central place theory, only part of the provincial public service located in a capital city gets the entire province as its market area since public administration is also subject to a certain deconcentration over space. Thus, basic employment in public administration in a capital city comes from supplementary jobs at the federal or local levels, or from a surplus at the provincial level indicating a lower degree of deconcentration than elsewhere.

27 This assumption has been successfully tested in J. Vanderkamp, "Inter-Regional Mobility in Canada: A Study of the Time Pattern of Migration", Canadian Journal of Economics, 1, Aug. 1968, and in T. J. Courchesne, "Inter-Provincial Migration and Economic Adjustment", Canadian Journal of Economics, 3, Nov. 1970.

28 All the information surveyed goes along these lines, Living Together: A Study of Regional Disparities, op. cit., chapter 9.

1880-90 and 1930; especially in the former case, the province suffered high emigration rates accompanied by internal colonization movements, that could almost be called temporary returns to a subsistance economy, in the Gaspé, Lac-St-Jean, and more recently the Abitibi-Temiscamingue regions.[29] Apart from these exceptional periods that led to a multiplication of rural parishes and thus a low rate of urbanization, the redistribution of the Quebec population within provincial boundaries has largely favoured Montreal. In the preceding section, we outlined the fundamental reasons for the selection of a metropolitan agglomeration by migrants as a favoured destination; the sociocultural characteristics of the francophone population thus reinforced this agglomeration bias, and this helps to further explain the high degree of concentration in the regional metropolis of Montreal.[30]

On the other hand, the spreading of the population over the hinterland did not leave as clear a trace around Montreal as in the other regions of Quebec.[31] The proportion of the population in semi-urban and rural areas is roughly equal in the two fabrication regions, 15.4 per cent in Toronto and 15.7 per cent in Montreal. Furthermore, the average population of the 78 semi-urban centres in the Toronto region is 2,333 compared with 2,324 in Montreal's 64 centres, while the total regional population is equal to 67.6 per cent of that in the Toronto region. In the Toronto hinterland, 42 urban agglomerations serve a non-urban population of 981,885, an average of 22,047 each; 26 agglomerations average a non-urban population of

29 C. Germain, "Mouvements migratoires et croissance démographique", L'Actualité économique, 38, 3, 1962, 411-21 and A. Gosselin, "L'évolution économique du Québec: 1867-1896", in Economie Québécoise, Montréal: Presses de l'Université du Québec, 1969, 105-41.

30 R. D. Hirsch, Les origines et la nature des déséquilibres régionaux du Québec, cahier 11/2 Québec, Conseil d'orientation économique du Québec, 1967.

31 It should be recalled that in 1971 the entire province of Quebec, while only 78.3 per cent as populous as neighbouring Ontario, had 163 semi-urban communities (between 1,000 and 5,000 population) compared to 122 in Ontario.

24,827 in the Montreal hinterland. In addition, the average population of an urban agglomeration is 120,996 in the former and 133,062 in the latter. To conclude, the specific difference in the urban structure of the Montreal region is not the number of urban nodes or the rate of urbanization but the degree of concentration in the regional metropolis.[32] Apart from the cultural factor mentioned above, some aspects of the supply of labour should be studied to better understand the migratory behaviour of the francophone population. These will be introduced at the end of the next section.

4.3. Traces Left by Successive Stages of Development

When examined in a historical perspective, the various indicators used to describe the functioning of an urban system may be listed in order of inertia. For example, since the location of urban sites is something that can be taken for granted since initial settlements usually go far back in the past, the relative geographic position of each urban centre and the distance between them change only slowly as improvements in the transportation infrastructure are made. Conversely, manufacturing activity moves much faster and with it, workers and population. Distribution channels for services and manufactured goods serving a local or regional market, which help to establish the urban hierarchy, occupy an intermediate position on this scale. Consequently, when a region crosses the threshold to a new development stage these indicators will adjust only gradually and some traces left by the preceding development stages will remain visible. They may even constitute obstacles to the region's new dynamics, in which case it might be advisable to accelerate the transition process on the basis of the structural correspondence developed here.

32 This subject was examined in a Quebec-Ontario comparison by M. Boisvert, Analyse économique du système urbain québécois, unpublished Master's thesis, Université de Montréal, 1972.

4.3.1. Transformation Regions

Because of its dependence on outside markets, a resource region has only a limited intra-regional transportation network and is characterized by a low rate of urbanization. With the establishment of processing plants, the risk is great that these will be scattered across the region and that the internal transportation network will not be sufficiently developed. As a result, the manufacturing base will be deprived of the positive effects arising from economies of agglomeration, economies of scale in the transportation industry, and intense exchange of ideas at the origin of local entrepreneurship. New Brunswick illustrates this well.

As indicated in Table 4-5, two categories of transformation industries are found in the Saint John urban system: agro-food and paper. Saint John and Moncton have long competed for the role of regional metropolis for the first industry, but no agglomeration can even pretend to make such a claim for the second: while six of the nine agglomerations in this urban system specialize in the paper industry, none has more than 26.5 per cent of all basic employment in the industry. Moreover, a glance at Map A-3 in Appendix A reveals the absence of hierarchical orientation in the road network compared with other transformation regions such as Quebec City or Winnipeg. As indicated at the beginning of this chapter, this situation is explained in large part by the importance of maritime transportation as well as by the low density of resources that contributed to the scattering of primary activity.

4.3.2. Fabrication Regions

Because of the domination imposed by the regional metropolis over both the urban structure and the pattern of interurban linkages in a transformation region, a large part of the transformation plants will be concentrated in the primate city, giving this city numerous locational advantages for the establishment of fabrication

Table 4-5

Estimates of Basic Employment by Industry in 1971, Agglomerations in the Saint John Urban System

Agglomeration	Hierarchical Level	Industries Forming the Economic Base of the Agglomeration	Total Basic Employment	Total Labour Force
Saint John	3	food and beverage 701, paper 591, communications 491, health 398, other manufacturing industries 186, metal fabricating 147	2,514	42,660
Moncton	3	transportation and storage 1,822, food and beverage 792, retail trade 586, public administration and defence 348, communication 90	3,638	28,665
Fredericton	4	public administration and defence 1,652, education 314, electrical power, gas and water utilities 147, wholesale trade 147, forestry 49, fishing and trapping 15	2,324	16,935
Bathurst	5	paper 566, mines 512, forestry 64, fishing and trapping 15	1,157	6,255
Campbellton	6	health and welfare 152, mines 512, transportation 106, paper 52	310	3,750
Chatham-Newcastle	6	public administration and defence 534, paper 202, wood, furniture and fixture 3	739	5,115
Dalhousie	6	paper 734	734	2,090
Edmundston	6	paper 624, wood, furniture and fixture 40, forestry 33, textile and clothing 9, fishing and trapping 5	711	4,415
Oromocto	6	public administration and defence 2,346	2,346	4,045

Source: Estimates from 1971 Census data based on the method presented in Appendix B.

industries: a developed transportation network, several transformation industries, and a large local market. In Chapter 2, we suggested that, because of the number of location factors affecting fabrication industries, all the urban centres located in the fabrication region would be candidates for the establishment of a new production unit, one having lower land costs, another a more rapid and diversified transportation network, yet another abundant unskilled labour. However, all will not be as likely to be chosen, if only because there are differences between agglomerations in the expertise and local entrepreneurship necessary to identify and exploit the comparative advantages of one location that could be perceived as absolute advantages by the industrialists. This factor is related more to individual attitude than to the historical sequence of development in a region, but the same is not true of the original location of transformation plants which lays the foundation for an urban hierarchy and orients in large part the development of the various transportation networks.

Returning to the comparison between the Montreal and Toronto regions,[33] let us ask the following question: which agglomerations in each urban system succeeded in 1971 in getting 1,000 jobs in a transformation industry? Table 4-6 answers this question. In the Montreal urban system, apart from the textile and paper industries, only three cities other than Montreal can be named: Sherbrooke, in the food and beverage industries, and Sorel and Trois-Rivières, in the primary metal industries. Since the paper industry in the province of Quebec is primarily oriented towards outside markets and the food and beverage industries ship the large majority of their products to trade channels, the textile industry (in nine cities) represented the foundations for spatial polarization influencing thereafter the location of fabrication

33 The analysis that follows has already been presented with more details in a lecture given to the Congrès annuel de l'Association de Science Régionale de Langue Française, held at Université Laval in Quebec City in September 1976 under the title: "Correspondance entre structure industrielle et armature urbaine: comparaison entre les régions de Toronto et de Montréal".

activities. In the Toronto region, the situation is completely different since, apart from the food and primary metal industries, seven agglomerations other than Toronto can be named. Thus, most of the urban agglomerations in the Montreal hinterland have established only an embryonic transformation sector; to a large extent, we could look at Sorel as a small-scale replica of Hamilton, Sherbrooke of London, Trois-Rivières of Ste-Catherines, Drummondville of Kitchener, and Shawinigan of Kingston.

What is being emphasized here is that the geographic location of the transformation industries influences the location of fabrication activities first in a direct way because of the inter-industrial flows of commodities but also in an indirect way because, within a fabrication region, urban size, which is related to the amount of basic employment in the transformation sector, stands for a large number of location factors.[34] In order to check for this relationship, we compared the number of new fabrication establishments[35] with the size of each urban centre, except the regional metropolis;[36] the coefficient of correlation is .95 in the Toronto region and .81 in the Montreal region. In short, on the one hand, the transformation industries are more concentrated in the regional metropolis in the Montreal region and on the other hand, the fabrication industries are spread out in the hinterland in a more irregular pattern.

The greater concentration in the Montreal metropolis can also be observed in the spatial dynamics. Maps A-6 and A-9 in appendix show that the number of direct road links of first category

34 Return to Chapter 1 for this matter.

35 In fact, we added the new establishments created in 1963 and 1972, two average years in the cycle. The data were taken from the semi-annual Statistics Canada publication, New Manufacturing Establishments in Canada, Catalogue No. 31-002.

36 Otherwise the coefficient of correlation reaches .99 in each case.

Table 4-6

Urban Agglomerations With Over 1,000 Employees in a Transformation Industry in 1971, Toronto and Montreal Urban Systems

Industry	Toronto	Montreal
Food and beverages	Toronto (32,800), Kitchener (5,645), Hamilton (5,480), London (5,355), Ste. Catherines (3,160)	Montreal (31,650), Sherbrooke (1,120)
Tobacco	Toronto (1,170)	Montreal (4,030)
Rubber and plastic	Toronto (11,535), Kitchener (4,850), Hamilton (1,330), London (1,110)	Montreal (5,300)
Leather	Toronto (5,095), Kitchener (2,300)	Montreal (7,910)
Textiles	Toronto (6,285), Kitchener (3,455), Hamilton (2,115), Kingston (1,535), Brantford (1,290), Ste. Catherines (1,140)	Montreal (12,120), Drummondville (2,720), Granby (1,510), Magog (1,450), Sherbrooke (1,360), Cornwall (1,245), St-Jean (1,235), Trois-Rivières (1,155), Valleyfield (1,120), Shawinigan (1,005)

Lumber	Toronto (3,095)	Montreal (3,220)
Paper	Toronto (15,375), Ste. Catherines (3,340), Hamilton (2,065), London (1,340)	Montreal (10,575), Trois-Rivières (3,230), Cornwall (1,515), La Tuque (1,490), Shawinigan (1,460)
Primary transformation of metals	Hamilton (24,695), Toronto (8,540), Ste. Catherines (6,605), Oshawa (1,515), Kingston (1,220)	Montreal (9,760), Sorel (2,720), Trois-Rivières (1,340)
Non-metallic mineral products	Toronto (9,900), Hamilton (2,980), Ste. Catherines (2,350)	Montreal (7,735)
Oil and coal products	Toronto (4,425), Sarnia (2,090)	Montreal (4,300)

Source: 1971 Census.

between the agglomerations in the Toronto urban system, apart from those with the regional metropolis, is twice as high, ceteris paribus, than the number in the Montreal region. Along the same lines, a recent study[37] on migration flows between agglomerations of over 50,000 population, based on data from the 1971 Census, concludes that 62 per cent of all persons who changed municipalities over the 1966-71 period chose the regional metropolis as destination in the Montreal region compared with only 34.8 per cent in the Toronto region.

A large part of this phenomenon is obviously explained by the differences in industrial structure between the two regions,[38] which we have already discussed; Table 4-7 goes into even more details. The Montreal urban system specializes in clothing and hosiery while the Toronto urban system specializes in transportation equipment and, to a lesser degree, in metal products and machinery. It is very simple to estimate a coefficient of spatial polarization by dividing the number of workers in a group of fabrication industries by the number of workers in the transformation industries with which they form an industrial complex. This coefficient is equal, in the case of hosiery and clothing combined with the textile industry, to 2.05 for the entire Montreal urban system and 1.19 for the Toronto region. However, because of the attraction exerted by the large centres on fabrication industries, each of the two regional metropolises produce a coefficient that is twice as high, 4.15 and 2.62 respectively. Once the two metropolises

37 J. W. Simmons, Canada: Choices in a National Urban Strategy, Research Paper No. 70, Centre for Urban and Community Studies, University of Toronto, 1975.

38 For an analysis of the causes of this differentiation which stresses the slowness of structural adjustments in industry, see J. M. Gilmour and K. Murricane, "Structural Divergence in Canada's Manufacturing Belt", Canadian Geographer, XVII, 1, 1973.

Table 4-7

Percentage Distribution of the Labour Force Among Fabrication Industries for Urban Agglomerations of 10,000 and Over Population in the Montreal and Toronto Regions in 1971

Fabrication Industries	Toronto Region	Montreal Region	Gap
Hosiery	1.4	3.7	-2.3
Clothing	4.6	23.3	-18.7
Furniture and fixture			
Printing and publishing	10.5	9.9	0.6
Metal fabricating	16.2	11.7	4.5
Machinery	11.1	5.1	6.0
Transportation equipment	21.6	11.0	10.6
Electrical products	15.1	13.6	1.5
Chemical products	8.4	10.0	-1.6
Miscellaneous manufacturing industries	7.4	6.7	0.7
Total	100.0 (406,200)	100.0 (210,280)	0.0

Source: Basic data from 1971 Census.

are excluded, the average unweighted coefficient[39] is equal to .69 in both regions. In the case of the metallurgical complex made up of the metal products, machinery, and transportation industries combined with primary metal, the coefficient is 4.07 for the entire Toronto urban system compared with 3.63 for Montreal. However, the regional metropolises show much different coefficients, 9.72 in Toronto and 5.10 in Montreal. Once the two regional metropolises are excluded, the average unweighted coefficient[40] is 16.8 in the Toronto region and 7.3

39 By also eliminating La Tuque, where there is no employment in textiles but 15 employees in hosiery. On the whole, the Montreal urban system has 17 urban agglomerations with over 10,000 population, the only ones examined here because of data shortages, compared with 25 in the Toronto urban system.

40 By also eliminating Cowansville, where there is no employment in the primary metal industry but 70 jobs in the tributary fabrication industries.

in the Montreal region. Two conclusions can be drawn from these observations: first the polarization effect of transformation industries on fabrication industries is in the case of a metallurgical complex than a textile complex;[41] and second, small and medium-sized cities can also attract fabrication industries with greater ease in the first case, even with a very limited transformation base.

To summarize, we have attempted to show in this last section how the characteristics of an urban system are often slow to disappear so that in passing from one stage to the next in the development process, a region keeps prints from the past. We do not believe, however, in determinism, since it is possible to reorient transportation networks or influence the location of new firms as well as the public infrastructure. The next chapter will be devoted to these questions of land use planning.

41 This conclusion would still be valid if we had added the leather and rubber industries to the textile industry.

5 The Influence of the Urban System on the Economic Base of a Region

In the preceding chapters, we paid attention to the influence exerted directly or indirectly by the industrial structure of a region on the operation of its urban system. But the concept of correspondence involves the possibility of a two-way cause-and-effect relationship, which would mean that we could influence the growth of the economic base of a region through adjustments in its urban system.[1] Two types of adjustments will be considered. The first ensures the structural adaptation to the existing economic base of the urban system in operation in each region; once this is accomplished, the existing industries should more fully experience the expansion announced by their potential, which will be reflected more in the level of productivity and degree of utilization of the area's resources (physical and human) than in major changes in the industrial structure itself. The second uses the growth of the urban system as an instrument of industrial restructuring in a perspective of regional development.

5.1. Adaptation to the Existing Economic Base

The elements that, in our opinion, appear to be the most important in implementing an urban strategy in Canada's regions have been grouped in Table 5-1.

1 This direction in the relationship between economic development and urbanization is receiving increasing attention. For example, see J.A.S. Ternent, "Urban Concentration and Dispersal: Urban Policies in Latin America", in A. Gilbert (ed.), Development Planning and Spatial Structure, New York: John Wiley & Sons, 1976.

Table 5-1

Elements of an Urban Strategy for the Canadian Regions

	Resource Regions	Transformation Regions	Fabrication Regions
Overall objective	Full utilization of the potential in resource endowment	Full utilization of the potential in local transformation of natural resources	Full utilization of the potential in human resources
Secondary objectives for action	- ensure domination by a development pole - seek integration of primary industries	- facilitate links between development pole and regional growth poles - induce economies of agglomeration	- encourage the diversification of services in intermediate-sized cities - stress the quaternary specificity of the metropolis
Favoured instruments	- exploration - public installations	- transportation - communications	- zoning - municipal coordination
Implications on the urban structure	- proliferation of small urban centres - emergence of a metropolis concentrating as many specialized services as possible	- development of a regular hierarchy	- growth of the peri-metropolitan satellites

Obstacles to avoid	- the practice of permanent installations - duplication of public installations	- municipal outbidding for attracting industries - perpetuation of a transportation network with multiple outlets	- forfeiting of recreational space and arable land to speculation - exclusive concentration in the metropolis
Canadian regions	Labrador Northern British Columbia Far North Northwestern Quebec Gaspesia Regina-Saskatoon Edmonton-Calgary	Southeastern British Columbia Central British Columbia Chicoutimi St. John's Sudbury Saint John Halifax Ottawa Quebec City Winnipeg Vancouver	Montreal Toronto

We assume in this section that the current economic base is given, our objective being to make the functioning of the urban system more adequate. We are therefore working in a perspective of economic growth.

