A FUNCTIONAL CLASSIFICATION OF CANADIAN CITIES

by

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ABSTRACT

The major cities in Canada have been classified in terms of their functional structure in order to develop an overview of the Canadian urban milieu. A quantitative method of classification based on census labour force statistics has been used to identify the functional character of cities. Examination of the traditional techniques of city functional classification reveals that a good quantitative classification scheme must recognize that all cities are multifunctional, that changing city size affects city functional structure, and that urban functions are essentially dichotomous by nature, having distinct "city-serving" and "city-forming" characteristics. Generally the city-serving activities are ubiquitous, being found in almost all centers and usually having relatively constant levels of importance in the functional profiles of cities. In contrast, the city-forming functions appear sporadically in cities and have a great range in the importance they exhibit in city functional structures. This importance ranges from complete domination to no representation at all for some functions. Because city-forming activity reveals the essential functional role of a city, only this activity should be utilized when classifying cities in terms of

function. The "minimum requirement" technique as developed by Ullman and Dacey has been used to classify the cities because it conforms most closely to theoretical considerations, using only city-forming activity as the basis of classification and allowing for the effect of changing city size on city functional profiles. In addition it provides for a measure of city functional specialization. The position of an activity in a city's functional profile should be examined on two distinct planes: (1) its importance relative to that of other functions in the city's functional structure, and (2) its importance in the city's functional profile relative to its importance in the functional profiles of all other cities. The activity that occupies the highest position in a city's functional structure--determined by the proportion of city-forming employment in the different functions--is termed the city's "dominant" function. A function that engages an atypically high proportion of a city's city-forming employment in relation to the proportion usually found in the function in most cities is called a "distinctive" function. By determining the dominant and distinctive functions of cities and analyzing the distribution patterns of functional relative importance and city functional specialization, several observations can be made regarding the character of the functional performance of cities.

The findings of the classification exercise generally coincide with observations based on qualitative data and with the results of other similar quantitative studies. Trade and manufacturing are the key urban functions both in the city-serving and city-forming profiles of cities. The propensity for functional specialization decreases with increasing city size. City size, however, is not the only factor governing city specialization. Elements such as the importance and kind of manufacturing in the functional profile, and the degree of "isolation" a city experiences are also important factors affecting city specialization.

The distribution patterns of relative importance of the key urban activities are extremely uneven and indicate that a fundamental difference in functional performance exists between the cities of the densely populated St. Lawrence Lowlands and southern Ontario--the "heartland"--and the cities of the remaining parts of Canada--the "periphery". Heartland cities are generally more specialized and emphasize manufacturing to a greater degree than do the peripheral cities. The latter, except for a very few resource-oriented manufacturing centers, are quite diversified and are inclined to have an important involvement with functions associated with distance such as wholesale trade and transportation.

The Canadian heartland and periphery are geographic realities. They differ in historical, economic, and to some degree, in cultural development. That their cities reflect these differences seems like a reasonable and to-be-expected conclusion.

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CHAPTER I

CLASSIFICATION OF CITIES: A CRITICAL REVIEW

> Cities serve manifold functions in the economy and culture of a people. All cities have some functions in common; all cities have some functions that are peculiar to their site and situation, to the people whom they serve; and all cities have some functions peculiar to their development and history; hence cities may be classified more effectively on the basis of their functions as criteria than perhaps according to any other attribute.[1]

I. THE PROBLEM

Statement of the problem. It was the purpose of this study to examine certain aspects of city functional character as manifested in Canadian urban centers. The objectives of the study were (1) to investigate the techniques available for city functional classification and to develop a taxonomy suitable for classifying Canadian cities; (2) to classify cities by their distinctive and dominant functions and degree of specialization; and (3) to describe and analyze: (a) the distribution patterns of the relative importance of functions among cities, and (b) the distribution patterns of city types and city specialization.

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[1] "Urban Functions," Economic Geography, XXI (April, 1945), 78.

Importance of the study. Study of the functional character of urban centers in Canada has been for the most part limited to evaluation of the functions of individual cities or, at most, to study of special groups of cities.[2] To the writer's knowledge no published studies exist which attempt to examine the functional character of Canadian cities by taking into consideration all principal cities and objectively relating the functional structure of each to that of the others. By dealing with all major Canadian centers in one study it was anticipated that an overview of the functional activity of the cities would emerge. Such an overview, it was hoped, would be a contribution to the knowledge of Canadian urban geography.

The study was macro in scale, consequently certain limitations were inherent in the work. The scope of the study prevented a detailed analysis of each city and individual urban activities. Consequently, the explanatory comments on the several distribution patterns of functional importance contain no "new" information; they are restatements of well known locational principles viewed in a

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[2]Three examples of such studies are: Louis Trotier, "Some Functional Characteristics of the Main Service Centers of the Province of Quebec," Cahiers de Geographie de Quebec, No. 6 (April-September, 1959), 243-259; J. Spelt, The Urban Development in South Central Ontario (Assen, The Netherlands: Van Gorcum & Company, 1955); Ira M. Robinson, New Industrial Towns on Canada's Resource Frontier (Chicago: University of Chicago, Department of Geography, 1962).

Canadian context. The contribution of the study lies, it is thought, in the way the data have been developed to obtain the overview of urban centers and their functions.

II. DEFINITIONS OF TERMS USED

City functional structure. The functional structure of a city was interpreted in this study as being the summation of all the socio-economic activity of a city. The units in the summation are the proportions of the city's labour force employed in all its different activities. In essence, "functional structure" has been equated with "employment structure" as it was thought that the activities in which a city's people earn their living are the best indicators of city functions. The terms "city activity" and "city function" were taken to be synonomous in this study.

Two kinds of functions were recognized when characterizing the functional structure of cities: distinctive functions and dominant functions. The distinctive functions in a city are defined as those activities whose proportions of the city labour force are extremely high in relation to their average proportions in all cities studied. They are very important in the functional structure or profile of the city relative

to their importance in other cities. The dominant function in a city is defined as the activity engaging the largest proportion of the city labour force. It is the most important function in the city's functional structure or profile, relative to the other functions in the city.

Canadian Regions: heartland and periphery. For the purpose of this study Canada was broken down into two regions; the "heartland" and the "periphery". The densely populated areas of the St. Lawrence Lowlands, the Eastern Townships and southern Ontario constitute the heartland and the remaining settled parts of Canada make up the periphery. The periphery has been divided into three components: the western periphery containing the four western provinces and northwestern Ontario; the "northern" periphery consisting of northern Ontario and Quebec; and the eastern periphery composed of the lower St. Lawrence area of Quebec and the Atlantic provinces. Areas not containing cities of ten thousand population and over were not considered; thus, the Northwest Territories and the most northerly areas of Quebec, Ontario, and the western provinces are ignored in this "regional system". Of the eighty Canadian cities studied, forty-five are in the heartland, fifteen in the western periphery, eight in the northern periphery, and twelve in the eastern

periphery. Figure 1 on page 56 indicates the regional location of the cities.