5.1.1. Resource Regions

Because of the determining role played by resource endowments in a resource region, we can consider the optimal use of this potential as the overall objective. In more precise terms, we could formulate this objective as follows: to maximize the actualized value (over a finite horizon) of regional output, or the sum of the products of the value and quantity of each category of resources.[2] However, a series of constraints will have to be imposed: first, the quantity of resources that should be available at the end of the period; second, the reproduction cycle for renewable resources; third, certain technical constraints peculiar to each industry resulting from technology and variation in the prices for the factors of production. Yet another constraint comes to mind based on the annual maximum number of migrants within the region, since we know that this particular industrial base requires greater geographical mobility at the cost of occasionally difficult relocations.

Under these conditions, the following two principles can be singled out as secondary objectives for action in the context of the urban system: to ensure the domination of a development pole and to seek the integration of primary industries. Indeed, as pointed out in Chapter 2, the very fact of participating in an international market often implies that the share of locally made decisions affecting development of the primary sector will be low. Consequently, it proves essential that the decisionmakers possess all the information required not only on the international situation (such as expected prices, discoveries of new deposits, and

2 We are thus assuming that the demand to be met by regional output is perfectly elastic.

new techniques), but also on the regional environment (such as climatic, physical, and social characteristics). The adaptation of new technology to conditions peculiar to each region is the main function of a development pole.[3] Reference to many works published on this matter[4] will confirm that Montreal and Toronto actually play this role; we can also state that Vancouver has reached if not crossed the threshold of fulfilling this polarization function for all of British Columbia, as Calgary has done for Alberta.[5] It is important that this polarization, based on the exchange of information and common decisionmaking, be carried out as efficiently as possible, thus necessarily implying continuous interaction, supported, if necessary, by government intervention: research centres with projects in resource regions; inter-university agreements; subsidies for the distribution of journals and reviews; presence of representatives from resource regions on boards of administration; and so forth.

Integration of primary industries involves two lines of action. First, it is essential that those responsible for implementing the region's public services and transportation and communications infrastructure -- the various levels of government to begin with -- avoid as much as possible a project-by-project procedure that adjusts to every change in the rate of growth of each industry forming the regional economic base. The preceding chapters have emphasized the characteristic independence of these various industries and therefore

3 For more detail, consult Chapter 2.

4 Particularly the Centre de Recherche en développement économique at the Université de Montréal and the Centre for Urban and Community Studies at the University of Toronto.

5 It appears that the Atlantic region is the only major Canadian region with no major development pole and many feel that the Halifax metropolitan region should fulfill this role as it actually did for many decades until the Montreal hegemony emerged. D. D. Burke and D. J. Ireland, An Urban/Economic Development Strategy for the Atlantic Region, Ottawa: The Ministry of State for Urban Affairs, 1976, pp. 45-46.

of the different components of the urban structure. Even if we must expect a proliferation of small urban centres and a fairly low rate of concentration in the regional metropolis, the costly duplication of public infrastructure must be avoided as much as possible. We have shown how great the temptation is for the public authorities to follow the pattern imposed by a growth pattern that leads to region-wide scattering; the effectiveness of public management requires long-term planning supported by research on integration of development plans for the primary industries, in order to achieve the highest coincidence in the location of plants, transportation nodes, and even (through interdepartmental co-ordination) personal services such as education and health, which indirectly obey the rules of the government.[6]

Second, this integration of primary industries can also occur at a functional level through co-operation in common operations: the development of new fertilizers (agriculture and fishing); sylviculture (agriculture and forestry) and exploration and inventories (mining and forestry). This co-operative approach at the level of the firm appears as the counterpart to the co-ordination observed in the labour market, since a large proportion of employment in a resource region is often seasonal[7] in character, thereof making periodic industrial mobility for each worker the most obvious solution to the resulting unemployment and income problems.

In short, adaptation of the urban system to the economic base of a resource region in this perspective leads to an increase in the rate of urbanization rather than to a greater degree of concentration in the regional metropolis. The latter, however, could benefit from increased concentration of specialized public and private

6 While this perspective of integration is recognized, for example, by the Société de développement de la Baie James, it has not yet appeared explicitly in planning for Canada's Far North.

7 R. Beaudry, Le chômage saisonnier et l'explication des disparités interrégionales de chômage au Canada, Ottawa: Economic Council of Canada, Discussion Paper No. 84, 1977.

services as well as from greater interdependence among the various parts of the region, obviously less a consequence of the characteristics of the economic base than of the workers' more frequent need for geographical mobility and of the citizens' demand for a better quality of public services. This mechanism of geographical mobility is best facilitated by avoiding the myopic practice of establishing permanent installations, an ever-present danger consisting of individual or collective investment in equipment whose life exceeds the one expected of the natural resources in the surrounding area.[8] Its forms are numerous: specific architecture; frontier mentality of the inter-regional scale; flexible municipal-regional administrative structure; reduced passenger fares; and so forth.

It would be risky to list all the cases in Canada where such considerations have not been applied, since a complete treatment of the question would require a quantity of information not readily available. Two examples will do it. With respect to the overall objective specific to resource regions, it is clear that, until the revision of its orientation in 1973, the Department of Regional Economic Expansion (DREE) had a uniform policy for all areas that favoured solely the manufacturing sector. Consequently, there was a lack of adaptation in many cases between the potential economic base and government intervention. Second, while the secondary objective of integration of the primary industries was clear to planners, it has not been given the same priority by government decision-makers, as demonstrated by the scattered installations on the north shore of the St. Lawrence Gulf.

5.1.2. Transformation Regions

If we consider the increase in local transformation of natural resources as an overall objective for a transformation region (see Table 5-1), it is

8 This remark, of course, only applies to non-renewable or partially-renewable resources.

then possible to adopt the growth poles approach[9], even though only the agglomerations located in fabrication regions can eventually become true growth poles, since they are the only ones to possess complete production sequences.

The concept of growth pole basically designates a set of economic activities with considerable and frequent flows of commodities among themselves and whose rate of increase in output is higher than the general average; the most common example is that of an industrial complex based on the transformation of a raw material and showing exceptional growth over a given period. The presence of a sectoral growth pole generally allows for better integration of the various parts of a vast area, but close interdependence in terms of inter-industrial linkages often leads to the geographical concentration of several stages of an industrial complex, either for purely technical reasons (petrochemical industry), for the purpose of minimizing transportation costs (transformation of pulp into newsprint), for benefiting from the presence of a common factor of production (a labour force having special characteristics, such as abundance and low cost), or for a particular transportation infrastructure such as water-route terminals. This geographical concentration usually occurs in an urban centre playing a polarizing role for its region.

Based on these mechanisms, a growth poles' policy is made up of two fundamental prescriptions: first, planning the integration of the greatest part of a region into one or several sectoral poles so that the recovery of one sector induces changes over the entire area, and second, installing, if necessary, a "firme motrice" whenever a region is deprived of growing industries, that is, a new activity triggering the polarization of the region's resources around a product or range of products enjoying a rapidly expanding market. To overcome obstacles to the emergence of such growth poles in the urban structure, the government must therefore

9 For a review of literature on this subject, consult D. F. Darwent, "Growth Poles and Growth Centers in Regional Planning: A Review", Environment and Planning, 1, 1969, 5-32, or N. M. Hansen, Growth Centers in Regional Economic Development, New York: Free Press, 1972.

seek to profit from the relationships of complementarity existing in each urban system: indirectly, by facilitating a better integration of the region through investment in infrastructure and improvement to the productivity of workers and firms; or directly, by allowing the establishment of an industrial nucleus capable of relating the existing polarization to an activity deemed dynamic. As for the repercussions in the intervention region, polarization, apart from the effects expected from growth itself, has three major advantages. First, it allows for the development conditions at the regional level to be modified with a much smaller number of interventions, thus lightening the process of regional planning while providing citizens themselves with more control over the political choices involved. Second, because this polarization helps to strengthen the growth of the regional metropolis, the latter is able to generate more economies of agglomeration and diversify its economic base until it can eventually play a major role in its own development and that of its region. Finally, this concentration may provide a very important instrument to a migratory policy, -- the appearance of alternatives to large metropolises.

Utilization of the transformation potential thus passes through examination of possibilities for substituting local production for current imports with respect to backward linkages and for current exports with respect to forward linkages. The question that must now be asked is: Why does growth in the manufacturing sector not occur naturally? In other words, what are the impediments to this process? Along with the limited perspective used here, which stresses the influence exerted by the urban system on the economic base, we will focus on two major points.

First, we indicated in Chapter 2 the importance of agglomeration economies in enabling a sectoral growth pole to firmly establish itself, and we also observed how this requirement led in practice to the rapid growth of the regional metropolis, notably through expansion of its role as transhipment point for exports. This orientation in intra-regional flows represents a very clear difference with the peculiar situation of a resource region where direct links with the outside is much more important. The

perpetuation of a transportation network with multiple outlets would thus hinder the natural concentration that must occur in the regional metropolis and should therefore be prevented. Moreover, the appearance of processing plants in the region may lead municipal officials to believe that any location within the region is capable of capturing a share of this investment. When, in addition, the growth of employment in each urban centre, being limited by its endowments in natural resources, as is often the case, trails growth in the labour force, municipalities will then be tempted to prevent forced emigration by providing aid through direct or indirect subsidies in order to get a "slice of the pie" for themselves. While this behaviour can be explained by the rationality of each municipal administration, it nonetheless does lead to outbidding[10] which, in the context of a zero-sum game, produces only a scattering of industrial installations. Once established, these investment subsidies become necessary simply to compensate for the absence of economies of agglomeration. On the basis of regional development, it is thus necessary to ensure correspondence between the economic base and the functioning of the urban system by allowing the regional metropolis both demographic concentration and economic nodalization. It is true, however, that a sectoral growth pole does not always require spatial concentration and that, under these circumstances, we often witness the emergence of an urban structure whose pyramidal structure is fairly regular.

Furthermore, as emphasized by the authors of the HMR report,[11] the growth poles (present and potential) in each region must be well integrated with the development poles, most often located outside the region. If on the one hand, it is important for a resource region to ensure the domination of a development pole, it appears, on the

10 See J. E. Moes, Local Subsidies for Industries, Chapel Hill: North Carolina University Press, 1962.

11 B. Higgins, F. Martin and A. Raynauld, Les orientations du développement économique régional dans la province de Québec, Ottawa: Department of Regional Economic Expansion, Ottawa, February 1970, pp. 113-34 and 146-47.

other hand, essential in our opinion that a transformation region not only have a similar link but also play an active role in this interaction, because it is automatically at a disadvantage since the fabrication region in which the development pole is normally found continues to reap a large part of its growth through transformation activities located there and which are therefore in a better position, due to smaller transportation and communication costs. Moreover, the greater participation of the transformation region's population in investment decisions affecting them is already required by the complexity resulting from extension of the regional economic base.

The application of these various orientations to Canada's regions allows us to make some hopefully useful remarks. For instance, once it is admitted that the regional metropolis deserves a large share of the infrastructure installations, it is difficult to understand the stay option favoured by the province of Manitoba. We also suggested that the regional metropolis could rely on a certain (very limited) number of urban agglomerations located in its hinterland as additional growth poles, specializing in different sectors. In this respect, we find the following examples highly relevant: Thetford Mines (asbestos) in the Quebec City region, Thunder Bay (forestry) on the edge of the Winnipeg region, Kelowna[12] (food and recreation) in the Vancouver region as well as Trail (copper) in Southeastern British-Columbia. Finally, it is easy to understand how the geographical partitioning into large regions originally done by DREE (the designated regions program), far from promoting the required long-run nodalization in transformation regions, helped to perpetuate the scattering of economic activity over the entire area; with the introduction of special zones and a greater effort

12 Kelowna is mentioned here tentatively only because it is the most populous agglomeration among the three urban centres in the Okanagan valley and because it occupies a central position in the South of the province. While we consider it necessary to proceed with a more detailed study aimed at selecting the attraction pole likely to become the growth pole in this part of British Columbia, we do consider the selection process indisputable.

in favour of infrastructure (rather than industrial subsidies), it is still possible to reintroduce the necessary correspondence of the urban structure.[13]

5.1.3. Fabrication Regions

The fabrication region's distinct features are, at the industrial level, the presence of a large number of production activities devoted to assemblying finished goods and, at the spatial level, a high population density, a very large regional metropolis, varied and numerous means of transportation and communications and strong intermediate-sized agglomerations located in the hinterland, particularly peri-metropolitan satellites. Such an environment produces the following changes in the labour market: an increase in the participation rate, particularly for women; attraction of unskilled labour; growth in demand for highly skilled labour and increased opportunities in on-the-job training for semi-skilled labour. Consequently, the guiding principle (see Table 5-1) of a strategy designed for a fabrication region could be stated as the best possible utilization of the potential represented by the available human resources. Incidentally, this overall objective takes on its full significance when viewed in a long-term perspective in which innovation plays a basic role.

Land use planning may facilitate or hinder the development of a fabrication region and we suggest that two objectives be pursued with determination. First, it is of utmost importance that the regional metropolis further consolidate its concentration in the quaternary sector.[14] This concentration, while

13 The utilization of the relative unemployment rate in each electoral district as criterion for granting subsidies certainly achieves a short-term goal but its long-term effectiveness along the lines of our discussion reveals itself doubtful.

14 As unceasingly repeated by the authors of the HMR report, this in no way implies the concentration of all investment in the metropolis. The quaternary sector is essential to the development pole and polarization must occur in an area extending considerably beyond the metropolitan region itself, if not the fabrication region as a whole; but these are primarily qualitative phenomena.

corresponding to a natural process, nonetheless requires the support of all levels of government since they can directly or indirectly influence the efficiency of this sector. At the municipal level, restructuring of the downtown area must be facilitated and the private sector must be provided with the installations necessary for its full operation, such as conference centres, intermodal transportation facilities, and the availability of such elitist activities as operas and subsidized international symposia. At the provincial level, special attention is required in order that this concentration, which affects not only the entire fabrication region but also those transformation and resource regions linked to it, instead of being counteracted, be fully utilized, particularly by ensuring adaptation between the supply of qualified labour (universities and colleges) and the demand for this category of personnel.[15] Finally, at the federal level, through greater attention given to the regionalization of policies, fabrication regions must be allowed to compete with each other in an equitable manner.

The second essential objective, in our view, is the encouragement of diversification and an increase in the quality of services in intermediate-sized cities located in the hinterland of this metropolis. The presence of a tertiary sector of superior quality should bring, among other things, the implementation of less hierarchically structured transportation and communications networks[16] and allow polynucleation, as a result of a directed deconcentration of the economic base. Even though fabrication activities require access to a metropolitan development pole and a large market,

15 It is therefore of utmost importance, in our opinion, that the two information networks operating independently in the Montreal market be joined. For more details on these networks, consult J. A. Boulet and A. Raynauld, L'analyse des disparités de revenus suivant l'origine ethnique et la langue sur le marché montréalais en 1961, Discussion Paper No. 83, Ottawa: Economic Council of Canada, 1977.

16 As described a long time ago by A. Losch, The Economics of Location, translated from German by W. H. Woglom, New Haven, Conn.: Yale University Press, 1954, pp. 101-37.

accessibility does not imply juxtaposition; other locational factors peculiar to each category of fabrication activities actually favour deconcentration.

It is obvious that these considerations are more immediately applicable to the Montreal region than to the Toronto region, given the persistently large domination of Montreal over its region. Admittedly, this approach is not new both at the international level,[17] and at regional level[18]; but it seems that the main difficulties lie at the tactical level, that is in the imperfection of those instruments of intervention in the hands of planners that could change the current situation into the desired one. The deconcentration of the economic base in this type of region involves both transformation and fabrication industries and can be based upon the relocation of a certain number of plants currently located in the metropolis, but even more so on the selection of a non-metropolitan location for new plants; in each case, however, it is clear that such instruments as zoning of agricultural land, adoption of master plans at the municipal level, or inter-municipal co-ordination of public transportation must be considered as necessary conditions but not sufficient ones, as are the actual economic policies. Structural correspondence dealt with here requires a comprehensive approach to economic development; the spatial dimension cannot therefore be disregarded in the

17 We refer here not only to strategies such as the "British new towns" as in H. W. Richardson, The Economics of Urban Size, op. cit., 173-214 and J. R. Boudeville, "Modèle de croissance urbaine du bassin parisien", op.cit., but also to theoretical discussions such as that by W. Alonso, "Urban Zero Population Growth", Daedalus, 102, 4, Autumn 1973, 191-206 and E. van Böventer, "Urban Hierarchies and Spatial Organization", Ekistics, 192, November 1971, 329-36.

18 We will only refer the HMR report already mentioned as well as to a recent report by a working group, L'Urbanisation au Québec, Quebec: Imprimeur officiel du Québec, 1976, Chapter 5.

first place but must go hand-in-hand with the economic dimension.[19]

5.2. Instruments for Industrial Adaptation

In Chapter 2, we sketched out a regional development model designed for the Canadian situation insofar as it was based on an abundance of natural resources and an almost total absence of native population. This model led to the following sequence of development stages: resource region; transformation region; fabrication region. After describing the characteristics of each type of region, we assigned every one of the 20 Canadian reference regions to one of these three groups. In a purely historical perspective, we should now ask two fundamental questions. Will all the regions follow this sequence? If a region does not meet all the conditions for moving into the next phase, is it assured of remaining at the point thus far reached?

All resource regions will not necessarily become transformation regions, any more than all transformation regions move into the fabrication stage. We already pointed out to what extent these structural transformations depended, among other things, upon the volume of regional activity and the accessibility to extra-regional markets for export products, the first factor corresponding to relative supply conditions and the second to external demand. A resource region's endowment in natural resources, in terms of both quantity and quality, will definitely play a determining role in the possible establishment of transformation plants. In a fabrication region, we stressed the importance of a metropolitan centre representing a large market and fulfilling the functions expected of a development pole.

19 In this respect, we must point out the effort recently undertaken by the Department of Regional Economic Expansion which, despite continuing difficulties in integrating the various sectoral policies of the federal government, still acknowledges the need for a spatio-economic strategy and, through its new program for the Montreal region, the role to be filled by the peri-metropolitan satellites.

In the same way, it is unreasonable to assume that, once the transformation or fabrication stage has been reached, a region cannot slip back to the preceding stage. To illustrate this, we need only imagine a transformation region undergoing the combined effects of saturation in the volume of extracted raw materials, technical progress in the transformation sector requiring a change to larger production units and greater capital intensity, and a production structure made up of a large number of small manufacturing establishments and financial institutions controlled from outside the region.[20] In this situation, interregional competition would impose the utilization of more modern technology, but as these would require both a merging of operations into larger units and large amounts of investment funds that would be difficult to make available because of socio-economic constraints, the result would be outright abandonment of transformation activities or maintenance at the current level of activity through government subsidies or privileges. In fabrication regions, accessibility to consumer markets is crucial since, by definition, such a region specializes in assembly operations preceding delivery to final demand for consumer goods and equipment. In an inter-regional context, it is quite possible that regions could develop at a different rate so that the centre of gravity of a nation's population (and thus of its economy) shifts thus decreasing gradually the absolute advantages[21]

20 The simplest case would be that of a region already possessing transformation plants but in which the resource deposits have been exhausted; because of the economic calculations made by manufacturing firms, this situation should, however, be very unlikely.