III. ORGANIZATION OF THE REMAINDER OF THE THESIS

The study was essentially an exercise in the classification of cities by functional specialization. This involved a problem in comparative analysis since cities of greatly different size and situation had to be dealt with on the same plane in the analysis. An important part of the study involved the development of classification techniques which make allowance for city size differences and the associated bias introduced in city functional structure. The techniques applied in the study were developed in similar studies carried out elsewhere, mainly in the United States. As in most works of this kind, census labour force statistics were used as the basic source material in the classification scheme.

Chapter I. The remainder of Chapter I is divided into two parts. The first part is a review of the literature on the functional classification of cities; the second is an outline of the methods and materials that were used in the study. In the literature review the various concepts, techniques and materials utilized in previous studies are examined. The problems encountered, both conceptual and

technical, are noted and a critique of the different approaches is offered. In the outline of methods and materials the approaches that were taken in this study to the problems of functional classification are briefly described. The detailed description of techniques is left to those chapters where they apply.

Chapter II. Because cities are multifunctional it was considered necessary to examine city functions in a systematic fashion as well as in terms of dominant activities so that no aspect of city functional structure remained hidden. Chapter II is devoted to a systematic discussion of the place of urban functions in Canadian cities. A measure of relative importance of urban activities in the functional structure of cities was developed in order that the objective of the chapter be met. In the first part of the chapter the measure of relative importance is outlined, and in the second part, the characteristics of urban functions and city functional structure are discussed. In the remaining section of the chapter the position of the functions in cities, as indicated by their relative importance, is discussed.

Chapter III. In Chapter III the distribution of city types in Canada is described and analyzed. To determine the patterns of city types and specialization, cities were classified by dominant function and degree of specialization. This discussion is the complement of that presented in Chapter II. Both views are required to provide a balanced view of urban functions and the functional structure of cities. The problem encountered here was the development of techniques suitable for identifying dominant functions and measuring the degree of city specialization. The techniques utilized in measuring the relative importance of functions were further developed to meet this problem.

Chapter IV. Chapter IV contains a summary of the findings of the preceding chapters and a concluding statement giving an assessment of the approaches and techniques of functional classification of cities.

IV. REVIEW OF THE LITERATURE ON FUNCTIONAL CLASSIFICATION OF CITIES

Qualitative Studies

The first studies to examine urban functions and to classify cities by function were made late in the nineteenth and early in the twentieth

centuries.[3] These first attempts at functional classification were based on qualitative analysis. Statistical data necessary for quantitative study were not available, their appearance having to await the development of modern enumeration devices. These first studies, while unable to classify cities with any real objectivity, were important however, because they provided a great deal of preliminary information on urban functions and city functional structure. Classic among these works is the study of M. Aurousseau on urban and rural characteristics.[4] In this report, Aurousseau presented theory on city existence and location that is still valid. He identified function as being the essential element of urban character and was able to relate the performance of urban functions to location.

> ...it is at once evident that function is the driving force in the life of towns.... A town comes into being either at a point having those characteristics of nodality which enable it to discharge that particular function to the best advantage or at a point artifically endowed with nodality.[5]

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[3]Many of these early studies are cited in: C.D. Harris, "A Functional Classification of Cities in the United States," Geographical Review, XXXIII (January, 1943), 86-99; P.E. James and C.F. Jones (eds.), American Geography: Inventory & Prospect (Syracuse: Syracuse University Press, 1954), pp. 143-44; G. Alexandersson, The Industrial Structure of American Cities (Lincoln, Neb.: University of Nebraska Press, 1956), pp. 20-21.

[4]M. Aurousseau, "The Distribution of Population: A Constructive Problem," Geographical Review, XI (October, 1921), 563-92.

[5]Ibid., 569.

He went further to identify six functions that urban centers perform and presented comments on the structure and location of cities of specific functional type. Recognition was also given to the fact that urban centers, although essentially multifunctional, usually have one dominant function.

> Within the national boundary are numerous urban groups which exist for the exercise of the following six functions: administration, defense, culture, production, communication, recreation.... as all towns are placed in nodal situations, many are conveniently situated for the discharge of more than one function. There is generally one phase of activity, however, which overshadows the rest.[6]

Aurousseau's comments on the character of urban activities are especially significant. Later theories on urban character were anticipated when he spoke of "primary" and "secondary" occupations existing in cities; the former concerned with the basic function of the city, the later concerned with the maintenance of the labour force engaged in the primary occupations.

These early investigators, by identifying the major urban functions and noting, in preliminary fashion, the relationship between functional performance and location laid the groundwork in the development of theory necessary for the rational classification of cities. Their contri-

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[6] Ibid.

butions were further refined in a later study by Harris and Ullman.[7] These authors recognized, as had earlier writers, that the existence of cities depends on the service they perform for their hinterlands. They noted the close association existing between functions and locational factors and were able to present a classification of cities based on the locational characteristics of functions. This classification, containing three categories, represents a keen insight into the role of cities and implicated all the primary or basic functions cities perform. The categories were:

1. Cities as central places performing comprehensive services for a surrounding area....
2. Transport cities performing break-in-bulk and allied services along transport routes, supported by areas which may be remote in distance, but close in connection because of the city's strategic location on transport channels....
3. Specialized-function cities performing one service such as mining, manufacturing, or recreation for large areas, including the general tributary areas of hosts of other cities....[8]

The multifunctional character of cities was also acknowledged by the authors in the statement that, "most cities represent a combination of the three factors

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[7]C.D. Harris and E.L. Ullman, "The Nature of Cities," Annals of the American Academy of Political and Social Science, CCXLII (November, 1945), 7-17.

[8]Ibid., 7-9.

[central place services, transport services, special-function services], the importance of each varying from city to city."[9]

Further clarification of the origin, character, and locational aspects of urban functions important to city classification has resulted from work in fields allied to geography. The economist, R.U. Ratcliff, in a succinct explanation of the economics of urbanization, identified the fundamental forces of urbanization, described the primary and secondary functions, and related them to locational factors.[10] He states that, "the explanation of the urban organization of society will be found in the socioeconomic activities that require the concentration of people, buildings, and machines within relatively small areas".[11] Although recognizing social forces as being the first urbanizing factors--survival, as well as religious and administrative activities demanded places of defense and assembly--he states that in the modern industrial state, economic forces are the principal urbanizing factors. "The

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[9] Ibid.

[10] R.U. Ratcliff, Urban Land Economics (New York: McGraw-Hill Book Company, 1949), pp. 19-59.

[11] Ibid., p. 20.

activities of man that are fundamental as agglomerative forces in the formation of cities are.....extraction, manufacturing, and trade".[12] Ratcliff observes, as did Aurousseau, that other functions occur in cities; those secondary activities that service the primary functions. These are identified as: financial, business, personal and professional services. The social functions: administrative, religious, cultural, and recreational activities, that led to the development of the first urban centers are, for the most part, also secondary functions having been relegated to this position by the emergence of the industrial state. Only in isolated cases do they continue to play their former roles of primary city functions.

The distinction made in the early studies between primary and secondary functions was given formal recognition in the economic base theory, formulated in the late 1920's and refined in the 1930's and 1940's. The main points of this theory have been outlined concisely by Pfouts:

> This theory may be characterized briefly by saying that it divides urban economic activity into two categories: exporting industry that brings money into the community from the outside world and

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[12] Ibid., p. 29.

> non-exporting industries whose goods and services are sold within the community. The exporting industries are referred to as basic industries and the non-exporting industries are called service industries.[13] It is also contended in discussions of the theory that the exporting or basic industries provide the source of urban growth; they are "city building" industries.[14]

J.W. Alexander has outlined three geographic qualities of the theory which have relevance to the classification of cities.[15] He states that the theory: (1) reaffirms the relationship between city and hinterland by providing a view of economic ties which bind a city to other areas; (2) permits the most satisfactory classification of cities in terms of regional function:

> Cities are more accurately distinguished by their basic economy than by their total economy because the basics express a city's service to its region. For such purpose, the nonbasics 'cloud the picture' and therefore should be subtracted from the total economy as one endeavors to distinguish industrial cities from commercial cities from government cities, etc.[16]

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[13] Sometimes called "nonbasic industries".

[14] R.W. Pfouts (ed.), The Techniques of Urban Economic Analysis (West Trenton, New Jersey: Chandler-Davis Publishing Company, 1960), p. 1. For additional comment on the economic base theory see: W. Isard et al., Methods of Regional Analysis: An Introduction to Regional Science (Cambridge, Mass.: The M.I.T. Press, 1960), pp. 189-205.

[15] J.W. Alexander, "The Basic-Nonbasic Concept of Urban Economic Functions," Economic Geography, XXX (July, 1954), 246-61.

[16] Ibid., 251-252.

Thirdly, the "basic-nonbasic ratio"--the ratio between total labour force in basic activity and total labour force in nonbasic activity--may be of significance in distinguishing types of cities since different types of cities appear to have different ratios.

Several intensive studies of individual cities were conducted in the 1940's using the concepts of the economic base theory.[17] Although these studies revealed much about the economic profiles of individual cities, certain technical and conceptual problems emerged with the application of the theory. It was found difficult to determine what was basic and what was nonbasic activity, and then more difficult to develop measures for separating basic from nonbasic activity. These problems precluded the use of the "basic-nonbasic ratio" as a criterion in differentiating city types in studies involving the comparative analysis of many cities. More significant in placing limitations on the usefulness of the theory has been the criticism levelled at certain conceptual aspects of the theory, especially that directed at the proposition that the basic activity of a city may be used as a criterion in predicting city growth.[18] Regardless of the shortcomings of the

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[17] Ibid., 255-259.

[18] For critiques of the economic base theory see: Pfouts, op.cit., pp. 213-341.

theory however, some of its concepts have been useful in the identification of distinctive and dominant functions in cities. Many analysts interested in classifying cities have based at least some parts of their classification scheme on concepts of the economic base theory. The influence of the theory is evident in such statements as "...'the city serving structure' was subtracted from the total structure before the classification was made",[19] and "the problem of functional classification is best undertaken by considering functional specialization in terms of the kinds of export activity of a community which creates an inflow of money to the community."[20]

The division of city functions into basic and service categories has resulted in some interesting observations regarding the place of the two components in the functional profile of cities. Alexandersson has noted that the distribution patterns of urban activities among cities can be grouped into two broad types: sporadic and ubiquitous distributions.[21] He termed those activities

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[19]Alexandersson, op. cit., p. 22.

[20]O.D. Duncan and A.J. Reiss, Jr., Social Characteristics of Urban and Rural Communities: 1950 (New York: John Wiley & Sons, 1956), p. 216, cited by E.D. Duncan et al., Metropolis and Region (Baltimore: The Johns Hopkins Press, 1960), p. 34.

[21]Alexandersson, op. cit., pp. 13-14.

which are not represented in many cities, but assume very important or dominant roles in some cities as being sporadic activities. Activities that are found in all cities were considered ubiquitous activities; only infrequently do these functions occupy distinctive or dominant positions in city functional structure.

Generally the sporadic activities can be considered as being basic functions. The very character of their distributions suggest they are exporting activities since when they do occur it is usually in great magnitude and they tend to dominate the functional profile of a city. Mining is an example of a sporadic activity; its importance is non-existent or insignificant in most cities, but in a few it occupies the position of extreme importance, being the sole basic activity of the city.

The characterizing of the ubiquitous functions as being either basic or service is somewhat more complex. Barring special circumstances however, most ubiquitous activities can be considered service functions. Only when certain characteristics of the sporadic-type distributions "invade" the normal ubiquitous pattern is this not valid. For example, all cities have an education function. In most cities this is a service function (city-serving), hence, the relative importance of the

function among cities remains relatively constant. Highly specialized college towns, however, do not fit the pattern. They have atypically high values for the education function. In this case an activity, normally found to be service or city-serving in character, has assumed the role of a basic or city-forming function. This characteristic of the sporadic activities found occasionally in the distribution patterns of primarily ubiquitous functions allows the isolation of those instances where activities normally considered secondary functions have assumed the role of primary activities.

These observations on the relationship between basic and service functions, and sporadic and ubiquitous distributions have provided an important aid in the identification of distinctive and dominant functions in cities as well as in supplying insight into the role of individual activities in many cities.

To summarize, the contributions of the qualitative studies, significant to city functional classification, are noted in the form of observations on cities and city functions which the studies have made possible. These observations have provided the foundation on which city classification, utilizing statistical data, has been built.

(1) <u>function</u> is the essential element of urban character.

(2) urban functions are those activities that require the concentration of people, goods, and services in small areas for their performance.

(3) cities are essentially multifunctional, but usually they have one and sometimes several dominant functions.

(4) city function and location are closely related because the existence of a city depends on the functions it performs for:

  (a) its immediate hinterland (central place functions).

  (b) the nation (transport and special-function services).

(5) trade, manufacturing, and extraction are the most important urban activities in an industrialized state.

(6) urban activities can be divided into two components: basic and service. Basic activities are the "exporting", "city-forming" or "primary" activities of the city. Service activities are the "non-exporting", "city-serving" or "secondary" activities which maintain the basic functions. Cities are best classified by their basic activities, since they are the raison d'etre of

the city and illustrate most clearly the functional relationship between the city and its hinterland, and the state.

(7) The distribution patterns of urban activities among cities usually approximate one of two patterns: sporadic or ubiquitous. Basic activities are usually characterized by sporadic patterns, whereas service activities usually have ubiquitous distributions. The fact that service activities are ubiquitous confirms the concept that cities are multifunctional, all having a standard repertoire of service functions. The sporadic distribution patterns of the basic activities illustrate the variability among cities in their functional roles within the state. The specific functional role a city fulfills is determined by its site and situation, and the economy of the state.

It now remains to be seen how these observations have been utilized in the classification of cities by quantitative means.

Quantitative Studies

The findings of the early qualitative studies established the fact that function is the key to an understanding of city existence and location. Once

detailed statistical data on cities were available it was possible to attempt the identification of distinctive functions in a large number of cities through quantitative study. The object was to identify distinctive and dominant functions, distinguish city types, and to relate the locational characteristics associated with specific functions to the actual locations of cities.