21 Much confusion surrounds the use of the expressions absolute and comparative advantages. It can be shown that private decision-makers (migrant workers and production firms) base their decisions on the absolute advantages of each location but that public decision-makers (governments), because they assume a given technology and a given quantity of human resources seek instead to allocate resources in terms of the comparative advantages of their region with respect to others. Cf. R. Tremblay, "La politique commerciale fédérale" in L'économie québécoise, R. Tremblay, ed., Montréal, Presses de l'Université du Québec, 1976, p. 210.

of a fabrication region over its rivals. This shift can even lead to a deterioration in the ability of the regional metropolis to play its role as development pole whenever the obstacles to the mobility of capital and decision centres are very small and the rules of the game are determined primarily at a supra-regional level.

These theoretical considerations are easily applicable to the reality of Canada's regions. Regions such as St. John's, Chicoutimi, and Sudbury are in danger of slipping from the transformation phase back to the resource phase given the net emigration observed in these regions caused in particular by the decline in the relative profitability of these locations compared with Alberta, British Columbia, and even southern United States.[22] Conversely, the region polarized by Calgary and Edmonton now appears to meet the conditions favourable for passage to the transformation phase, particularly because of its proximity to the Canadian Far North and British Columbia. It is also possible that, at the disadvantage of the Montreal's region, fabrication activities would continue to move to the Toronto region and may even take off in the near future within the Vancouver region. Many indicators related to the location of the quaternary sector and to the relative quality of transportation networks available in each case have lent support to this scenario in recent years.[23]

The preceding may give the impression that the production sequence development process implies an improvement in the standard of living with passage from the resource stage to the transformation and fabrication stage. While not without foundation, this assertion must be formulated in a different way, given for instance, that as indicated by the information in Tables 5-2 and 5-3,[24] a resource

22 In the forest-based industries.

23 We need only refer to J. Chung, "La nature du déclin économique de la région de Montréal", in L'économie québécoise, op.cit., pp. 427-38.

24 The data in these two tables are difficult to compare because of the different compiling methods used and, for the income indicator, different definitions. Inter-regional comparison within each table does, however, remain valid.

Table 5-2

Indicators of Economic Welfare by Region, 1970-71

		Annual Average Growth Rate of the Population 1961-71	Participation Rate 1971	Unemployment Rate 1971	Per Capita Income 1970
			(Per cent)		(in dollars)
Resource regions					
East:	Labrador	2.6	42.8	7.7	1,236
	Gaspesia	-0.8	45.1	19.1	1,487
	Northwestern Quebec	-0.8	49.4	12.8	2,007
	Average	-0.1	46.3	14.3	1,686
West:	Regina-Saskatoon	0.0	58.6	5.4	2,091
	Far North	3.4	54.6	7.4	2,129
	Calgary-Edmonton	2.0	62.7	6.3	2,590
	Northern British Columbia	3.5	64.1	8.0	2,766
	Average	1.4	61.1	6.2	2,414
	Overall average	1.2	59.2	7.0	2,315

Transformation regions					
East:	St. John's	1.1	47.1	9.5	1,651
	Halifax	0.7	53.8	7.8	2,133
	Saint John	0.6	52.7	8.4	1,960
	Chicoutimi	1.2	47.8	14.0	2,000
	Quebec City	0.9	50.3	9.2	2,159
	Ottawa	1.9	60.0	6.6	3,001
	Sudbury	0.9	56.9	7.8	3,078
	Average	1.0	53.5	8.5	2,340
West:	Winnipeg	0.3	59.8	6.5	2,519
	Southeastern British Columbia	1.8	57.2	8.6	2,631
	Vancouver	2.9	58.7	9.2	3,030
	Central British Columbia	4.5	61.4	8.2	2,303
	Average	2.0	59.2	8.1	2,783
	Overall average	1.5	55.8	8.3	2,500
Fabrication regions					
East:	Montreal	1.7	55.6	9.4	2,686
West:	Toronto	2.4	62.0	6.9	3,189
	Overall average	2.1	59.4	7.9	3,000
Canada		1.7	58.0	7.8	2,707

Source: Basic information taken from 1971 Census.

Table 5-3

Indicators of Economic Welfare by Region, 1976-77

		Annual Average Growth Rate of the Population 1971-76	Participation Rate June 1977	Unemployment Rate June 1977	Per Capita Income 1974
			(Per cent)		(in dollars)
Resource regions					
East:	Labrador	1.8	54.4	19.0	2,373
	Gaspesia	-0.6	54.3	17.5	2,408
	Northwestern Quebec	-0.2	56.0	13.4	3,065
	Average	0.1	54.9	16.3	2,653
West:	Regina-Saskatoon	-0.2	62.9	3.5	3,754
	Far North	2.0	n.a.	n.a.	3,181
	Calgary-Edmonton	2.5	67.4	3.3	4,202
	Northern British Columbia	1.0	69.2	11.3	4,111
	Average	1.6	66.0	3.5	4,013
	Overall average	1.4	64.4	5.1	3,831

Transformation regions					
East:	St. John's	1.1	54.3	13.5	2,697
	Halifax	1.0	57.3	9.3	3,211
	Saint John	1.3	55.8	11.8	3,086
	Chicoutimi	1.1	59.4	13.9	3,403
	Quebec City	0.7	57.5	8.5	3,364
	Ottawa	1.8	66.0	8.3	4,657
	Sudbury	0.0	60.7	9.1	3,862
	Average	1.3	59.6	11.9	3,552
West:	Winnipeg	1.7	62.7	4.6	4,024
	Southeastern British Columbia	2.1	62.7	7.1	3,962
	Vancouver	2.4	63.0	7.8	5,018
	Central British Columbia	4.0	67.5	8.6	4,461
	Average	1.9	63.8	3.9	4,590
	Overall average	1.5	61.3	8.5	3,969
Fabrication regions					
East:	Montreal	0.6	61.0	9.2	3,969
West:	Toronto	1.4	66.4	6.6	4,937
	Overall average	1.1	64.3	7.6	4,552
Canada		1.3	63.0	7.5	4,214

Source: Basic information taken from 1976 Census, labour force survey by Statistics Canada and Fiscal Statistics, Revenue Canada, 1976.

region like Alberta registers better performances in both years, than a fabrication region like Montreal in all but one indicators examined (population growth rate, participation rate, rate of unemployment, and per capita income). But if we look closer, particularly at the regions' age (roughly indicated by its position on the East-West axis), it is possible to suggest the following statement: a region that does not succeed in reaching the following stage in the development sequence will eventually face serious problems of labour surplus that will result in lower participation rates accompanied by higher unemployment rates and lower per capita income levels. These difficulties are in large part linked to demographic pressure (natural growth) and imperfect geographical mobility on the one hand, and to the limited quantity of natural resources and the relative downward rigidity of wage rates on the other hand.

If we examine in detail the most recent data (Table 5-3), we find very clearly that the variation in performances between the various types of region is much more pronounced in the East than the West. The population growth rates are 0.1 per cent, 1.39 per cent, and 0.6 per cent in the first case and 1.6 per cent, 1.9 per cent, and 1.4 per cent in the second; the unemployment rates are 16.3 per cent, 11.9 per cent, and 9.2 per cent in the East compared with 3.5 per cent, 3.9 per cent, and 6.6 per cent for the West. The data on per capita income show an even more pronounced distinction between East and West. Indeed, we obtain roughly the same value for this indicator in resource and transformation regions but, when the East-West distinction is introduced, we find a very large gap in each case between the two types of region.

In short, there is enough evidence in our view to suggest that, given the current conditions of rigidity and imperfection in labour markets, passage from one phase to another in the production sequence development process is a necessary condition, although not a sufficient one, for improvement in the economic welfare of the population.

By altering the urban structure of a region, it is possible to bring about a mutation in industrial structure. While some modifications in the geographical distribution of population are not the direct

result of action taken by governments, for example, the decrease in rural and semi-urban population in the Eastern townships being one of the fundamental factors in the decline of the textile industry, other changes result from deliberate moves by governments. The rest of this chapter will briefly examine how some characteristics of a regional urban system can be used as control levers to accelerate passage from one development phase to another, again in the Canadian regional context.

5.2.1. Increases in the Rate of Urbanization

Given the numerous studies devoted to this matter -- including our own -- it should be easily agreed that expansion of a region's manufacturing base is accompanied by a greater concentration of the population in urban centres. While the Calgary-Edmonton region already appears to have achieved the urbanization rates generally observed in transformation regions, such is not the case for such a resource region as Labrador nor, to a lesser extent, for the regions of British Columbia other than the Vancouver region.

Since it is obviously easier to redistribute resources in a volume in full growth,[25] the implementation of such a strategy proves more difficult in Labrador than in British Columbia. Because of the underlying feature of independence observed among the population settlements in resource regions, concrete measures must first be applied at the regional level; these include location of public facilities, use of investment subsidies and special attention given to the housing market.

5.2.2. The Role of the Regional Metropolis

In our approach, the regional metropolis plays a dominant role in a transformation region and an

25 This argument is often given to support for a low rate of inflation.

integrating role in a fabrication region. This implies that concentration in the metropolis is not only accepted in the first case but is favoured. In our opinion, the polynucleation that characterizes the Prairie region can only continue if the economic base remains largely dominated by the primary sector. In the specific case of Alberta, we consider two scenarios. In the first, Calgary or Edmonton would grow to the relative size needed to play in full the role of a growth pole expected of a metropolis in a transformation region; in the second, both agglomerations would become regional metropolises by carving out an exclusive hinterland that would spilled over the province's boundaries, Calgary extending its influence into Southeastern British Columbia and Edmonton into the Northwest Territories. Manufacturing activity should take on greater importance in the economic base of each region because of the economies of agglomeration made possible by this reorganization.

In a fabrication region, the integrating role played by the regional metropolis imposes upon it a much more selective growth process that allows the urban centres in its hinterland to compete for the location of fabrication industries. It is thus important that the location advantages of each urban agglomeration be emphasized and that no obstacles be set up. For example, as the availability of low-wage labour represents one of these locational factors, it would be incoherent to consider the entire fabrication region as a homogeneous entity insofar as working conditions are concerned. Similarly, while the regional metropolis must play an intermodal role in terms of transportation networks, not all terminals need be located in this metropolis. Finally, even if it is only natural that the quaternary sector, when choosing to locate in this type of region, favours the regional metropolis and thus allow industrial restructuring of the entire region through the increase in the share of fabrication activities in the regional economic base, it is not certain that the concentration of the quaternary sector is the most important measure in every development strategy. In the case of Vancouver, the development of fabrication industries could be expected to accelerate with the expansion of port activities in a coastal agglomeration other

than Vancouver and the selection of an agglomeration in the Okanagan Valley as a growth pole, that is, the implementation of a policy of industrial deconcentration.

5.2.3. Planning of Transportation Networks

There are two ways of directing the spatial location of economic activities. The first deals primarily with urban structure and influences the selection of a location through restrictions (such as zoning) and privileges (such as industrial subsidies). The second is interested more in spatial dynamics and sets upon the relative accessibility of each urban centre through the organization of transportation and communications networks. The range of instruments is just as large (from expressways to parcel express) but the results usually take longer to show up.

As we have often repeated, the intensity of intra-regional interaction increases when a region passes from the resource to the transformation and fabrication stages; it is thus necessary to anticipate and plan for this expansion. What is perhaps less well-known is that the direction of these flows also changes since a network made up of a large number of outlets and fairly parallel lines is normally replaced by a much more hierarchical network centred on the regional metropolis and that, upon reaching the fabrication phase, the missing inter-urban linkages, particularly those not involving the regional metropolis, must be provided. In this respect, we believe that the controlled access highway network and mass transit lines in the Montreal region have not yet adapted this reality.

6 Summary and Conclusions

6.1. Summary

Many studies at both the theoretical and empirical levels have examined the relationships between urban size and various indicators of economic performance such as per capita income, participation rate of the adult population, growth rate of the job market, and unemployment rate. Except for the last indicator, the correlation has always been positive to varying degrees and, although there is not yet available any urban development model sufficiently broad to account for all of these variables, the main explanatory factors of these relationships have been known for some time. In Chapter 1, we examined these phenomena for Urban Canada and reviewed the most important elements of explanation; we also acknowledged important differences in the rate of urbanization and the number of metropolitan agglomerations in each of the major regions of the country. The question we then formulated was: What are the major obstacles to a high concentration of economic activity in metropolitan centres? To answer this question, we found it essential to consider each urban agglomeration in relation with the urban system to which it belonged and to first examine the influence exerted by the industrial structure of a region.

Chapter 2 presented the main theoretical elements of a regional economic development model based on the notion of production sequences. From the "Toronto School", we borrowed the staples theory, and then introduced the distinction between transformation and fabrication activities among the manufacturing industries capable of diversifying the industrial structure of a region. The former are

primarily oriented toward the production of semi-finished goods and processed raw materials, while the latter mostly involve operations by which a large quantity of inputs are being assembled into finished goods, ready for the market. Three broad types of regions were thus identified and the second part of the chapter was devoted to deriving the characteristics of the spatial settlement patterns associated with each of these types of regions, particularly the form of the urban pyramid, the rate of urbanization, the degree of concentration in the regional metropolis, the intensity and direction of intra-regional interaction and the allometry of the various urban components in each system with respect to population growth.

In Chapter 3, we attempted to test the foundations of our model by applying it to the Canadian situation. After partitioning the country into 20 reference regions on the basis of criteria drawn from gravity models, we used a canonical correlation analysis to test the correspondence between the industrial structure and urban structure at the regional level and discriminatory analysis to classify each of the 20 regions into one of the three types defined in the preceding chapter: seven were classified as resource regions, eleven as transformation regions and two as fabrication regions. Following this, multiple regression analysis was used to test in more detail how the economic base influences each of the indicators of the functioning of an urban system by examining in turn urban structure, spatial dynamics, and temporal dynamics.

It is clear however that industrial structure alone cannot explain all the differences in spatial settlement and that the structural correspondence with the economic base only imposes fairly broad constraints on the working of an urban system. For this reason, Chapter 4 introduced those factors of distortion best able to explain the residual variability. The bio-physical characteristics of a region proved very useful in this respect, in more than one way. The differences in economic behaviour appeared, on the other hand, related less to truly cultural considerations -- except in the migratory pattern of Québécois -- than to the influence exerted by the economic base through the reaction of

each individual faced with the uncertainty peculiar to each type of region. Finally, as expected, the traces left by the previous development stages proved more restrictive in regions faced with stagnation or economic decline than in those showing a rapidly growing output.

To introduce a strategic dimension into our study, Chapter 5 sought to demonstrate the influence of the urban system on the economic base of a region by going beyond the relationship between urban size and the economic performances of an agglomeration. This influence was first described by assuming that the existing economic base was considered satisfactory and then by assuming an objective of industrial restructuring. Most of the considerations in this chapter remained at a fairly general level, since they belong more to economic strategy and thus require more than the partial approach adopted here.

6.2. Conclusions

We have seen, throughout this study, that the industrial structure of a region could represent an obstacle to the emergence of populous urban agglomerations and that some variables such as the bio-physical characteristics of a region promoted or hindered this process. It was then demonstrated that the numerous economic advantages linked to concentration of activity made it possible to still promote this concentration while respecting the broader constraints of industrial structure. Consequently, the first conclusion of our study is that there is no ideal urban size independent of the environment but that there is rather a correspondence between the characteristics of an urban system and the economic conditions of a region, particularly its industrial base. The second conclusion, derived from the first, is that economic development is only possible under the assumption of polarization by a fabrication region and that it is only truly ensured if the latter possesses a dynamic development pole.

To be even more precise, we can now attempt to answer the questions raised at the end of Chapter 1

concerning regional planning. It should now appear obvious that the policy to be adopted in the Atlantic region depends primarily on the region's economic future. If the transformation industries can be maintained and developed, the efforts devoted to this end should, in our opinion, be accompanied by a reorganization of the area based on an increased role for the regional metropolis. While it is clear that St. John's must play such a role in Newfoundland, we believe that the Maritime provinces should have only one regional metropolis because the fragmentation typical of this region ought to be eliminated as soon as possible. The desired concentration must extend beyond the limits of a sub-region[1] and select a particular urban agglomeration whose polarization over the entire territory could be ensured. But, in the case of an economic future linked exclusively to raw materials, the strategy to be followed would rely less on the selection of a regional metropolis than on increased nodalization in the lower levels of the urban hierarchy. The technical progress that ensures growth in productivity, in labour income, and in industrial competitiveness as well as in employment stability is accompanied in the primary industries, in the transportation industry, and even in the tourist industry by a reduction in the number of firms and by an increase in their average size.

In the past, the Montreal area experienced remarkable growth and its share of provincial output increased over time. It is also true that despite faster growth in the Toronto area, the same concentration has not occurred in the province of Ontario. Our study served as a reminder that Montreal and its region should be compared not with the rest of Quebec but with Toronto and its region since another fabrication region is necessary to appraise its performances. With the extension of the manufacturing base in Canada and the tertiarization experienced in recent years, it was normal that the first regions to benefit would be the fabrication regions as they are specialized in

1 For example, the triangular region found in between Saint John, Moncton and Halifax, as presented by C. D. Burke and D. J. Ireland, An Urban/Economic Development Stragegy for the Atlantic Region, op. cit.

finished goods and endowed with development poles. But it is also important to realise that in a long-term outlook, the strength of the resource and transformation regions depends in large part on the dynamics of the market represented by the economic activity of the fabrication region and particularly on the efficiency with which the metropolis of this region fulfills its role as development pole. Nonetheless, it is clear that the degree of concentration in Montreal continues to be excessive in view of the deconcentration of economic activity that should be expected in a fabrication region.

In the Prairie region, major changes in the economic base and in the working of the various urban systems will certainly be accomplished soon. Winnipeg has not succeeded in dominating the entire region and the province of Alberta is now engaged in a process of industrialization that should allow Calgary (and/or Edmonton) to play a more extensive dominant role. Efforts to promote the local transformation of raw materials will only produce full results if the location of transformation plants is carefully studied, particularly the advantages related to concentration in a metropolitan region. Briefly, we must plan already for a greater interdependence of urban agglomerations in this region; as in the Maritime provinces, interprovincial joint action should thus proceed beyond the stage of reciprocal information.