The first functional classifications of cities based on quantitative data appeared in 1943. C.D. Harris[22] classified all American cities of 10,000 population and over into eight city-type classes, and W. William-Olsson[23] published a classification of urban centers in northern Sweden in which towns were grouped into three categories. These two studies established the general format which most of the later works of similar type were to follow.

The majority of the studies to classify cities by function in the Harris-William-Olsson tradition appeared in the late 1940's and 1950's. They covered urban centers

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[22]C.D. Harris, "A Functional Classification of Cities in the United States," Geographical Review, XXXIII (January, 1943), 86-99.

[23]"Utredning angaende Norrlands näringsliv," Statens offentliga utredningar (1943:39), cited by G. Alexandersson, The Industrial Structure of American Cities (Lincoln, Neb.: University of Nebraska Press, 1956), p. 21. See also: W. William-Olsson, Ekonomisk-geografisk karta over Sverige (Economic geographical map of Sweden), Stockholm, 1946.

in the European countries, New Zealand and Japan as well as those in the United States and in a part of Canada.[24] These studies, with some notable exceptions, follow conceptual approaches to the problem similar to those used by Harris and William-Olsson, but they differ in technical detail from the first studies and from each other. A multitude of city types have been recognized and numerous ways of identifying distinctive functions have been established.

The one factor which identifies these studies as members of a distinct group of studies is their common

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[24]Alexandersson cites the functional classification studies carried out up to 1955. G. Alexandersson, The Industrial Structure of American Cities (Lincoln, Neb.: University of Nebraska Press, 1956), p. 21. Similar studies published on city functional classification since the appearance of Alexandersson's work include: I. Morrissett, "The Economic Structure of American Cities," Papers and Proceedings of the Regional Science Association, IV (1958), 239-56; L. Kosinski, "Problem of the Functional Structure of Polish Towns," Przeglad Geograficzny (Polish Geographical Review), XXXI (Supplement, 1959), 35-67, (in English); J.W. Webb, "Basic Concepts in the Analysis of Small Urban Centers of Minnesota," Annals of the Association of American Geographers, XLIX (March, 1959), 55-72; L. Trotier, "Some Functional Characteristics of the Main Service Centers of the Province of Quebec," Cahiers de Geographie de Quebec, No. 6 (April-September 1959), 243-259; E.L. Ullman and M.F. Dacey, "The Minimum Requirements Approach to the Urban Economic Base," Papers and Proceedings of the Regional Science Association, VI (1960), 175-194; Y. Watanabe, "An Analysis of the Function of Urban Settlements Based on Statistical Data - A Functional Differentiation Vertical and Lateral," The Science Reports of the Tokoku University (Geography), No. 10 (September, 1961), 63-94.

use of census data as the source material for classification. They are quite distinct from studies which utilize other data in addition to census material for classification purposes.[25] Usually the methods of analysis are more complex in these latter studies, hence, fewer cities are normally dealt with in them. This study is modelled after the former type where only one source of data is used, but where many cities are involved in the study.

The basic problems encountered when formulating city classifications based on statistical data include: (1) the choice of quantitative source material, (2) the selection of methods to identify distinctive and dominant functions in cities, and (3) the establishment of city-type classes. The classification schemes that have been developed using single sources for data, are discussed below in terms of these three problems.

Quantitative source material. The statistical data selected as source material for a quantitative study in city functional classification must meet two requirements.

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[25]Examples of such studies are: O.D. Duncan et al., Metropolis and Region (Baltimore: Johns Hopkins Press, 1960); M. Palomaki, The Functional Centers and Areas of South Bothnia, Finland (University of Helsinki, Publications of the Department of Geography, No. 35. Vammala, Finland: Vammalan Kirjapaino Oy, 1963).

They must be available in a standard form for a large number of cities, and they must be presented in a form that allows them to be grouped into classes which can be equated with specific urban functions. Comprehensive statistics covering all major cities in a state are found only in the national censuses, consequently most functional classifications of cities have been based on census data.

A question arises as to what type of census material should be used in measuring the importance of a function in a city relative to the other functions. Several possible bases are available, among them, figures on employment and value added. Discussion usually surrounds the choice of the most appropriate data for measures and often no agreement is reached among individuals on which are the best. This problem of selecting bases for measurement has been somewhat ameliorated by results of a study carried out by J.W. Alexander and J.B. Lindberg.[26] These results suggest that there is no significant difference among most measures available in the census, including data on employment and value added, for rating functional activity. Employment figures have been used almost exclusively in city functional studies. This has occurred

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[26] J.W. Alexander and J.B. Lindberg, "Measurements of Manufacturing: Coefficients of Correlation," Journal of Regional Science, III (Summer, 1961), 71-81.

primarily because data on value added are not as comprehensive and detailed as those on labour force, and labour force statistics are more easily related to population figures.

Two sets of labour force statistics are available in the censuses of most industrialized countries. One set, collected at place of residence and giving the number of workers classified by industry and occupation, usually appears in volumes of the Census of Population. The other set is collected from manufacturing and commercial establishments and gives the number of workers by place of work classified by industrial groupings. The latter statistics normally appear in censuses of manufacturing and commerce which are often carried out annually.

Most quantitative studies of city functions have utilized labour force statistics for place of residence classified by industry. Although an element of error is introduced by using figures collected by place of residence rather than place of employment, these figures are comprehensive, covering all a city's labour force.[27] Statistics

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[27]By using statistics collected by place of residence two assumptions are made: (1) most workers are employed in the city where they live, and (2) the character of the labour force commuting to jobs within the city from surrounding areas is similar to that of the labour force residing in the city. The errors introduced when using these statistics have been shown to be insignificant for the most part. See: J.F. Hart, Functions and Occupational Structures of Cities of the American South," Annals of the Association of American Geographers, XLV (September, 1955), 271.

given in censuses of manufacturing and commerce normally cover only the labour force in industry and trade; usually omitted are data on government and some professional groups. Statistics classified by industrial groups, rather than by occupation, are preferred in city functional study because census industrial categories are more readily equated with specific functions. For example, it is possible to obtain directly from the census tables on labour force classified by industry, the number of workers in manufacturing, wholesale trade, transportation and other functions. Census data grouped by occupation do not allow this ready conversion of census categories into city functional categories.

Included for summary purposes are Tables I and II illustrating, respectively, the kinds of source materials utilized in city functional studies, and a conversion of census industrial categories into city functional categories.

Methods of identifying functional importance. The methods developed to identify distinctive and dominant functions in city classification studies can be grouped into three broad categories: (1) those based on empirical observations, (2) those based on statistical measures such as means, and (3) those based on "minimum requirements."

TABLE I

EXAMPLES OF SOURCE MATERIALS UTILIZED IN QUANTITATIVE STUDIES OF CITY FUNCTIONAL STRUCTURE

Author of Study	Publication Year	Source Material
Harris[a]	1943	United States Bureau of the Census, Fifteenth Census of the United States: 1930. Population, Vol. IV, "Occupations" (Washington: Government Printing Office, 1933). United States Bureau of the Census, Census of Business: 1935. Retail Distribution, Vol. II, "County and City Summaries" (Washington: Government Printing Office, 1936); Wholesale Distribution, Vol. III, "Cities and Counties" (Washington: Government Printing Office, 1937). United States Bureau of the Census, Biennial Census of Manufacturers: 1935 (mimeographed press release for each state). Note: Because occupation figures were not classified by industry in the 1930 U.S. Census of Population, (for example, employment in trade was not broken down into wholesale and retail trade), Harris used employment figures, classified by industrial groups, from the Census of Business and Manufacturers as his main basis of classification.

[a]C.D. Harris, "A Functional Classification of Cities in the United States," Geographical Review, XXXIII (January, 1943), 86-99.

TABLE I (continued)

Author of Study	Publication Year	Source Material
Pownall[b]	1953	New Zealand Department of Labour and Employment, Location and Decentralization of Industry--District Office Returns, April, 1950. (Wellington, New Zealand: Department of Labour and Employment). Note: Twice yearly (April and October) the New Zealand Department of Labour and Employment collects statistics stating the number of workers gainfully employed in 69 different industrial codes, Pownall has used the April 1950 statistics as the basic material for his classification scheme.
Trotier[c]	1959	Dominion Bureau of Statistics, Ninth Census of Canada: 1951. Labour Force, Vol. IV (Queen's Printer, 1953). Note: The Census of Canada gives labour force statistics classified by industry and occupation for urban centres of 10,000 and over. Similar data on centers 1,000-10,000 population are available on request. Trotier based his classification on these labour force statistics classified by industry.

[b]L.L. Pownall, "The Functions of New Zealand Towns," Annals of the Association of American Geographers, XLIII December, 1953), 332-350.

[c]L. Trotier, "Some Functional Characteristics of the Main Service Centers of the Province of Quebec," Cahiers de Geographie de Quebec, No. 6 (April-September, 1959), 243.

TABLE I (continued)

Author of Study	Publication Year	Source Material
Hart[d]	1955	United States Bureau of the Census, Seventeenth Census of the United States: 1950. Population, Vol. II "Characteristics of the Population" (Washington: Government Printing Office, 1952).
Nelson[e]	1955	
Alexandersson[f]	1956	
Morrisset[g]	1958	
Webb[h]	1959	
Ullman & Dacey[i]	1960	
		Note: The 1950 U.S. Census of Population gives labour force figures classified by industry as well as occupation. This has allowed classification schemes to be constructed on this one source. No supplemental data are required as was the case when Harris developed his functional classification.

[d]J.F. Hart, "Functions and Occupational Structures of Cities of the American South," Annals of the Association of American Geographers, XLV (September, 1955), 268-286.

[e]H.J. Nelson, "A Service Classification of American Cities," Economic Geography, XXXI (July, 1955), 189-210.

[f]G. Alexandersson, The Industrial Structure of American Cities (Lincoln, Neb.: University of Nebraska Press, 1956).

[g]I. Morrissett, "The Economic Structure of American Cities," Papers and Proceedings of the Regional Science Association, IV (1958), 239-256.

[h]J.W. Webb, "Basic Concepts in the Analysis of Small Urban Centers of Minnesota," Annals of the Association of American Geographers, XLIX (March, 1959), 55-72.

[i]E.L. Ullman and M.F. Dacey, "The Minimum Requirements Approach to the Urban Economic Base," Papers and Proceedings of the Regional Science Association, VI (1960), 175-194.

TABLE II

EXAMPLE[a] OF CONVERSION OF CENSUS INDUSTRIAL CATEGORIES INTO CITY FUNCTIONAL CATEGORIES

Census Categories by Industry Groups	Functional Categories
Agriculture, Forestry, and fisheries	Omitted
Mining	Mining
Construction	Omitted
Manufacturing	Manufacturing
Railroads & railway express service	Transportation and communication
Trucking service & warehousing	Transportation and communication
Other transportation	Transportation and communication
Telecommunications	Transportation and communication
Utilities & sanitary service	Omitted
Wholesale trade	Wholesale trade
Food & dairy produce stores, & milk retail	Retail trade
Eating & drinking places	Retail trade
Other retail trade	Retail trade
Finance, insurance & real estate	Finance, insurance & real estate
Business services	Omitted
Repair services	Omitted
Private households	Omitted
Hotels & lodging places	Personal service
Other personal service	Personal service
Entertainment & recreation	Personal service
Medical & other health services	Professional services
Educational services, government	Professional services
Educational services, private	Professional services
Other professional & related services	Professional services
Public administration	Public administration
Industry not reported	Omitted

[a]Example is taken from H.J. Nelson, "A Service Classification of American Cities," Economic Geography, XXXI (July, 1955), 190. Census categories are from the 1950 U.S. Census of Population.

Representative of methods in category one is the one devised by C.D. Harris.[28] Harris' method calls for the examination of the labour force statistics of cities "of well recognized types."[29] On the basis of the percentage breakdown of the labour force employed in various industrial categories in these cities, he established specific percentage values for different functions which must be equalled or exceeded for the function to be considered dominant. For example, a city's manufacturing employment must be at least 60 per cent of the total employment in manufacturing, retailing, and wholesaling before manufacturing is considered the dominant function of the city. For wholesaling to be a dominant function, however, only 20 per cent of the labour force in manufacturing, retailing, and wholesaling must be employed in wholesaling.[30] As Harris was interested primarily in classifying cities by dominant function and only incidentally interested in the

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[28] Harris, op. cit., 86-89.

[29] Ibid., 87. Unfortunately Harris did not identify the cities "of well recognized types" that he selected and the criteria he uses to classify cities must be accepted on faith. The reputation that this classification study enjoys suggests that his choice was sound; however, this method of determining criteria for identifying functional importance is essentially subjective because of the judgment involved in selecting type cities.

[30] Ibid., 88.

relative importance of all functions in the city functional profile, he provided no means for evaluating functional relative importance within or among cities. Other analysts using methods similar to Harris' include Kneedler, Jones, and Hart.[31]

The methods used by Pownall, Nelson, Steigenga and Webb are representative of those in category two.[32] These methods are based wholly on statistical measures. Usually average percentage values of employment in various census industrial categories are calculated from figures for all cities under study and these values are used as a "normal

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[31] G.M. Kneedler, "Economic Classification of Cities," The Municipal Year Book, 1945 (Chicago: The International City Manager's Association, 1945), pp. 30-38, 48-68; V. Jones, "Economic Classification of Cities and Metropolitan Areas," The Municipal Year Book, 1954 (Chicago: The International City Manager's Association, 1954), pp. 31-36, 62-70, 81-108; J.F. Hart, "Functions and Occupational Structures of Cities of the American South," Annals of the Association of American Geographers, XLV (September, 1955), 269-286.