While the geographic distribution of economic activity in a region can have important repercussions on the level of personal income and in the labour market, the system must still possess sufficient flexibility for an action to produce a reaction. Canada possesses this flexibility because of the importance of its unexploited natural resources, the relatively small number of large cities, the country's expected population growth, and the strong degree of regionalism rooted in the land.

Appendices

A Definition of Reference Regions

A.1. List of Census Divisions in Each Region

St. John's, Newfoundland

divisions 1 to 7 inclusive

Labrador, Newfoundland

divisions 8 to 10 inclusive

Halifax, Nova-Scotia

provinces of Prince Edward Island and Nova Scotia

Saint John, New Brunswick

province of New Brunswick

Gaspesia, Quebec

Bonaventure	West Gaspé	Matane
East Gaspé	Iles de la Madeleine	Matapédia

Chicoutimi, Quebec

Chicoutimi	West Lac St-Jean	Territory of Abitibi
East Lac St-Jean	Saguenay	Territory of Mistassini

Quebec City, Quebec

Arthabaska	Kamouraska	Montmorency #2
Beauce	Lévis	Portneuf
Bellechasse	L'Islet	Quebec
East Charlevoix	Lotbinière	Rimouski
West Charlevoix	Mégantic	Rivière-du-Loup
Dorchester	Montmagny	Témiscouata
Frontenac	Montmorency #1	Wolfe

Montreal, Quebec

in province of Quebec

Argenteuil	Iberville	Richelieu
Bagot	Ile de Montréal	Richmond
Beauharnois	Ile Jésus	Rouville
Berthier	Joliette	St-Hyacinthe
Brome	Labelle	St-Jean
Chambly	Laprairie	St-Maurice
Champlain	L'Assomption	Shefford
Châteauguay	Maskinongé	Sherbrooke
Compton	Missisquoi	Soulanges
Deux-Montagnes	Montcalm	Stanstead
Drummond	Napierville	Terrebonne
Huntingdon	Nicolet	Vaudreuil
	Verchères	Yamaska

in province of Ontario

Glengary	Prescott	Stormont

Northwestern Quebec

Abitibi (excluding territories of Abitibi and Mistassini)	Témiscamingue

Ottawa, Ontario

in province of Quebec

Gatineau	Papineau
Hull	Pontiac

in province of Ontario

Dundas	Leeds	Renfrew
Grenville	Ottawa-Carleton	Russell
Lanark		

Sudbury, Ontario

Algoma	Nipissing	Sudbury
Cochrane	Parry Sound	Timiskaming
Manitoulin		

Toronto, Ontario

Brant	Huron	Peel
Bruce	Kent	Perth
Dufferin	Lambton	Peterborough
Durham	Lennox &	Prince Edward
Elgin	Addington	Simcoe
Essex	Middlesex	Toronto
Frontenac	Muskoka	Victoria
Grey	Niagara	Waterloo
Haldimand	Norfolk	Wellington
Haliburton	Northumberland	Wentworth
Halton	Ontario	York
Hastings	Oxford	

Winnipeg, Manitoba

in province of Ontario

Kenora	Rainy River	Thunder Bay

in province of Manitoba

Census division 1 to 15 and 17 to 20 inclusive

Far North

in Manitoba, division 16
in Saskatchewan, division 18
all of Northwest Territories

Regina-Saskatoon, Saskatchewan

Census division 1 to 17 inclusive

Calgary-Edmonton, Alberta

province of Alberta

Southeastern British Columbia

Central-Kootenay
Columbia-Shuswap
Kootenay Boundary
East Kootenay

Vancouver, British Columbia

Alberni-Clayoquot
Capital
Central Fraser
Central Okanagan
Cowichan Valley
Dewdney-Alouette
Fraser-Cheam
Greater Vancouver
Nanaimo
North Okanagan
Okanagan-Similkameen
Squamish-Lilloet
Sunshine Coast
Thompson-Nicola

Central British Columbia

Buklkey-Nechako
Cariboo
Comox-Strathcona
Fraser-Fort George
Mount Waddington
Ocean Falls
Powell River

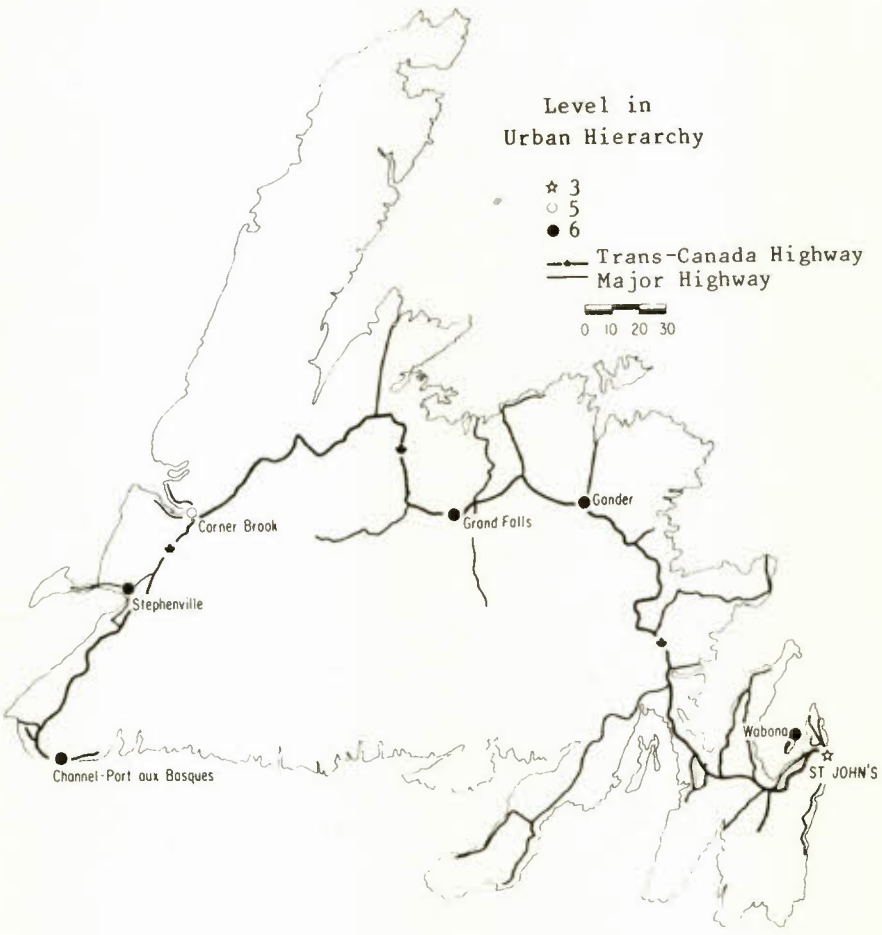
Northern British Columbia

Kitimat-Stikine
Peace River-Liard
whole of Yukon
Skeena A
Stikine

A.2. Maps of Urban System

Map A-1

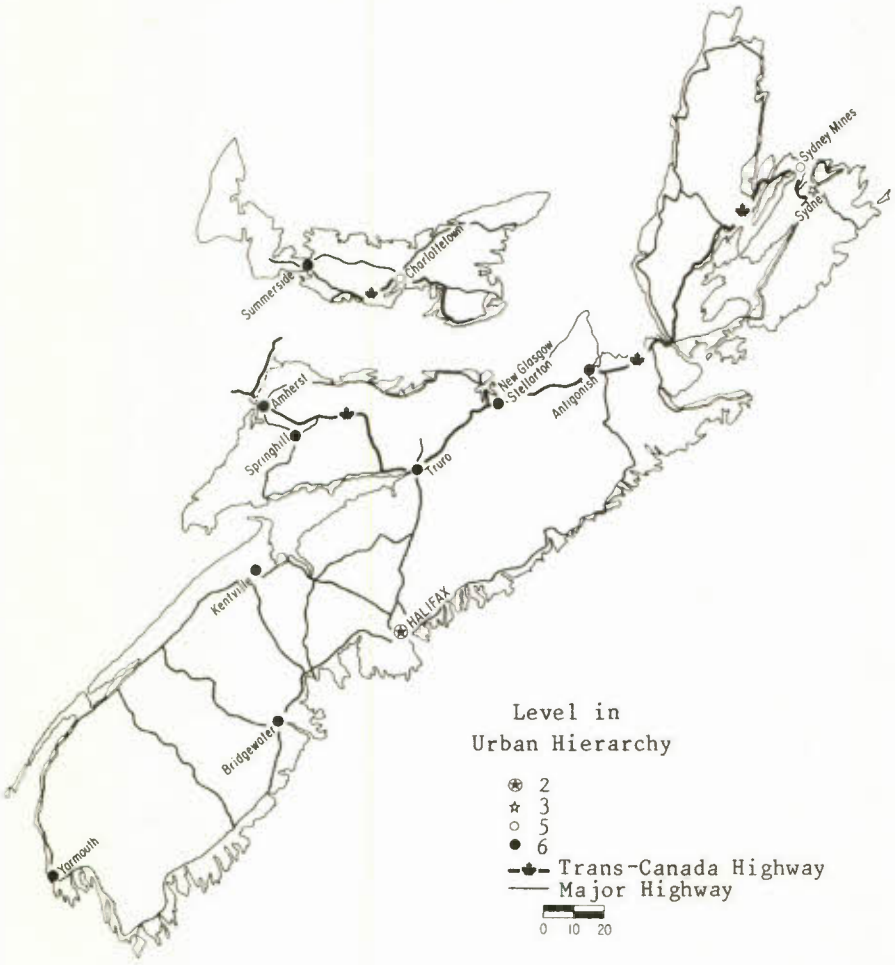
St. Johns's Urban System



Source: Official road map, Newfoundland Department of Tourism.

Map A-2

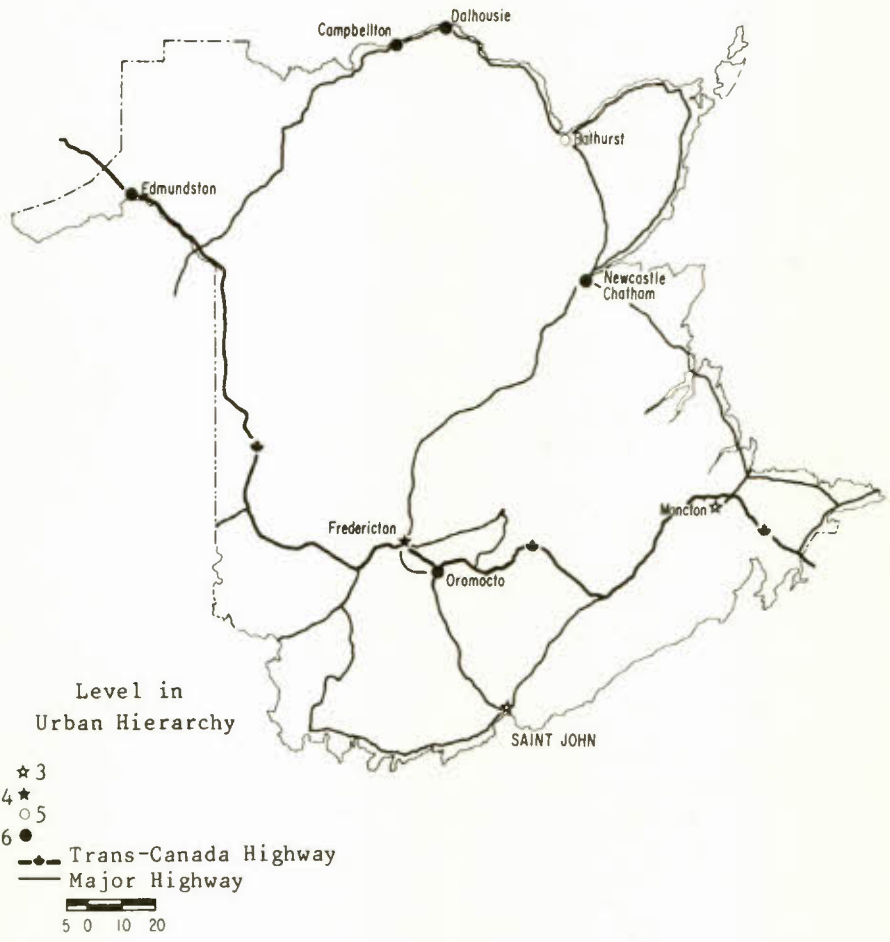
Halifax Urban System



Source: Official road map, Nova-Scotia Department of Tourism, 1973.

Map A-3

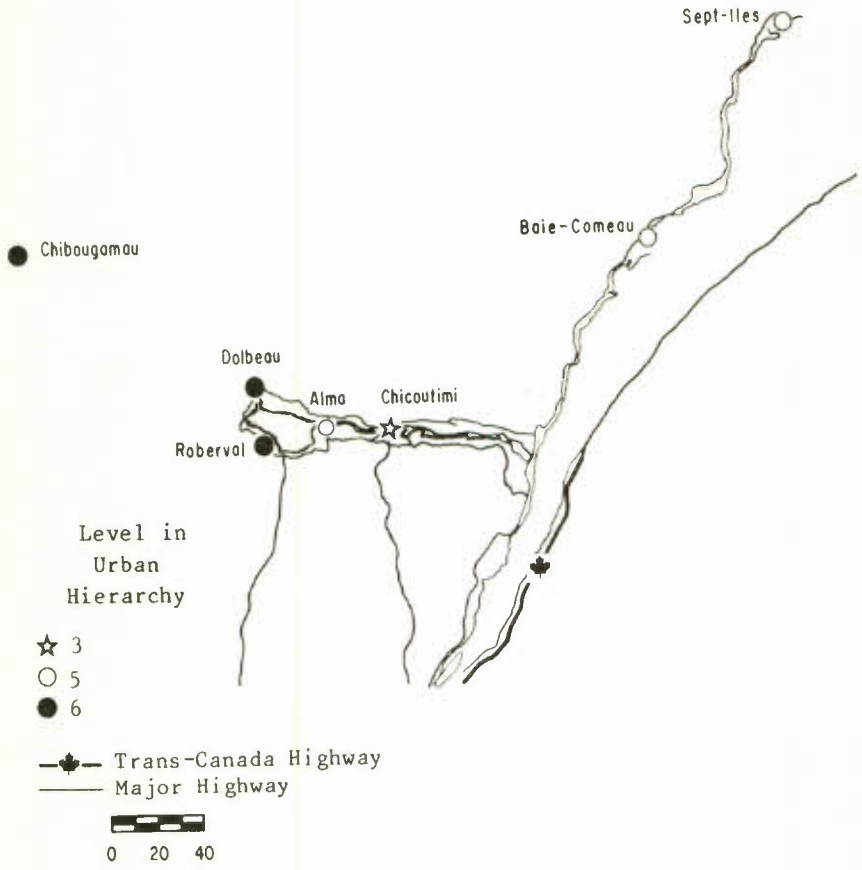
Saint John Urban System



Source: Official road map of Tourist Information Service, Government of New Brunswick, 1973.

Map A-4

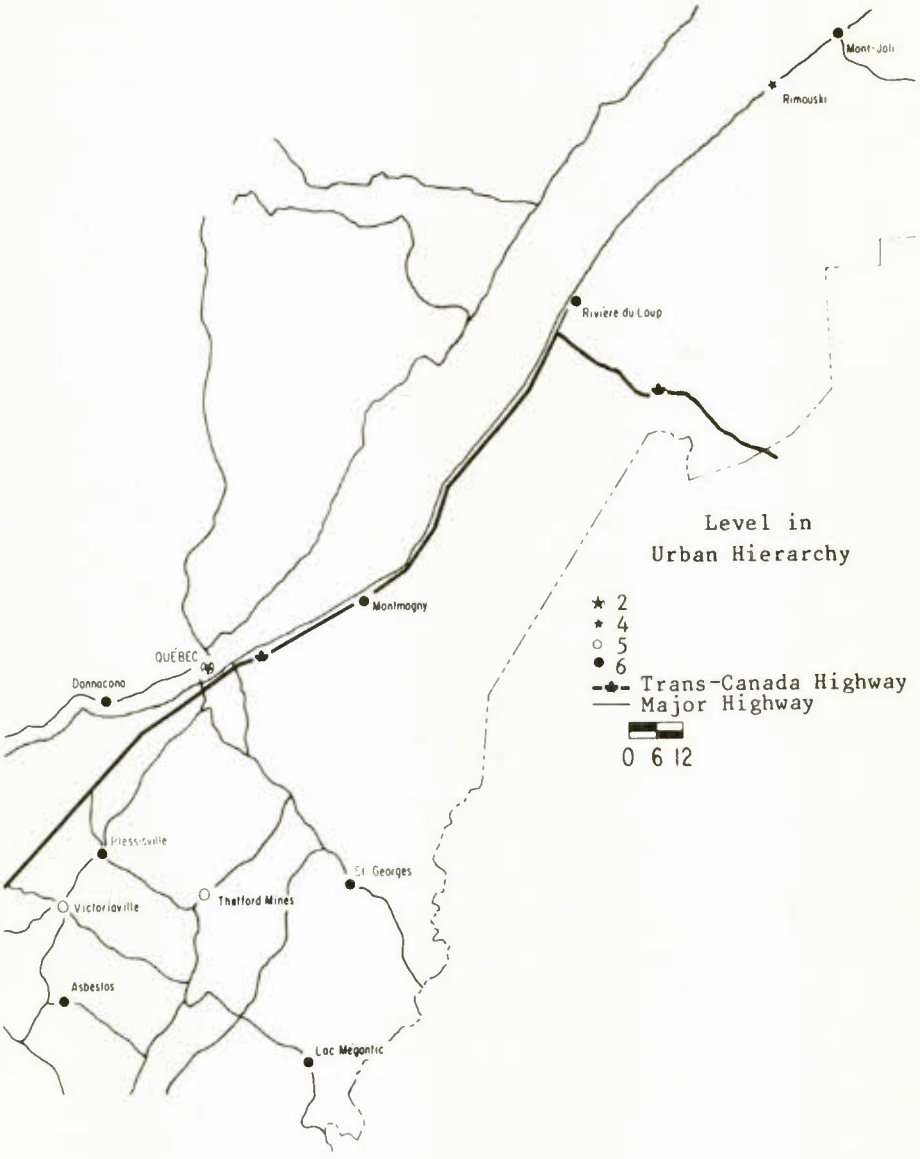
Chicoutimi Urban System



Source: Les routes du Québec 1973, Quebec Department of Transport, 1973.

Map A-5

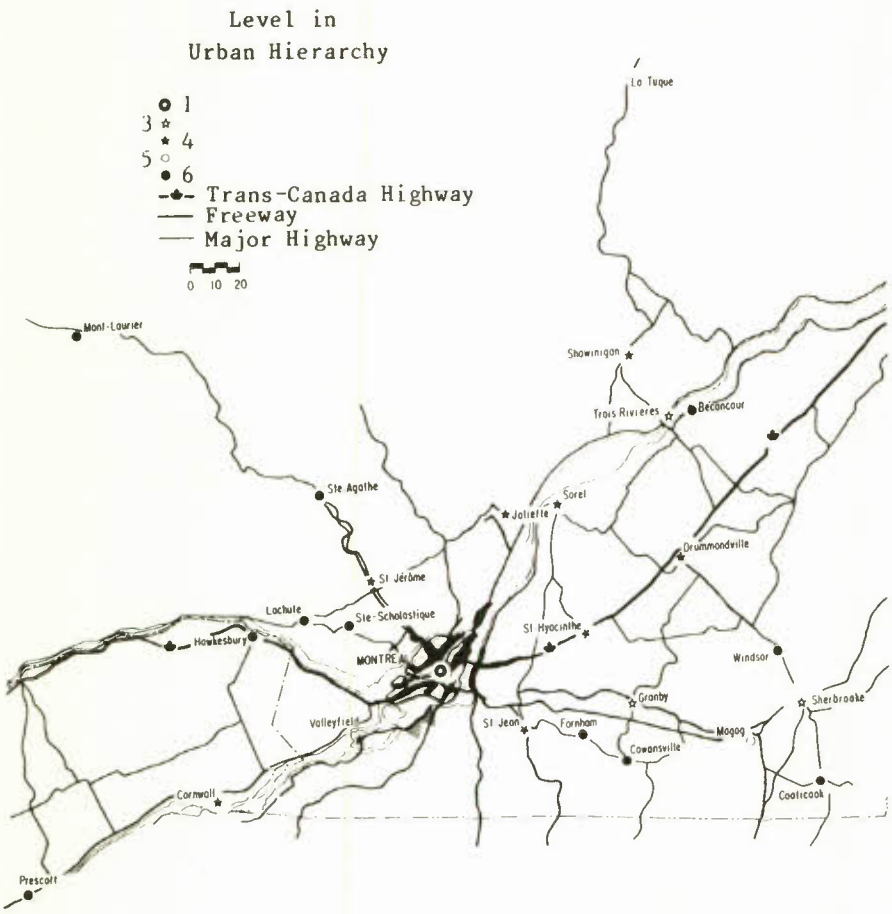
Quebec City Urban System



Source : Les routes du Québec 1973, Quebec Department of Transport, 1973.

Map A-6

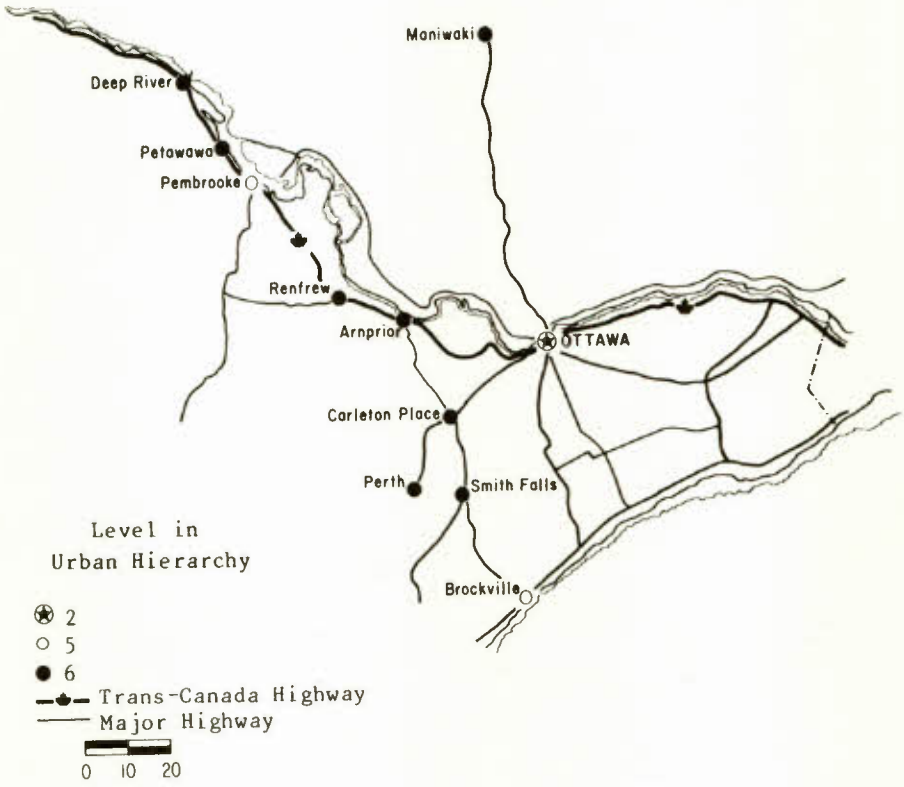
Montreal Urban System



Source : Les routes du Québec 1973, Quebec Department of Transport, 1973.

Map A-7

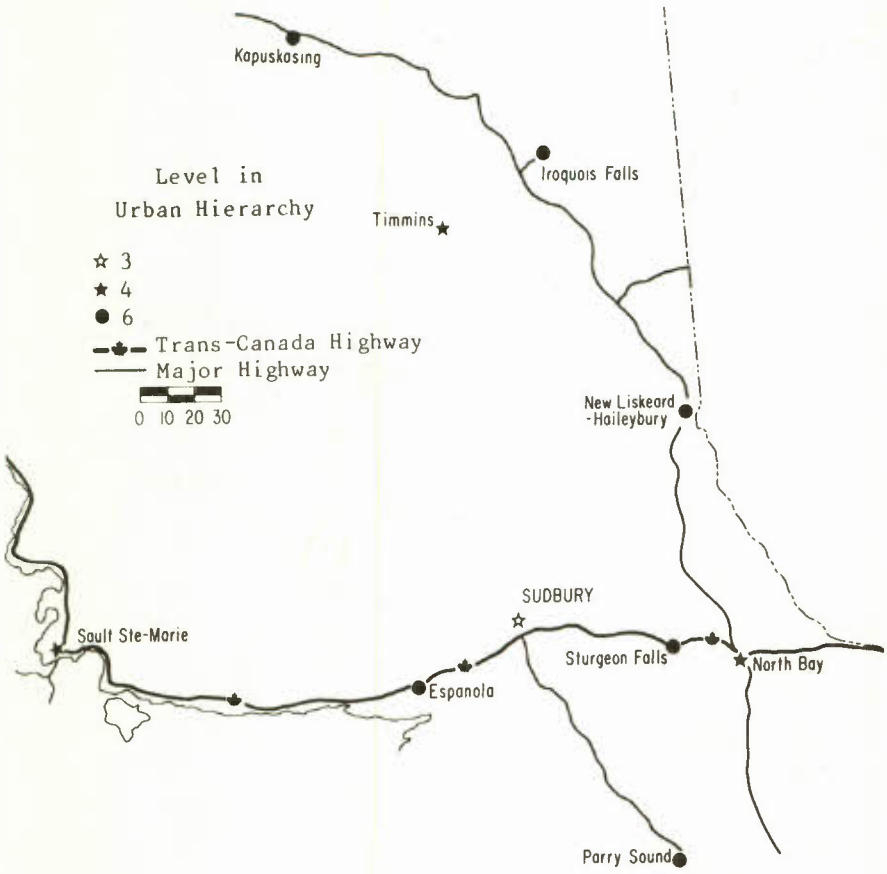
Ottawa Urban System



Source: Texaco road map, 1972.

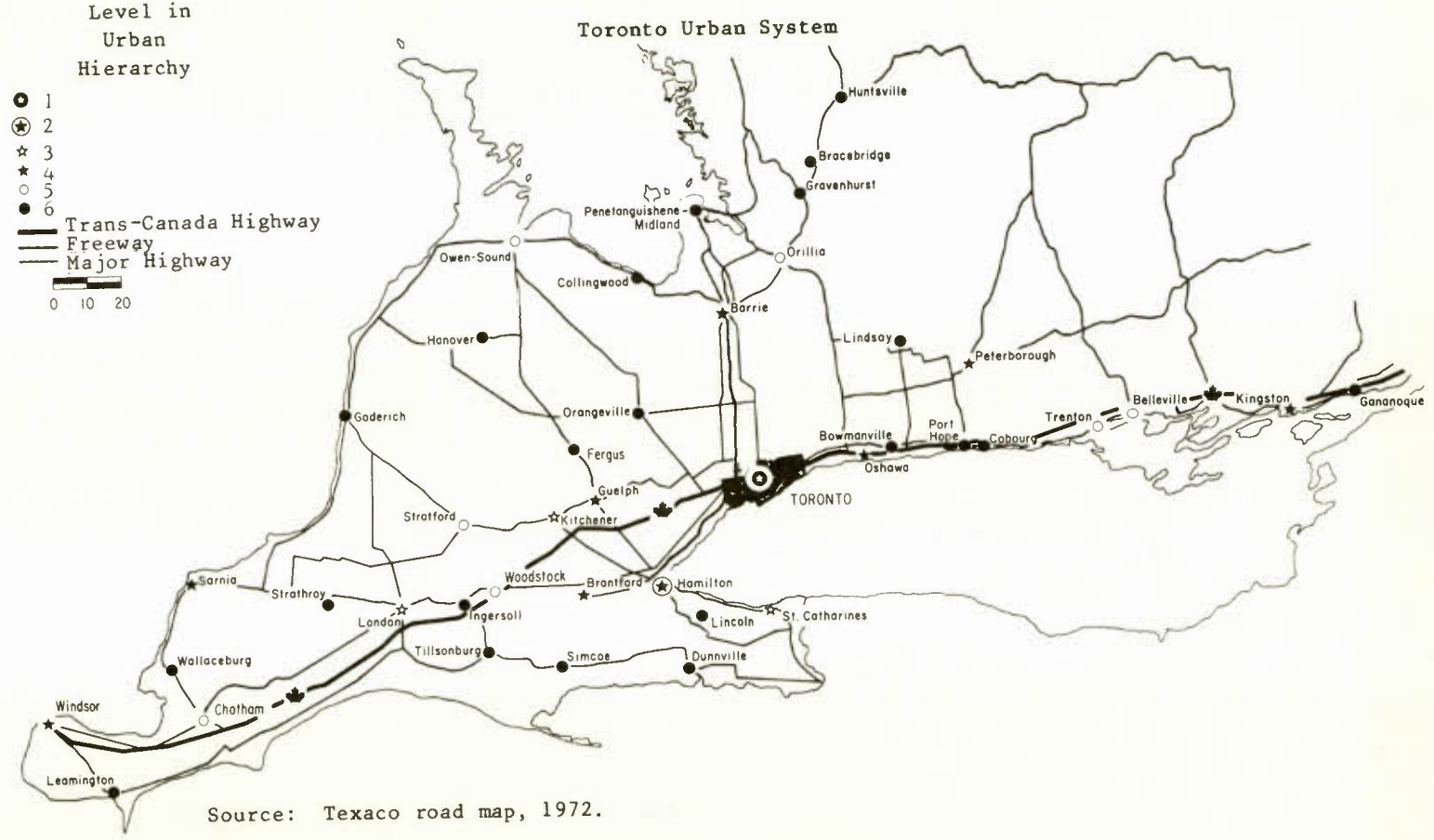
Map A-8

Sudbury Urban System



Source: Texaco road map, 1972.

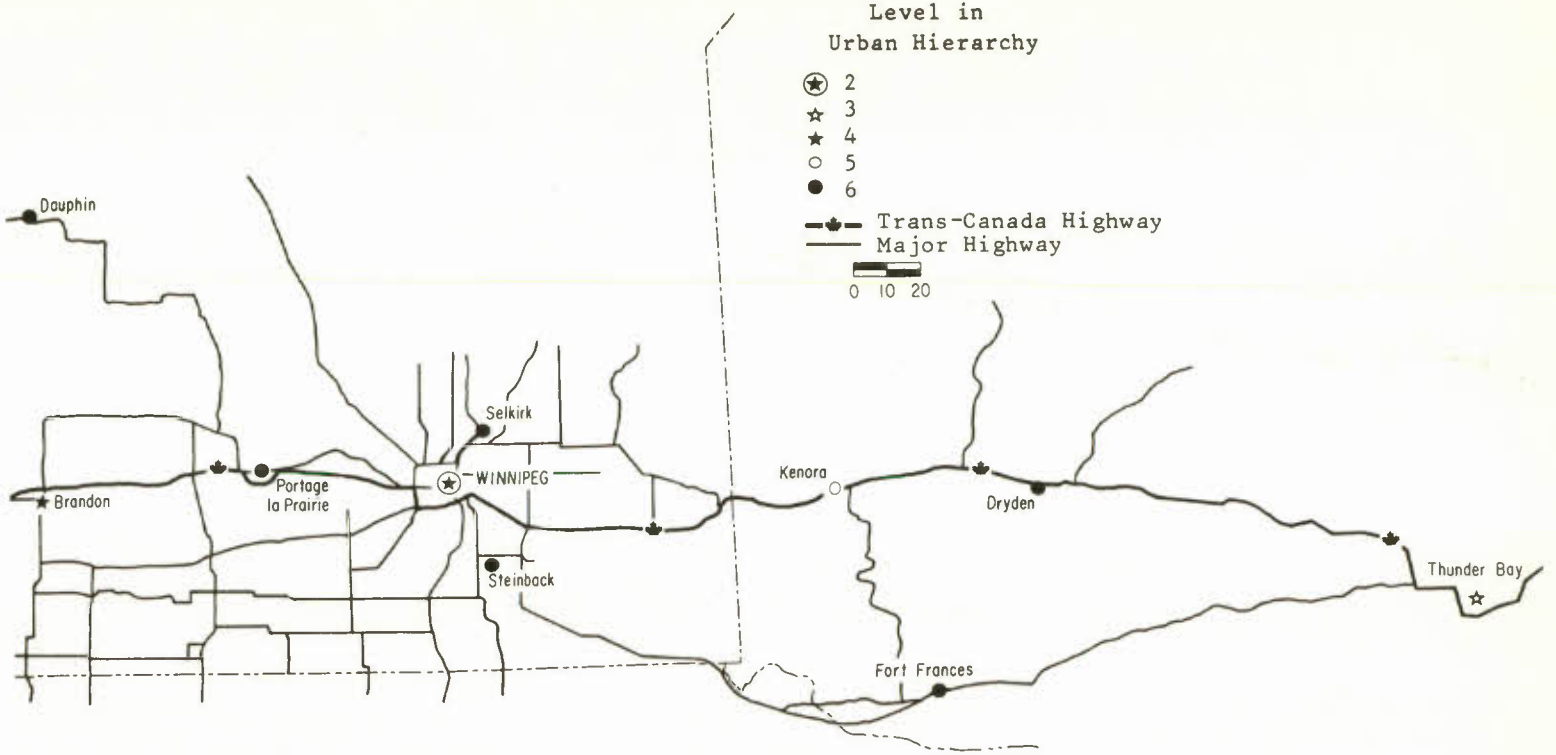
Map A-9



Source: Texaco road map, 1972.

Map A-10

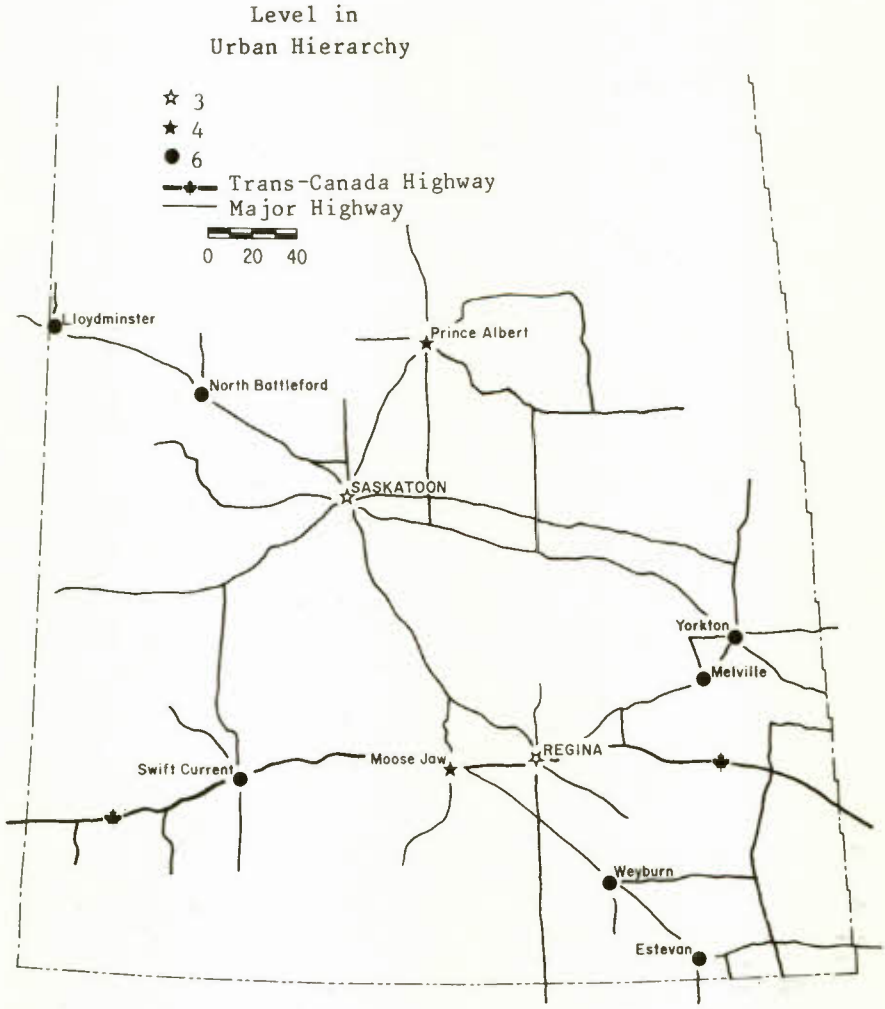
Winnipeg Urban System



Source: Official road map of Department of Highways, Province of Manitoba, 1973.