[32] L.L. Pownall, "The Functions of New Zealand Towns," Ann. Assoc. Am. Geog., XLIII (Dec., 1953), 332-350; H.J. Nelson, "A Service Classification of American Cities, "Econ. Geog., XXI (July, 1955), 189-210; W. Steigenga, "A Comparative Analysis and a Classification of Netherlands' Towns," Tijdsckrift voor Economische en Sociale Geografie, XLVI (1955), 105-19, cited by J.W. Webb, "Basic Concepts in the Analysis of Small Urban Centers of Minnesota," Ann. Assoc. Am. Geog., XLIX (March, 1959), 55; J.W. Webb, "Basic Concepts in the Analysis of Small Urban Centers of Minnesota," Ann. Assoc. Am. Geog., XLIX (March, 1959), 55-72.

structure" against which the employment structure of individual cities is compared. In some studies national percentage figures for labour force employed in various activities are selected as the "normal structure". The positive deviations of each city's percentage values from the "normal" or "expected" values for the respective industrial categories are measured to determine the relative importance of the various activities. Distinctive activities are usually determined by ranking city percentage values for activities according to their degree of deviation from the "norms"; the activity with the largest degree of deviation is considered the most distinctive function in the city.

Several refinements in methodology have been introduced in these studies. Pownall and Webb, in developing their "normal structures", have taken city size into consideration. They grouped the cities under study by size classes and calculated average percentage values for employment in census industrial categories for each of the city-size classes. Percentage values for individual cities were then compared with the average values of the appropriate city-size group. The division of cities into size groups was made on the assumption that city functional structure is modified with changes in city

size--a city of 10,000 population cannot be expected to have a functional role similar to that of a city of 100,000 population. This assumption has been proven to be correct.[33] Another refinement was provided by Steigenga and Nelson with their introduction of the standard deviation in the measurement of the deviation of city values from the "normal" or "average" values. The use of the standard deviation permits the comparison of the degree of functional variation, thus facilitating greatly the comparison of the relative importance of different functions in and among cities.

The methods in category three have been used in the most recent functional studies of cities, and are outgrowths of the economic base theory. One of the major points of the base theory is the breaking down of city functional activity into two components: basic and service sectors. In most of the early economic base studies attempts were made to identify what activities belonged in each sector. Often a tedious job was involved and results were not always satisfactory. Later students, the first to publish in English being Alexandersson, developed a new tact in utilizing the theory. While recognizing the dichotomous nature of city functional activity as stated in the economic

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[33]Morrissett, op. cit., 249-250

base theory, these students, rather than trying to allocate individual activities to either basic or service sectors, focused their attention on the question, what minimum proportions of employment in urban activities are required to keep the city viable? Alexandersson stated the question as,

> ....what ratios in different industries are a necessary minimum to supply a city's own population with goods and services of the type which are produced in every normal city?[34]

This approach to city functional study has been called the "minimum requirement approach". The minimum requirement of a city may be equated with its service or nonbasic sector. It is the "city-serving" sector. When using this approach to develop methods for identifying distinctive and dominant functions, the "minimum requirement" for each urban activity being studied must be calculated. These minimum values provide a "base structure" against which the values of individual cities can be compared. By measuring each city's degree of "excess" activity over and above the minimum values, a measure of "city-forming" activity is obtained, as well as a measure of functional importance.

Alexandersson determined the minimum requirements

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[34]Alexandersson, op. cit., p. 17.

--he termed them "k-values"--for census industrial categories by calculating the percentage of city labour force in the respective industrial categories and arraying each category's city values in increasing order. The city value at the 5th percentile in each of the arrays was then selected as the minimum requirement or "k-value". This value was selected rather than the lowest value in the array "to avoid extreme ratios representing such agglomerations .... [which] are not towns in the ordinary sense".[35] Alexandersson wished to avoid dormitory cities and other abnormal centers so that his "k-values" would, as nearly as possible, be representative of "normal" cities. Once the minimum requirements ("k-values") were calculated, the "excess" was determined in each activity for all cities under study. Activities were rated in terms of "excess" value, the activity experiencing the greatest excess being considered the dominant function.

A refinement to Alexandersson's work was contributed by Morrissett who investigated the effect of city size on minimum requirements. Using Alexandersson's method, Morrissett calculated a series of "k-values" for cities grouped by city-size classes. His work demonstrated that

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[35] Ibid.

city size has a real effect on city functional structure and should be taken into consideration when the minimum requirement of cities is being calculated.[36] He observed that:

(1) small cities are much less diversified than large cities.

(2) as population increases, diversification increases and specialization decreases.

(3) the proportion of persons employed in most industries is higher in large cities than in small. That is, the minimum requirement increases with city size.

(4) differences in functional structure is greater between small- and medium-sized cities than between medium-sized and large cities.[37]

Further refinements of Alexandersson's technique have been made by Ullman and Dacey.[38] Their method not only takes city size into consideration when calculating minimum requirements, but also provides a means of using

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[36]Trotier, in his study of Quebec centers, used Morrissett's "k-values" in determining the relative importance of urban functions. Trotier, loc. cit.

[37]Morrissett, loc. cit.

[38]Ullman and Dacey, loc. cit.

empirical data to determine the minimum requirement values. They selected at random a standard number of cities within specified city-size classes and calculated the percentage values for each city's labour force employed in fourteen census industrial categories. Within each size class the lowest city percentage value for each industrial category was noted. Once the minimum city values for an industrial category were known for each size class, they were plotted on semi-logarithmic paper against the logarithm of city population and a regression line was calculated for the points. The regression lines are used to read off the minimum requirement values in each activity for cities of all sizes.

This method would appear to be superior to Alexandersson's because it avoids the necessity of arbitrary choice in the selection of minimum requirement values--Alexandersson arbitrarily chose the 5th percentile values in his arrays of city values. The use of regression lines, rather than Alexandersson's "k-values", for determining minimum requirement values is especially desirable when only a small number of cities is being studied. If Alexandersson's method is used, the 5th percentile in the arrays of city values will often be the lowest value in the arrays and could well belong to

a city with an abnormal structure. In addition, Ullman and Dacey's method allows minimum requirement values to be calculated for each city on the basis of the city's exact population size rather than on the basis of city-size classes where broad ranges in city population are encountered, as in Morrissett's work.

City-type classes. In all classification problems the question arises as to what criteria should be used to classify individuals and what kinds of categories should be established. In city functional classification a concensus appears to have been reached regarding the kinds of criteria that should be used. Most analysts have used distinctive or dominant functions and/or degree of city functional specialization to classify cities. City-type classes, however, have varied greatly in kind and number among studies. This multiplicity has resulted from the necessity of basing classes on the city functions recognized, which in turn are based on census industrial categories. The specific city activities recognized, and hence the city-type classes formulated, depend on how the census industrial categories are subdivided and combined. As many as thirty-six census industrial categories have been recognized as separate city functions and used as

city-type classes (Alexandersson); in contrast, W. William-Olsson, using six census industrial categories, formulated only three city-type classes.