Map A-11

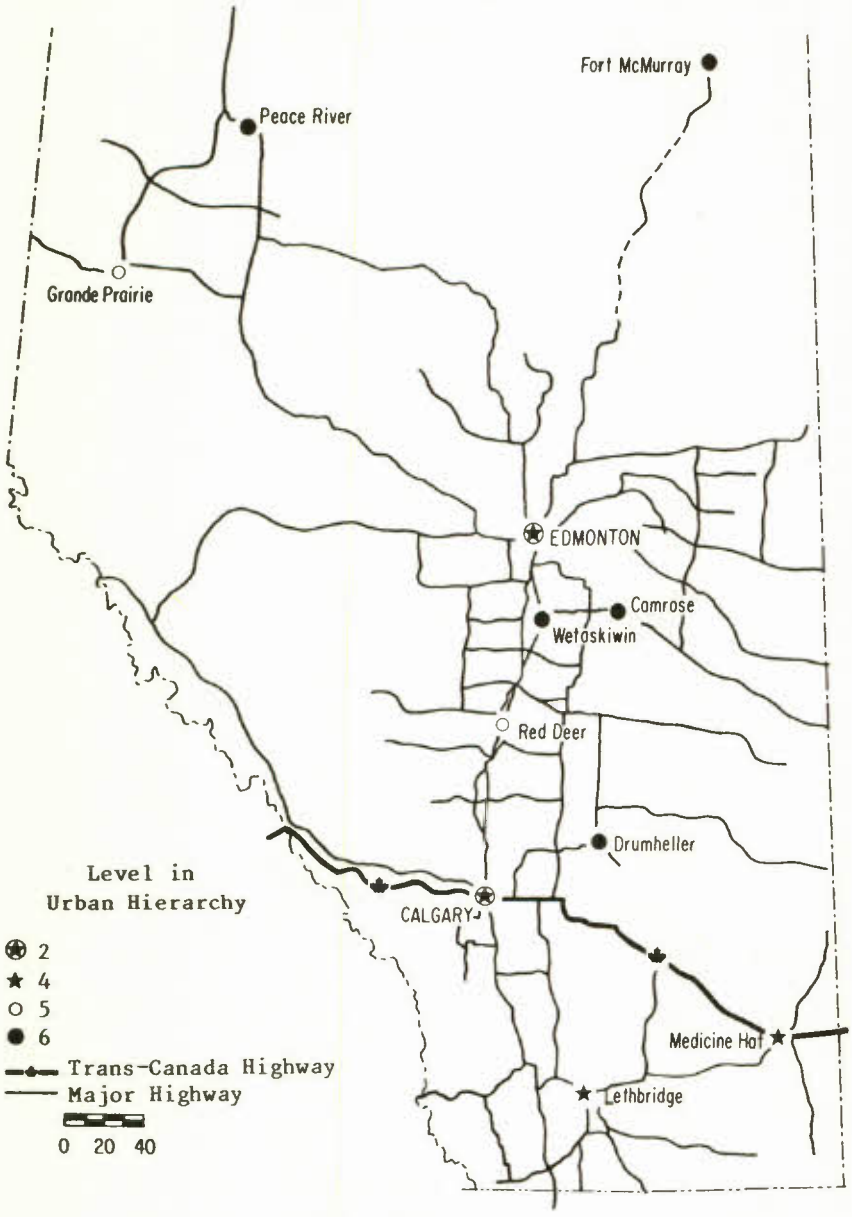
Regina-Saskatoon Urban System



Source: Official highway map, Department of Highways and Transportation, Province of Saskatchewan, 1974.

Map A-12

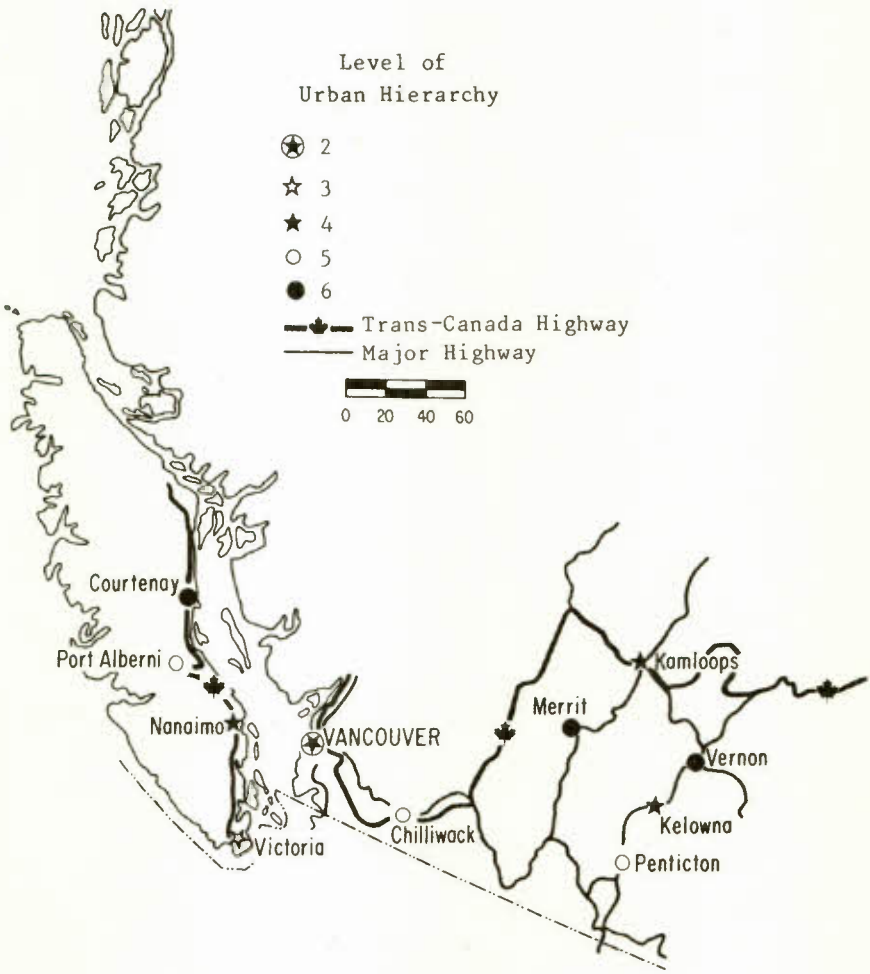
Calgary-Edmonton Urban System



Source: Official road map, Department of Highways and Transportation, Province of Alberta, 1973.

Map A-13

Vancouver Urban System



Source: Official road map, Department of Travel Industry
Province of British Columbia, 1974.

Table A-1

Population and Hierarchical Level of Urban Agglomerations in Rural Regions, 1961 and 1971

	Population 1961[a]	Population 1971	Level in Hierarchy
Labrador			
Labrador City[b]	n.a.	7,622	n.a.
Northwestern Quebec			
Rouyn Noranda	30,193	28,562	4
Val d'or	15,541	17,421	5
Amos	6,455	6,984	6
La Sarre	3,944	5,185	6
Malartic	6,998	5,347	6
Gaspesia			
Gaspé	15,613	17,211	5
Matane	11,066	11,841	6
Percé	6,667	5,616	6
Ste-Anne des Monts	5,210	5,546	6
Far North			
Thompson	3,423	19,001	5
Flin Flon	11,104	9,344	6
The Pas	4,671	6,062	6
Yellowknife	3,245	6,122	6
Southeastern British Columbia			
Cranbrook	7,181	12,000	6
Kimberley	7,719	7,641	6
Nelson	9,142	9,400	6
Trail	11,927	11,149	6
Central British Columbia			
Prince George	24,036	49,100	4
Quesnel	4,673	6,252	6
Northern British Columbia			
Prince Rupert	11,987	15,747	5
White Horse	8,923	11,217	5
Dawson Creek	11,273	11,885	6
Fort St-John	5,118	8,264	6

a As for the urban agglomerations in urban regions, the 1961 population corresponds to the 1971 geographic limits.

b Labrador City was not an incorporated municipality under the terms of the 1971 Census but is nonetheless included here without any hierarchical level.

Source: Basic data from 1971 Census.

B A Method for Determining Basic Employment at the Industry and Urban Area Levels

B.1. Purpose

Our export-base theory[1] distinguishes between that production which satisfies regional demand and the one which serves an extra-regional market -- namely, between a non-basic and a basic (export) sector. This distinction is primarily useful in forecasting since it is assumed that economic growth is a function of expansion in the export sector, with the non-basic sector adjusting afterwards to the new size of the regional market. When this approach is applied at the level of urban areas, the region includes the agglomeration itself as well as the immediate hinterland whose limits correspond to its exclusive market area, that is, the area served exclusively for a given category of goods by the production units located in the agglomeration. In accordance with classical central place theory[1] it is assumed that there exists a limited number of categories (or families) of goods so that, in sum, these non-basic activities are distributed over space as a series of superimposed networks, distinguished by the density of production units and so distributed as to yield the greatest coincidence in the location of production units of varying categories of goods within the large urban agglomerations. Accessibility to the market indeed represents the major locational factor for non-basic activities. For basic activities, on the other hand, this is of secondary importance and their geographic distribution is less regular. Each production unit serves a very wide market and the

1 A brief description as well as a few bibliographic references are given in Chapter 2.

locations chosen are distributed over space in different ways because some of the essential elements for production -- inputs or factors of production -- are only available in a limited number of locations and the technical characteristics of the production process often impose a minimum volume of operation that is very high.

In practical terms, as no complete information on the market area of each production unit is available, a certain number of reasonable assumptions must be made and the readily available statistical information must be relied upon. Several methods[2] have already been proposed for determining the proportion of jobs in an industry at the level of an urban agglomeration that should be considered as non-basic; these are unsatisfactory in our opinion insofar as they are not directly related to the theory of industrial location and ignore in particular spatial competition and urban hierarchy. The method proposed here, which could be called the histogram method,[3] arose from a confrontation of the theoretical underpinnings of the central place scheme with empirical observations made for Canada. Like all its predecessors,however, it contains a very important limit: the number of basic jobs must be interpreted as a minimum. The flexibility of this method, though, could allow for improvement through supplementary statistical work, thus reducing the margin of underestimation.

B.2. Description of the Histogram Method

The classical version of central place theory presented by Christaller is deductive, and its

2 Such as G. Alexandersson's technique of minimum employment coefficient in Industrial Structure of American Cities, Lincoln: University of Nebraska Press, 1956, the location quotient approach by W. Isard, Methods of Regional Analysis, Cambridge, Mass.: M.I.T. University Press, 1960, and F. Carrière and P. Pinchemel's graph method in Le fait urbain en France, Paris: Armand Colin, 1963.

3 This method was first outlined in M. Boisvert, Analyse économique du système urbain québécois, op. cit.

initial assumptions thus indirectly determine the pattern of location for non-basic employment. Specifically, a constant ratio is assumed between the population of the market area and the population of the urban agglomeration itself. While this ratio remains the same for all agglomerations at the same level in the urban hierarchy, it does, however, vary from one level to another because of the classification of goods into families based on a varying degree of economies of scale. Besides, by assuming an identical demand function and purchasing power for all consumers as well as identical technology for all producers, a constant proportionality is inferred between the number of workers in an economic activity in an urban agglomeration and the population size of that agglomeration, although this proportion will vary from one hierarchical level to the next.

$$(B.1)\quad \frac{E_{ij}^{k}}{P_{j}^{k}} = e_{ij}^{k} = e_{i\ell}^{k} = \frac{E_{i\ell}^{k}}{P_{\ell}^{k}} \qquad \begin{matrix} k = 1, 2, \ldots K \\ j, \ell = 1, 2, \ldots m^{k} \\ i = 1, 2, \ldots N \end{matrix}$$

where $E_{ij}^{k}, E_{i\ell}^{k}$ = number of workers in activity i, located in agglomeration $j(\ell)$, level k.

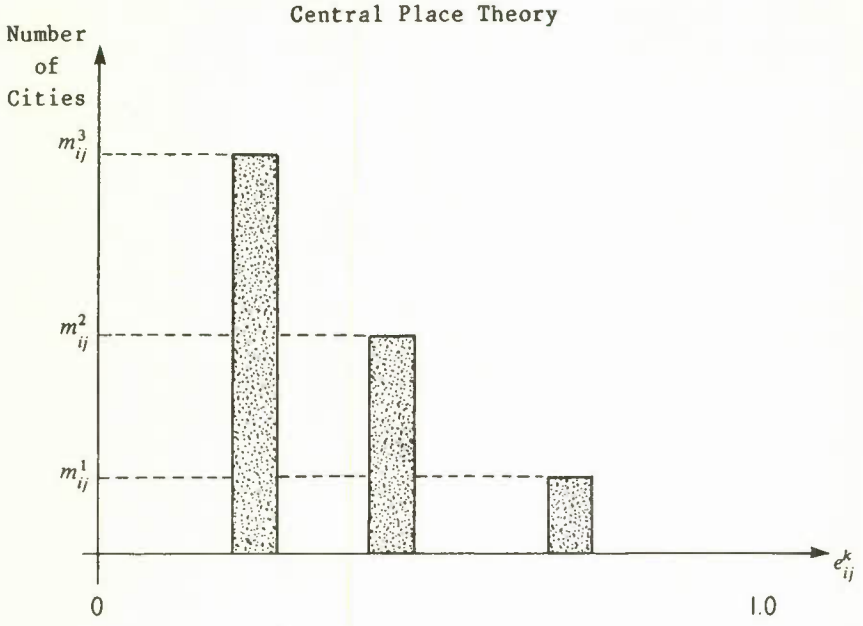
$P_{j}^{k} P_{\ell}^{k}$ = population, in thousands, of agglomeration $j(\ell)$, level k.

To gain an idea of the spatial distribution of employment in any activity i over a given area, a histogram can be used. Chart B-1 clearly indicates that all the urban agglomerations of the same hierarchical level will have an identical ratio but that this ratio will differ from one level to another, with the highest level in the urban hierarchy being equal to 1.

If we now drop the assumption of uniform supply and demand conditions in these markets, it is possible to represent the resulting situation for each family of goods by a histogram whose curve linking the mid-point of each summit gives a normal distribution, provided we assume either that each factor (income, education, productivity of labour,

Chart B-1

Histogram Based on Classical Central Place Theory

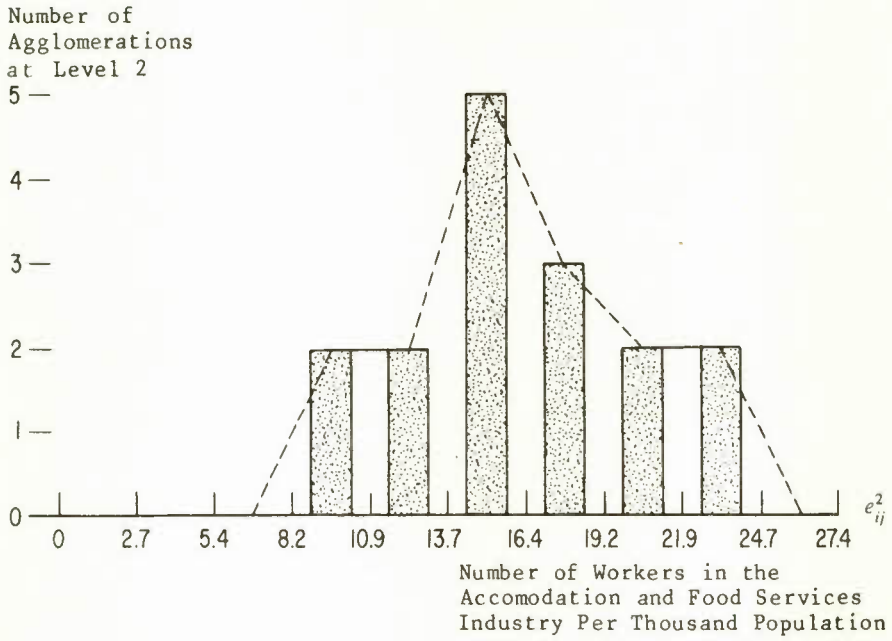


and so forth) is normally distributed or that the number of factors is so great that their combined effect is unpredictable. Chart B-2 illustrates this with the accommodations and food services industry among the 16 Canadian Level 2 agglomerations taken as an example. An agglomeration in which income is higher than average would, ceteris paribus, register an increase in the consumption of good i as well as in the number of workers in industry i and consequently would have a ratio e_{ij}^k to the right of the maximum in the histogram; conversely, an agglomeration in which the number of children per family is lower than in the average urban centre of the same level would have fewer workers in education and thus would have an e_{ij}^k ratio in the first half of the histogram.

Thus far, no agglomeration has basic jobs since each one adjusts its ratio to local supply and demand conditions following the assumptions of classical central place theory. But this approach

Chart B-2

Type I Histogram: Example of the Accomodation and Food Services Industry



Source: Data from 1971 Census.

is obviously very restrictive and, as Losch pointed out,[4] there is no necessity, for example, that an urban centre of a given hierarchical level totally and solely meet the demand for goods of this level coming, in addition to its own population, from all urban centres of a lower level and their respective market areas located in its "normal" hinterland. In other words, it is possible that a Level 3 urban centre will not be selected as the location for Level 4 activities, even though the lower categories of goods as well as those of Level 3 already have production units there. Besides, several types of goods cannot be classified easily in one of the families determining the urban hierarchy and, in practice, an industry under the Statistics Canada definitions includes production activities that are not perfectly homogeneous.

4 A. Lösch, op. cit.

We must therefore conclude that some agglomerations may have a proportion of basic employment, on the basis that the extra-regional market in this case generally corresponds to the neighbouring regions. Accordingly, the histogram will be so modified as to make the curve connecting the mid-point of the various columns correspond more to a Gamma-type function. Chart B-3 illustrates this with education[5] in the 32 Canadian Level 3 agglomerations taken as an example. The critical point ${}^{*}e_{ij}^{k}$ which indicates the level of ratio e_{ij}^{k} beyond which we can consider the additional jobs in an agglomeration in a given activity as export-oriented, is therefore determined by looking for the moment at which the function changes from a normal to Gamma type; for example we can compute ${}^{*}e_{ij}^{k}$ so that its distance to the mean is equal to the distance between the mean and the minimum observed ratio as in the following formula:

$$(B.2)\quad {}^{*}e_{ij}^{k} = e_{i.}^{k} + (e_{i.}^{k} - \min e_{ij}^{k})$$

where ${}^{*}e_{ij}^{k}$ = ratio e_{ij}^{k} serving as a critical point for determining basic employment;

$e_{i.}^{k}$ = average of ratios e_{ij}^{k} observed among the level k urban agglomerations;

$\min e_{ij}^{k}$ = minimum ratio observed e_{ij}^{k} among the level k agglomerations.

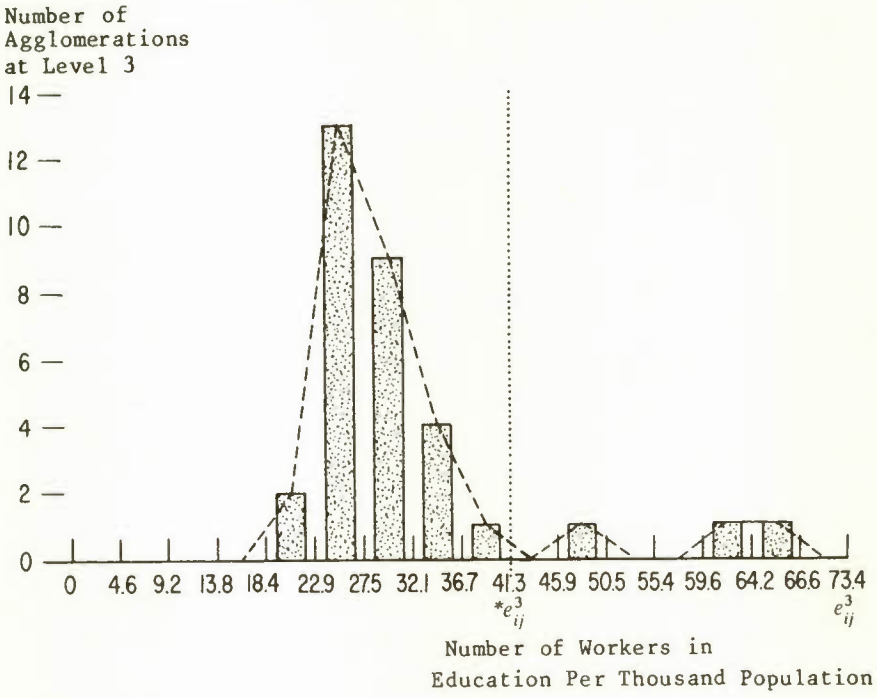
To further simplify the computation, we have used that point on the abscissa that served to construct the histogram closest to ${}^{*}\hat{e}_{ij}^{k}$ as the critical point ${}^{*}e_{ij}^{k}$. Thus the number of basic jobs in an agglomeration for a given industry is simply:

$$(B.3)\quad B_{ij}^{k} = (e_{ij} - {}^{*}\hat{e}_{ij}^{k})\,P_{j}^{k} \text{ si } e_{ij}^{k} > {}^{*}\hat{e}_{ij}^{k}$$
$$= 0 \qquad \text{otherwise}$$

5 To satisfy the reader's curiosity, it can be mentioned the three urban agglomerations at Level 3 which, based on the application of the histogram method, appear in Chart B-3 to possess basic employment in education are Kingston, Guelph and Fredericton, in order of importance.

Chart B-3

Type II Histogram: Example of the Education Industry



Source: 1971 Census data.

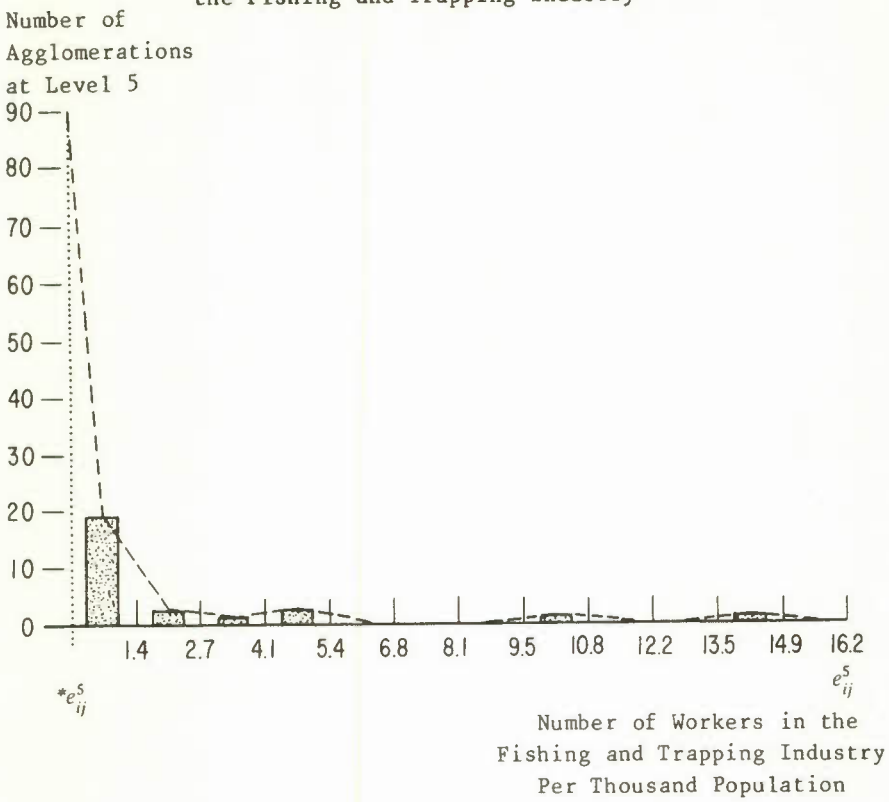
As will be seen, this type of industry is the one most frequently found in the service sector.[6]

Let us now consider those activities where basic employment is the rule, that is, where those

6 Under the assumption of important cultural or economic differentiation within a country, it is possible that the group of urban agglomerations of a given hierarchical level would in fact be composed of two or more sub-groups, each with distinct pattern, eventually resulting in a histogram giving rise to a multi-modal function and the necessity of finding two (or more) distinct critical points. Because of the important differences in the population growth between urban agglomerations in Eastern and Western Canada, the construction industry is liable to show this characteristic. We were unable, however, to reach a definite conclusion on this, perhaps because of the compensating effect of lower labour productivity in the East.

Chart B-4

Type III Histogram: Example of the Fishing and Trapping Industry



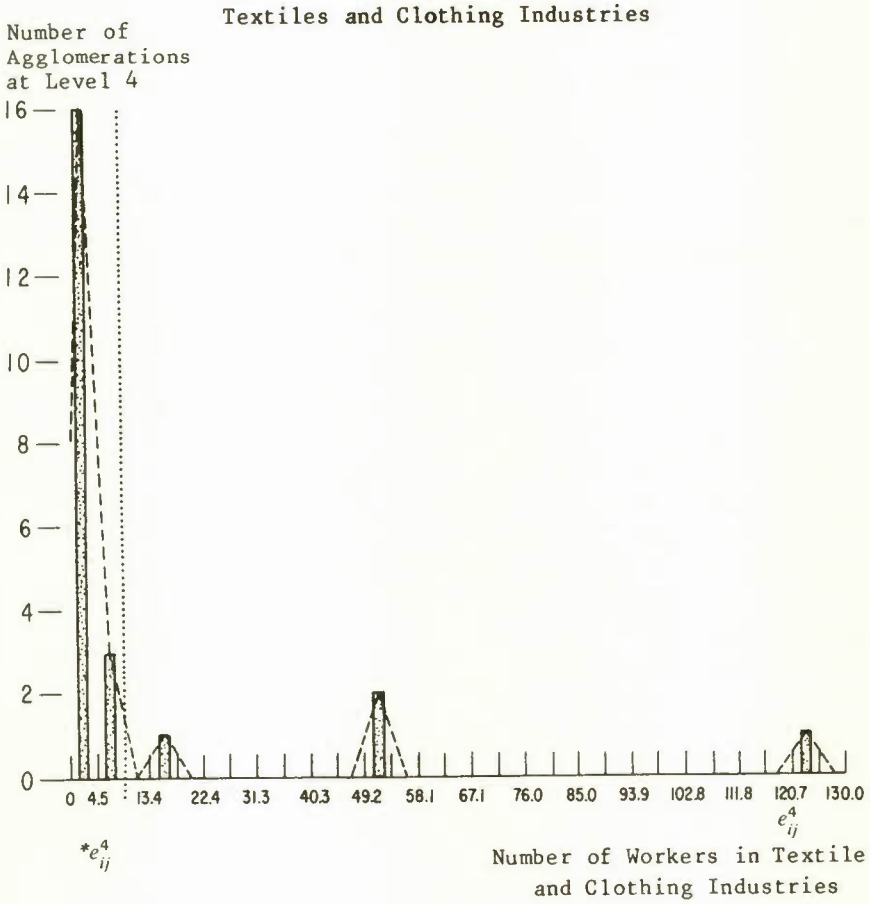
Source: 1971 Census data.

elements essential for production are not available everywhere, particularly the primary industries where accessibility to raw materials is the determinant locational factor for production units. The purest case is that where the majority of agglomerations of a given hierarchical level have no workers employed in an activity and where the other agglomerations have a ratio e_{ij}^k which varies according to the local supply conditions. Chart B-4 illustrates this situation for the fishing and trapping industry in the 116 Level 5 Canadian agglomerations. The distribution derived from the Type III histogram corresponds to a logarithmic function. Critical point $*e_{ij}^k$ has been fixed at 0.0

so that all jobs are considered as basic employment. But when the only available data come from information gathered at place of residence rather than place of work, there is a risk of overestimating not the volume of basic employment in an agglomeration but the actual number of agglomerations with basic employment in an industry; in this case we suggest that the first point on the abcissa used for constructing the histogram be considered as critical point ${}^{*}e_{ij}^{k}$.

Chart B-5

Type IV Histogram: Example of the Textiles and Clothing Industries



Source: 1971 Census data.

Moreover, several manufacturing industries include craft-type production units, such as ornamental iron (metal fabricating industries), bakeries (food and beverage) and sash and door (wood industries). Consequently, there are very few agglomerations, or none at all, with no workers in these industries and the Type IV histogram therefore looks more like a Gamma-type function. Chart B-5 presents the textile and clothing industries in the 31 Canadian Level 4 agglomerations. Type IV is distinct from Type II because the smallest values are very close to or are equal to 0 and because the dispersion around the mode is much smaller in the former case; critical point $*e_{ij}^{k}$ is nonetheless fixed according to the same procedure.[7]

B.3. Application to Canadian Data

The histogram method thus provides us with four basic types of production activities and a procedure for determining basic employment in each case. Our application to the Canadian urban structure was based upon an industrial structure made up of 26 components. All 204 Canadian urban agglomerations of 5,000 population or more in 1971 had already been classified into five hierarchical levels.[8] Hence a total of 130 histograms were examined in order to be allocated to one of the four basic types. Table B-1 provides some statistics on each of these histograms, while Table B-2 shows the classification reached as well as the critical point identified and the number of agglomerations with basic employment in each of the industries. It must be stressed once again that we prefer underestimation to overestimation for this number of agglomerations (as well as

7 Here again regional differentiation could influence the form of the histogram but because these activities are primarily oriented to ward extra-regional markets, it would not be necessary to determine two (or more) distinct critical points.

8 This classification is reproduced in the maps of Appendix A and in Table A-1. One urban agglomeration, Yellowknife, is missing here because of data shortages.

for the number of jobs themselves) because our primary objective is to identify the industrial specialization of each urban agglomeration and to characterize the role of each Canadian urban system on the basis of information where these activities linked only to local markets have been ruled out.

Chart B-6 illustrates the change in the ratio of basic employment (all industries) to total labour force by level in the urban hierarchy and by type of region.[9] As expected, the percentage of basic jobs decreases with urban size since the largest agglomerations naturally increase their total activity by being selected for the location of higher-level services aimed at a larger hinterland. The difference between the three types of regions arises from a more diversified industrial structure in the fabrication regions than in the transformation and resource regions.

B.4. The Impact of the Location of Political Capitals

In order to estimate the population of capitals in the absence of all basic employment in public administration, we have developed a simple urban model that borrows both from export-base theory and central place theory and uses the results obtained thus far.

First, the population of the "normal" market area of urban agglomeration j at level k (P^T_{kj}) is broken down into two parts: the population of the agglomeration itself (P^A_{kj}) and that of the hinterland (P^H_{kj}).

$$(B.4)\quad P^T_{kj} \equiv P^A_{kj} + P^H_{kj}$$

Labour force in agglomeration (L_{kj}) belongs either to the basic (B_{kj}) or non-basic (NB_{kj}) sector.

9 These are unweighted averages. Furthermore, there are six hierarchical levels rather than five because we are separating Montreal and Toronto from Level 1 and moving all other agglomerations one level down.

Table B-1

Number of Workers in an Industry per 1,000 Population e_{ij}^{k}, Based on Five Levels in the Urban Hierarchy, 1971

Industry \ Hierarchical Level[a] and Statistic	1			2			3		
	Minimum	e_{ij}^{k} Median	Maximum	Minimum	e_{ij}^{k} Median	Maximum	Minimum	e_{ij}^{k} Median	Maximum
1. Agriculture	0.898	2.957	7.554	1.182	3.499	12.184	0.525	4.977	17.377
2. Forestry	0.066	0.174	3.099	0.049	0.350	8.207	0.0	0.687	21.542
3. Fishing and trapping	0.010	0.040	1.455	0.0	0.048	2.145	0.0	0.0	6.191
4. Mining, quarries and oil wells	0.547	0.978	27.484	0.255	1.170	94.901	0.127	1.437	85.718
5. Food and beverage	4.049	11.237	15.575	4.375	10.675	24.862	3.378	6.128	32.753
6. Textile and clothing	0.404	4.772	22.761	0.054	1.456	24.025	0.0	4.458	67.814
7. Wood, furniture and fixture	0.965	3.713	17.281	0.548	1.819	10.910	0.382	2.728	30.346
8. Paper and allied	0.574	3.634	7.833	0.225	4.001	32.982	0.0	3.016	32.154
9. Printing and publishing	3.792	5.824	11.742	1.672	3.912	7.814	0.580	3.429	9.547
10. Primary metal	0.359	2.244	49.536	0.234	3.148	38.929	0.0	1.607	111.541
11. Metal fabricating	2.506	9.992	24.351	1.570	5.218	38.770	0.878	4.509	63.026
12. Other manufacturing industries	10.414	20.220	51.808	4.278	11.889	83.126	1.575	24.447	114.571
13. Construction	18.573	26.026	39.125	14.210	25.072	31.880	11.579	22.447	47.956

14. Transportation and storage	10.763	22.081	34.844	9.345	16.327	59.230	7.759	13.625	33.299
15. Communication	4.663	10.045	13.277	4.599	6.930	14.895	2.707	6.433	26.074
16. Electric power, gas and water utilities	2.726	4.156	5.726	1.359	3.863	7.496	1.726	4.491	14.197
17. Wholesale trade	11.145	21.022	27.893	6.432	15.023	25.149	6.201	11.862	23.947
18. Retail trade	39.323	49.464	56.713	33.020	47.990	63.851	32.338	48.325	66.356
19. Finance, insurance and real estate	15.702	21.967	32.162	6.965	14.820	27.831	6.960	13.146	20.564
20. Education	24.655	29.856	37.734	19.251	29.265	50.217	22.046	27.876	68.202
21. Health and welfare	23.285	27.440	36.090	18.722	28.729	45.820	17.505	27.069	60.513
22. Personal services	8.085	8.952	9.710	6.544	9.146	11.071	6.026	8.795	13.342
23. Accomodation and food services	12.747	15.519	20.035	9.049	15.659	22.789	10.203	17.089	28.946
24. Other service industries	21.042	26.508	37.017	11.144	20.994	28.102	9.345	17.192	26.830
25. Public administration and defence	15.957	32.461	130.379	16.112	25.979	77.783	10.686	22.942	90.091
26. Other industries	27.220	32.466	36.495	24.476	29.061	37.445	22.398	29.870	39.537

(continued)

Table B-1 (concluded)

Industry \ Hierarchical Level[a] and Statistic	4 e_{ij}^k Minimum	4 e_{ij}^k Median	4 e_{ij}^k Maximum	5 e_{ij}^k Minimum	5 e_{ij}^k Median	5 e_{ij}^k Maximum
1. Agriculture	0.0	1.871	37.212	0.0	2.597	82.122
2. Forestry	0.0	1.105	50.171	0.0	0.800	36.627
3. Fishing and trapping	0.0	0.0	18.883	0.0	0.0	13.502
4. Mining, quarries and oil wells	0.0	1.505	179.727	0.0	1.245	151.433
5. Food and beverage	1.783	8.792	42.230	0.0	7.974	85.769
6. Textile and clothing	0.0	0.593	124.990	0.0	0.521	85.437
7. Wood, furniture and fixture	0.566	2.905	94.496	0.0	4.743	99.968
8. Paper and allied	0.0	3.928	113.749	0.0	0.909	149.222
9. Printing and publishing	0.0	3.058	25.177	0.0	2.356	17.928
10. Primary metal	0.0	0.847	38.355	0.0	0.0	125.123
11. Metal fabricating	0.0	2.074	47.943	0.0	2.197	72.182
12. Other manufacturing industries	1.131	6.271	105.489	0.0	9.600	112.531
13. Construction	8.015	16.941	38.611	2.625	20.745	59.202
14. Transportation and storage	5.083	15.684	49.753	1.750	13.613	125.378
15. Communication	2.324	6.870	15.601	0.875	5.685	32.798
16. Electric power, gas and water utilities	0.943	3.794	26.690	0.0	3.708	45.847

17. Wholesale trade	2.671	12.994	26.378	0.535	10.867	29.891
18. Retail trade	30.213	46.358	61.610	22.923	48.374	76.967
19. Finance, insurance and real estate	5.877	12.104	22.199	1.780	10.670	23.456
20. Education	14.736	24.238	36.026	10.535	24.732	86.536
21. Health and welfare	11.052	27.106	67.572	6.232	27.798	100.678
22. Personal services	4.473	8.568	11.671	2.750	9.447	18.061
23. Accomodation and food services	6.759	16.795	40.229	2.850	17.004	41.576
24. Other service industries	8.522	16.047	48.355	3.365	14.739	211.602
25. Public administration and defence	9.473	16.797	116.055	8.515	22.037	251.597
26. Other industries	20.822	29.062	61.959	12.251	27.579	67.547

a The agglomerations were classified in the urban hierarchy in terms of the size of their population and the size the population in their hinterland; there is a total of 10 Level 1 agglomerations, 16 Level 2, 32 Level 3, 31 Level 4 and 115 Level 5. This classification is reproduced in Appendix A.