Despite the apparent diversity, systems of city-type classes can be characterized as belonging to either one of two types: systems using mutually exclusive city-type classes where a city appears in only one of the established categories, or systems using non-exclusive city-type classes where a city appears in as many categories as it has distinctive functions. The classification studies utilizing methods similar to those devised by Harris have been the major users of the mutually exclusive city-type classes, while investigators such as Alexandersson, Nelson and Webb have been advocates of non-exclusive city-type classes.

The classification systems using mutually exclusive classes, although offering the most compact and convenient form of classification, have one major disadvantage. Because cities appear in one city-type class only in these classification systems, the implication is made that cities are unifunctional when in fact they are essentially multi-functional in character. J.W. Webb has stated the criticism of this approach concisely.

> The finality of such terms as manufacturing town, retail trade center, and mining town seems to exclude the possibility that a mining town may also have a significant function as a retail trade center or as a manufacturing town.[39]

To avoid this problem most of the more recent studies have used non-exclusive city-type classes, thus recognizing that a city may be classified in terms of several specialities. Cities are characterized by listing their distinctive functions in order of relative importance and, in some studies, grouping cities by degree of functional specialization.

Table III gives examples of the two basic classification systems that have been used in city functional classification studies.

A critique of quantitative studies in city functional classification. The general methodology in city classification is clear. It is the objective of the classification process to identify what is "distinctive" in the functional profile of a city in comparison with other cities, to determine the dominant functions of cities, and to relate city functions to locations. As indicated in the preceding section, this has been done in most studies by (1) establishing "standards" of city functional structure

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[39]Webb, op. cit., 55

TABLE III

EXAMPLES OF CITY-TYPE CLASSES USED IN CITY FUNCTIONAL CLASSIFICATION STUDIES

Mutually exclusive city-type classes (a city appears in one category only)	Non-exclusive city-type classes (a city may appear in as many categories as it has distinctive functions)
Harris[a]	Nelson[b]
Manufacturing cities (2 sub classes divided on basis of manufacturing specialization)	Manufacturing
Retail centers	Retail trade
Diversified cities[c]	Diversified[c]
Wholesale centers	Wholesale trade
Transportation centers	Transportation & communication
Mining towns	Mining
University towns	
Resort and retirement towns	
	Professional service
	Personal service
	Public administration
	Financing, insurance and real estate

[a]C.D. Harris, "A Functional Classification of Cities in the United States," Geographical Review, XXXIII (January, 1943), 88.

[b]H.J. Nelson, "A Service Classification of American Cities," Economic Geography, XXXI (July, 1955), 196.

[c]a residual category is usually present in both systems of city-type classes. Cities which have no distinctive functions according to the definitions formulated in a study to determine functional importance are placed in the residual category. They are often referred to as diversified cities since no one function appears to be of major importance in them.

against which the functional structure of individual cities is scrutinized, and (2) using measures[40] of functional importance and specialization which are based on the established "standards", to classify cities into city-type classes. When carrying out these two steps certain qualities of city character should be considered if the classification scheme is to be effective.

Studies of urban character have revealed that function is the essential element of the city; that most cities are multifunctional; that cities have activities present in their functional profiles in different proportions; that city activity can be broken down into two components: basic and service. It has been noted that the service activities, with few exceptions, exist in all cities in relatively constant proportions. When exceptions do occur and an abnormally high proportion of a city's employment is in one of the service activities, it is usually found that the activity is operating in the capacity of a basic activity and not in its customary role of "city-server".

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[40]The units in these measures have been proportions of city employment in specified activities. It has been the practice in all studies to equate functional importance with proportions of city labour force employed in various census industrial categories. The conceptual aspects of this practice have been questioned, but in light of the findings of Alexander and Lindberg (loc. cit.), and in the absence of better procedures, this practice is accepted as the best means available for developing measures of functional importance.

The proportions of the different basic activities in cities have been shown to vary greatly among centers being reflections of the functional relationship existing between individual cities and their hinterlands--local, national, and international. It has also been observed that city size has a direct bearing on city functional structure.

These observations suggest that the "best" classification scheme will:

(1) use only basic activity in characterizing city functional profiles since only the basic activity reveals the relationship existing between city function and location.

(2) utilize "standards" of city functional structure that: (a) have some basis in theory, and (b) are designed to compensate for changes in city size.

(3) use measures of functional importance that are based on relative rather than absolute values in order that an unbiased comparison of functional importance in and among cities is made possible.

(4) use a system of city-type classes that provides for the recognition of the multifunctional character of cities by allowing cities to be classified in terms of several specialities.

The "standards" of city functional structure that have been established in classification studies include empirically derived structures (Harris), statistical measures (Pownall, Nelson, Webb), and minimum requirement profiles (Alexandersson, Ullman and Dacey). The empirical structures were the first to be used. They have the advantage of being taken directly from reality and in this respect enjoy an advantage over statistically derived profiles. This kind of standard, however, is only as good as the analyst's judgment in selecting cities representative of different functional types. Furthermore, using it and the associated system of city-type classes means that a city is characterized by its dominant function only; no account is taken of other functions that may be distinctive in the city functional profile. This procedure tends to negate the concept that cities are multifunctional. In addition, no allowance appears to have been made for differing city sizes in the studies using this kind of "standard".

The most frequent statistical measure to be used as a "standard" of functional structure has been the arithmetic mean. The mean enjoys the advantages of being easily and objectively determined, and the standard deviation, the best measure of deviation, is based on the

mean. Using the mean, analysts have been able to take city size into consideration by calculating means for a series of city-size classes and comparing a city's values for functional activity with the appropriate class means. By using deviation from the mean values of city activity as a measure of functional importance, cities have been classified in terms of all their distinctive functions rather than by dominant function alone, thus recognizing the multifunctional concept.

When using deviation from the mean as a measure of functional importance, relative rather than absolute values should be used. Pownall, in his study of New Zealand towns,[41] took city size into consideration by using mean values calculated for several city-size classes as his "standards", but he used absolute values of deviation to measure functional importance, thereby precluding effective comparison of functional activity in and among cities. This was improved on in such studies as Nelson's[42] where the standard deviation was used to measure functional importance, allowing the relative values of importance to be determined. Nelson, however, did not allow for changes in city size; he used one set of mean values for all cities studied regardless

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[41]Pownall, loc. cit.

[42]Nelson, loc. cit.

of population. J.W. Webb[43] has also used mean values as standards. He developed weighted location quotients[44] to get functional and specialization indices. These indices incorporated two distinct values: (1) the importance of the function in a city relative to its importance in all cities, and (2) the importance of the function in a city relative to the importance of other functions in the city. Although representing new uses of location quotients, these indices are of limited use as interpretative devices because of their complexity. The fact that two values are combined in the indices makes it impossible to ascertain the position of individual functions in cities without referring to the data from which the indices are derived.

The most serious technical difficulty in using the mean as a "standard" of city functional activity is associated with activities whose distributions of relative

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[43]Webb, loc. cit.