Table B-2

Classification of Each Industry by Level in Urban Hierarchy, Value of Critical Point $^{*}e_{ij}^{k}$ and Number of Agglomerations With Basic Employment

Industry \ Hierarchical Level[a]	1			2			3		
	Critical			Critical			Critical		
	Type	Point	Number	Type	Point	Number	Type	Point	Number
1. Agriculture	II	6.600	2	II	6.600	3	II	6.600	8
2. Forestry	IV	2.150	1	IV	2.150	3	IV	2.150	10
3. Fishing and trapping	III	1.350	1	IV	1.350	3	III	0.0	12
4. Mining, quarries and oil wells	IV	15.143	1	IV	15.143	2	IV	15.143	2
5. Food and beverages	I	--	--	II	8.090	10	II	8.090	14
6. Textile and clothing	IV	8.942	2	IV	8.942	3	IV	8.942	13
7. Wood, furniture and fixture	IV	6.526	1	IV	3.263	4	IV	3.263	16
8. Paper and allied	II	6.551	1	II	6.551	5	IV	6.551	9
9. Printing and publishing	II	7.950	1	II	6.360	1	II	6.360	5
10. Primary metal	IV	9.835	1	IV	9.835	5	IV	9.835	6
11. Metal fabricating	II	12.430	2	IV	6.215	7	IV	6.215	13
12. Other manufacturing industries	IV	33.759	3	IV	22.506	5	IV	33.759	14
13. Construction	II	32.787	2	I	--	--	II	36.430	2
14. Transportation and storage	II	28.896	2	II	33.712	2	II	24.080	7

15. Communication	I	--	--	II	10.295	4	II	10.205	7
16. Electric power, gas and water utilities	I	--	--	I	--	--	II	10.300	1
17. Wholesale trade	I	--	--	I	--	--	II	17.616	6
18. Retail trade	I	--	--	II	55.648	2	I	--	--
19. Finance, insurance and real estate	II	28.184	1	II	19.512	4	I	--	--
20. Education	I	--	--	II	41.292	2	II	41.292	3
21. Health and welfare	I	--	--	II	32.430	7	II	37.835	5
22. Personal services	I	--	--	I	--	--	I	--	--
23. Accomodation and food services	I	--	--	I	--	--	I	--	--
24. Other service industries	II	28.755	3	I	--	--	I	--	--
25. Public administration and defence	II	30.836	6	II	30.836	4	II	46.254	6
26. Other industries	I	--	--	I	--	--	I	--	--

(continued)

Table B-2 (concluded)

Industry \ Hierarchical Level[a]	4			5		
	Critical			Critical		
	Type	Point	Number	Type	Point	Number
1. Agriculture	IV	6.600	3	IV	6.600	27
2. Forestry	IV	2.150	13	IV	2.150	38
3. Fishing and trapping	III	0.0	14	III	0.0	26
4. Mining, quarries and oil wells	IV	15.143	7	IV	15.143	15
5. Food and beverages	IV	8.090	16	IV	8.090	50
6. Textile and clothing	IV	8.942	4	III	8.942	24
7. Wood, furniture and fixture	IV	3.263	15	IV	3.263	68
8. Paper and allied	IV	6.551	8	III	6.551	29
9. Printing and publishing	II	6.360	2	IV	6.360	7
10. Primary metal	IV	9.835	6	III	9.835	8
11. Metal fabricating	IV	6.215	9	IV	6.215	24
12. Other manufacturing industries	IV	22.506	7	IV	11.253	54
13. Construction	II	29.144	6	I[b]	--	--
14. Transportation and storage	II	28.896	5	II	28.896	14
15. Communication	II	10.295	4	II	16.472	9
16. Electric power, gas and water utilities	II	7.725	2	II	10.300	9
17. Wholesale trade	I	--	--	II	17.616	25
18. Retail trade	I	--	--	I	--	--

19. Finance, insurance and real estate	I[c]	--	--	I	--	--
20. Education	I	--	--	I[d]	--	--
21. Health and welfare	II	37.835	8	II	48.645	13
22. Personal services	I	--	--	I	--	--
23. Accomodation and food services	II	27.480	3	II	32.876	3
24. Other service industries	II	28.755	2	II	25.560	4
25. Public administration and defence	II	46.254	6	II	46.254	10
26. Other industries	I[e]	--	--	I[f]	--	--

a The agglomerations were classified in the urban hierarchy in terms of the size of their population and the size the population in their hinterland, there is a total of 10 Level 1 agglomerations, 16 Level 2, 32 Level 3, 31 Level 4 and 115 Level 5. This classification is reproduced in Appendix A.

b Stephenville represents the only exception to normal distribution with a coefficient of 59.202, the second highest coefficient being less than 47.0.

c Owen Sound represents the only exception to normal distribution with a coefficient of 22.199, the second highest coefficient being less than 17.0.

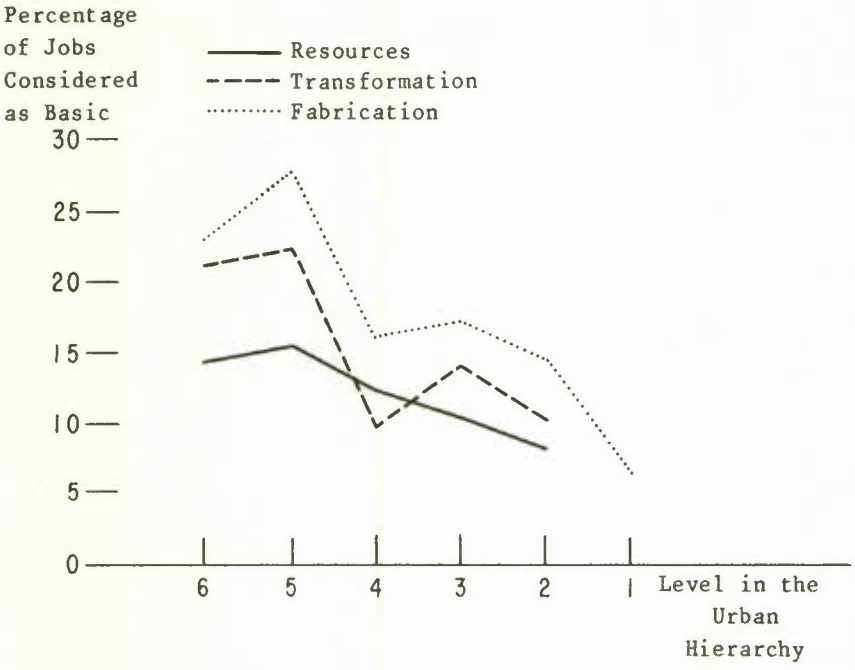
d Antigonish represents the only exception to normal distribution with a coefficient of 86.536, the second highest coefficient being less than 46.0.

e Whitehorse represents the only exception to normal distribution with a coefficient of 61.959, the second highest coefficient being less than 44.0.

f Sturgeon Falls represents the only exception to normal distribution with a coefficient of 67.547, the second highest coefficient being less than 49.0.

Chart B-6

Percentage of Total Employment Considered as Basic, by Level in Urban Hierarchy and Type of Region



(B.5) $L_{kj} \equiv B_{kj} + NB_{kj}$

In addition to these two identities, we assume a linear relationship between the adult proportion of the population and the participation rate on the one hand and urban size on the other hand in order to get a second-degree relationship between the labour force and the population that can be approximated by a series of straight lines of the form:

(B.6) $P^{A}_{kj} = a_{ko} + a_{k1} L_{kj} \qquad k = 1, 5$

Finally, following the approach used in the histogram method, the non-basic sector is assumed

proportional to the size of the market as represented by the population in the market area; again this proportion varies with the hierarchical level:

$$(B.7)\quad NB_{kj} = b_k P^T_{kj} \qquad k = 1, 5$$

This set of structural relationships can easily be reduced to a form that relates the population of the agglomeration to the exogenous variables of the system through substitution:

$$P^A_{kj} = a_{ko} + a_{k1} B_{kj} + a_{k1} b_k (P^A_{kj} + P^H_{kj})$$

hence

$$(1 - a_{k1} b_k) P^A_{kj} = a_{ko} + a_{k1} B_{kj} + a_{k1} b_k P^H_{kj}$$

so that

$$(B.8)\quad P^A_{kj} = \frac{a_{ko}}{1-a_{k1}b_k} + \frac{a_{k1}}{1-a_{k1}b_k} B_{kj} + \frac{a_{k1}b_k}{1-a_{k1}b_k} P^H_{kj}$$

This equation points out how the population size of an urban agglomeration is tied first to the volume of basic employment in the agglomeration (along the lines of export-base theory) and second to the size of the population in the hinterland (along the lines of central place theory).

The data were obtained as follows: (P^A_{kj}) from the 1971 Census, (B_{kj}, NB_{kj}) from the application of the histogram method and (P^H_{kj}) the estimates of the hinterland population, by assuming that all urban centres of a given level in a region served an identical population equal to the total regional population less the population located in the centres at this level or a higher level divided by the number of centres at this level and a higher level.[10] Given the arbitrariness of this last

10 For example, the population in the Bathurst hinterland is equal to 100,510 because the total population of the region is 634,557 and the population of Bathurst proper and of the three other centres of a higher level (St-John, Moncton and Fredericton) is 232,518, which gives a population in the total hinterland of Level 5 equal to 402,039 which divided by 4 gives 100,510.

method, we limited the problems by using as a sample for the Level 5 agglomerations only those located in an urban region.

The estimated results for equation (B.8) are as follows:

$$\text{Level 1} - P^A_{1j} = \underset{}{194{,}182} + \underset{(0.605)}{0.433}\ P^H_{1j} + \underset{(1.015)}{10.52}\ B_{1j} \quad \underset{(0.836)}{}$$

$$F = 5.18 \quad \bar{R}^2 = .482 \quad n = 10$$

$$\text{Level 2} - P^A_{2j} = \underset{}{133{,}466} - \underset{(2.637)}{0.179}\ P^H_{2j} + \underset{(1.075)}{7.914}\ B_{2j} \quad \underset{(6.549)}{}$$

$$F = 21.5 \quad \bar{R}^2 = .73 \quad n = 16$$

$$\text{Level 3} - P^A_{3j} = \underset{}{23{,}486} + \underset{(7.190)}{0.0064}\ P^H_{3j} + \underset{(0.262)}{7.784}\ B_{3j} \quad \underset{(16.356)}{}$$

$$F = 138.2 \quad \bar{R}^2 = .90 \quad n = 31$$

$$\text{Level 4} - P^A_{4j} = \underset{}{9{,}444} + \underset{(2.03)}{0.0589}\ P^H_{4j} + \underset{(1.50)}{4.798}\ B_{4j} \quad \underset{(3.484)}{}$$

$$F = 6.12 \quad \bar{R}^2 = .29 \quad n = 26$$

$$\text{Level 5} - P^A_{5j} = \underset{}{4{,}606} + \underset{(3.88)}{0.0697}\ P^H_{5j} + \underset{(2.29)}{3.084}\ B_{5j} \quad \underset{(4.47)}{}$$

$$F = 10.44 \quad \bar{R}^2 = .16 \quad n = 97$$

Although sometimes weak, we find these results satisfactory for our immediate needs. Table B-3 shows the population of each capital as observed in 1971 and as estimated by the model, as well as an estimate of the total population after the elimination of all basic employment in public administration,[11] with and without a specific correction coefficient to take into account the model's estimation error.

11 We thus assume that the basic employment in the other industries is not related to public administration.

Table B-3

Population of Federal and Provincial Capitals,
Based on Various Assumptions in 1971

Capital	Population Observed A	Population Estimated B	Specific Factor of Correction A/B	Population Estimated After the Elimination of Basic Employment in Public Administration	
				Without Correction Factor	With Correction Factor
Ottawa	602,510	1,160,687	.52	344,217	178,993
St. John's	131,814	100,129	1.32	90,638	119,642
Halifax	222,637	642,134	.35	487,740	170,709
Fredericton	37,684	42,466	.89	29,610	26,353
Charlottetown	25,253	22,838	1.11	19,975	22,172
Quebec City	480,502	974,541	.49	461,039	225,909
Toronto	2,628,043	2,849,251	.92	2,849,251[a]	2,628,043[a]
Winnipeg	540,262	544,275	.99	509,224	504,132
Regina	140,734	131,933	1.07	98,822	105,739
Edmonton	495,702	458,279	1.08	379,120	409,450
Victoria	195,800	184,949	1.06	112,295	119,033

a There is no basic employment in public administration in Toronto.

Source: 1971 Census data.

C Method for Eliminating Heteroscedasticity

As illustrated in Chart C-1, the dispersion of unemployment rates appears to decrease with urban size and, if this relationship cannot be statistically rejected, a correction procedure for heteroscedasticity will have to be provided before any regression analysis between these two variables be carried on.

In order to test whether the overall relationship had a non-uniform residual variance, we used the method suggested by Goldfeld and Quandt.[1] Thus, after ranking the 204 Canadian urban agglomerations by order of population size, we eliminated some of the observations (52) and carried out a simple regression analysis first for the 76 smallest agglomerations and then for the 76 largest. The residual variance in the first case is 11.392 and 3.637 in the second. According to the Fisher test, we must reject the hypothesis of homoscedasticity if

$$(C.1)\quad \frac{S_1^2}{S_2^2} \geq F_{\alpha,\, n_1-K,\, n_2-K}$$

where S_i^2 = residual variance for group i

n_i = number of observations in group i $_{i(n_1 = n_2)}$

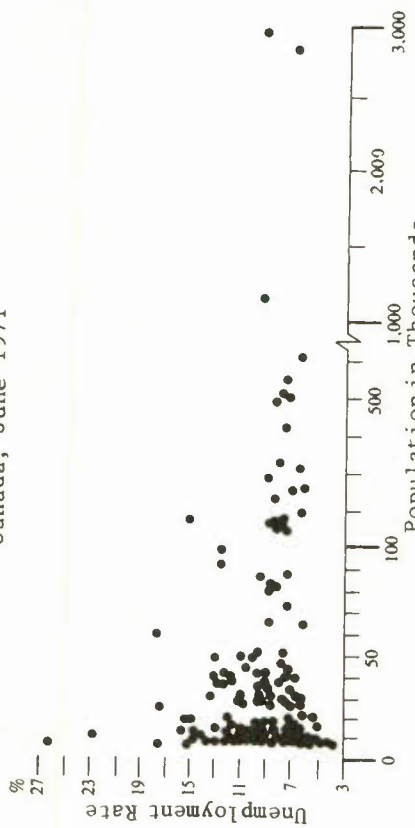
K = number of variables used;

in our case, $3.134 > F_{.99,\,74,\,74} = 1.8$ so that we must account for the presence of heteroscedasticity.

1 J. Johnston, Econometric Methods, New York: McGraw-Hill, 1972, p. 218.

Chart C-1

Unemployment Rate in Urban Agglomerations, Canada, June 1971



Source: 1971 Census data.

The relationship between urban size and the unemployment rate that we wish to test has a quadratic form and is written as follows:

(C.2) $U = b_0 + b_1 POP + b_2 POP^2 + u$

where U = urban unemployment rate

POP = population size of the urban centre

POP^2 = population size of the urban centre squared

u = residual term.

Given the presence of heteroscedasticity and the shape of the relationship illustrated in Chart C-1, we corrected our variables by assuming that the variance of the residuals was inversely proportional to urban size, i.e.

(C.3) $V(u) = V\left(\frac{\epsilon}{POP}\right) = \frac{1}{POP^2} \cdot V(\epsilon),$

Thus suggesting that the true relationship between the unemployment rate and urban size would be as follows:

(C.4) $U = b_0 + b_1 POP + b_2 POP^2 + \frac{\epsilon}{POP}$

Consequently, the parameters , b_1 and b_2 were estimated through application of the ordinary least squares method to the equation.

(C.5) $U \times POP = b_0 POP + b_1 POP^2 + b_2 POP^3 + \epsilon$

When, in addition, we introduce dummy variables to take into account each major region in the country, the results obtained are the following:

before correction for heteroscedasticity

$$(C.6)\quad U = \underset{(21.36)^*}{7.538} - \underset{(0.515)}{(0.117 \times 10^{-5})POP} + \underset{(0.254)}{(0.230 \times 10^{-12})POP^2}$$
$$+ \underset{(2.786)^*}{1.672ATL} + \underset{(8.116)^*}{4.175QUE} - \underset{(0.125)}{0.076PRA} + \underset{(2.397)^*}{1.672COL}$$
$$F = 13.13 \qquad \bar{R}^2 = .26$$

after correction for heteroscedasticity

$$(C.7)\quad U = \underset{(34.93)^*}{7.76} - \underset{(4.13)^*}{(0.241 \times 10^{-5})POP} + \underset{(4.10)^*}{(0.797 \times 10^{-12})POP^2}$$
$$+ \underset{(1.04)}{0.405ATL} + \underset{(28.1)^*}{2.175QUE} + \underset{(3.86)^*}{0.655PRA} + \underset{(13.49)^*}{3.232COL}$$
$$F = 14{,}757 \qquad \bar{R}^2 = .99$$

The figure used for the Student test is found in parentheses under each parameter and an asterisk indicates a non-zero coefficient at a confidence level of 90 per cent. It is clear, following these results, that, in the absence of a correction procedure for heteroscedasticity, urban size does not play a significant role and the regional variable takes on all regularity. Furthermore, the quadratic relationship cannot be rejected when the appropriate corrections are made and the minimum unemployment rate is found in an agglomeration of approximately 1.5 million population, which puts Montreal and Toronto in a distinct class.

Michel Boisvert

The author holds a Master of Arts degree with Economic Science option from the University of Montreal and a Ph.D. with Regional Science option from the University of Pennsylvania. Following two years at the Institut National de la Recherche Scientifique (Quebec), he joined the research staff at the Economic Council of Canada in 1974. He now teaches at the Institute of Urbanism at the University of Montreal.

Summary

Despite the economic advantages generally associated with the concentration of activity in large urban agglomerations, not all of Canada's regions would gain equally from this phenomenon because of major differences in their economic base. A region's industrial structure in fact imposes certain constraints on its urban system. The study explains this aspect by dividing the country into twenty regions and classifying them in one of three categories: resource region; transformation region or fabrication region. Other factors capable of changing the operation of an urban system are examined as well, such as a region's bio-physical characteristics and the traces left by previous stages of economic development. Elements of strategy are proposed, such as the greater integration of primary industries in resource regions, the formation of growth poles in transformation regions and the strengthening of peri-metropolitan satellites in fabrication regions.