[44]Location quotients, taken in the context of Webb's study, are devices for comparing the importance of a function in an individual city with its importance in some basic aggregate (in the case of Webb's study, the aggregate was made up of mean values of functional activity in the cities studied). Relative measures are used. In essence a location quotient is a ratio of ratios. For example:

$$\frac{\frac{\text{Number of persons employed in given industry in the city}}{\text{Total number of persons employed in the city}}}{\frac{\text{Number of persons employed in given industry in all cities studied}}{\text{Total number of persons employed in all cities studied}}}$$

importance are highly sporadic. For these functions the means are misleading as "standards". For example, an activity that is not represented in 70 out of 80 cities under study, but has extremely high percentage values in the remaining 10 cities will have an unrealistically high value for a "standard". The 70 cities without the activity will be shown to be deficient in the function when in fact they may represent the "normal" situation.

The major conceptual disadvantage of the mean when used as a "standard" of functional activity is that it does not have a foundation in reality as does the empirically derived structure, nor a grounding in theory as has the minimum requirement profile. There is no reason for believing that the mean structure is the most typical or normal functional profile. In essence, it is a statistical abstraction which is difficult to interpret when used in this context.

Of the three kinds of "standards" established only the minimum requirement profile is based directly on theory. In the studies utilizing this "standard", a conscious attempt has been made to use only basic activity to characterize city functional structure; all other studies have used total city activity.

The first attempts to utilize minimum requirement profiles involved the use of relatively crude techniques. Alexandersson had to resort to arbitrary methods to determine his "k-values", and when measuring functional importance he used absolute rather than relative values.[45] In addition, although noting that city size affected the minimum requirement profiles of cities, his analytical method does not allow for changing city size. Despite the limitations of his techniques, Alexandersson was still able to classify

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[45]Alexandersson used fixed cut-off points of excess employment to rank activities by classes of importance, and ignored the variable quality of his base unit--the "k-values". He developed three classes of functional importance based on the amount of excess employment over the minimum requirement: "k" + 20.0 per cent, "k" + 10.0-19.9 per cent, and "k" + 5.0-9.9 per cent. Since "k-values" varied from 0.0 per cent to 8.0 per cent for different activities, his classes of functional importance discriminate against activities having only small percentages of city labour force even when highly concentrated in a city. For example, the "k-value" of activity A is 1.0 per cent of city labour force and a city has 5.0 per cent of its labour force in activity A. In this instance the excess employment is 4 per cent of city labour force or 400 times greater than the "k-value". In activity B the city has 18 per cent of its labour force, and the "k-value" for this activity is 8.0 per cent; therefore excess employment is equal to 10.0 per cent of city labour force or 125 times the "k-value". Despite the fact that the degree of concentration of activity A in the city is greater than that of activity B, "A" is not registered as a distinctive function because the "excess" employment does not exceed the "k-value" by 5.0 per cent of the city labour force. Activity B, although not as concentrated in the city as "A" in relative terms, has excess employment of 10 per cent thus placing the city in the second of the three classes of functional importance in terms of this function.

cities in terms of several specialities rather than by the dominant function alone.

As noted in an earlier section, Morrissett improved on Alexandersson's method by calculating "k-values" for cities grouped by size classes. By studying trends in "k-values" he was able to make several generalizations regarding the relationship between city size and functional structure. Although making a significant contribution in this study, Morrissett used Alexandersson's crude technique of arbitrarily selecting certain points in the arrays of city values to act as "k-values" or minimum requirement values. It was not until Ullman and Dacey's paper appeared that a fairly objective and rational means of determining minimum requirements was made available. The method presented in the paper conforms with most of the requirements associated with the "best" classification scheme. Only a procedure for evaluating the importance of a function in a city relative to its importance in all cities is omitted. Such a procedure can easily be developed by extending the use of some of the authors' data. Like Webb, Ullman and Dacey developed an index of specialization which allows cities to be ranked by degree of functional specialization, thus allowing a correlation to be made between kinds of distinctive and dominant functions and specialization.

To summarize it may be said that none of the studies cited has included all the best methods of analysis that have been presented; however, when they are taken together, the methodology is fairly complete. By selecting the best elements in each method it is possible to approximate most of the conditions laid down for a "best" classification scheme. In the next section is presented an outline of the method used in this study. It represents a partial synthesis of the methods described in this section.

V. METHOD OF STUDY

Cities studied. In 1951 there were 106 incorporated urban centers in Canada with populations of ten thousand and over. Many of these municipalities are in Census Metropolitan Areas and others, although not of metropolitan rank, are contiguous. By recognizing Census Metropolitan Areas as individual cities and grouping other contiguous municipalities to form single units, the total number of cities for this study was reduced to eighty. The clustering of adjoining municipalities allowed "geographical" rather than "legal" cities to be used, thereby obtaining a better approximation of "functional" centers.

Unincorporated urban centers of ten thousand population and over, as well as all cities under ten

thousand population were omitted from this study because the labour force statistics necessary for functional study are not published for them. Kirkland Lake (unincorporated; 1951 population: 18,392) is the only large center affected by this lack of data. Table IV gives the population and constituent municipalities or Census Metropolitan Area for all cities studied, and Figure 1 shows city location.

Source materials. Canadian census labour force statistics for place of residence classified by industry were utilized exclusively as source material in this study.[46] They represent the most comprehensive data available for city functional study. In addition, the form in which the statistics are presented allowed some of the key values derived in American studies of city functional structure to be utilized in analyzing Canadian cities.

Labour force statistics from the 1951 Census of Canada were used because the required labour force data for the 1961 Census of Canada were not available at the time the study was made. Since the emphasis of the project was on methodology as well as on fact finding, the use of somewhat dated source material was not thought to be a

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[46]Dominion Bureau of Statistics, Ninth Census of Canada: 1951. Labour Force, Vol. IV, Tables 17 and 21 (Ottawa: Queen's Printer, 1953).

TABLE IV

CITIES EXAMINED: POPULATION, LOCATION, AND LEGAL CONSTITUENTS

City[a]	Population (1951)	Location	Component Municipalities or Census Metropolitan Areas (C.M.A.)
Arvida	11,078	northern periphery	Arvida
Barrie	12,514	heartland	Barrie
Belleville	19,519	"	Belleville
Brandon	20,598	western periphery	Brandon
Brantford	36,727	heartland	Brantford
Brockville	12,301	"	Brockville
Calgary	139,105	western periphery	Calgary C.M.A.
Charlottetown	15,887	eastern periphery	Charlottetown
Chatham	21,218	heartland	Chatham
Chicoutimi	23,216	northern periphery	Chicoutimi
Cornwall	16,899	heartland	Cornwall
Drummondville	14,341	"	Drummondville
Edmonton	173,075	western periphery	Edmonton C.M.A.
Edmundston	10,753	eastern periphery	Edmundston
Fredericton	16,018	eastern periphery	Fredericton
Galt	19,207	heartland	Galt
Glace Bay	25,586	eastern periphery	Glace Bay
Granby	21,989	heartland	Granby
Grand'Mère	11,089	"	Grand'Mere
Guelph	27,386	"	Guelph
Halifax	133,931	eastern periphery	Halifax C.M.A.*

[a]"Geographical" rather than "legal" cities have been used where possible. Census Metropolitan Areas are considered as single cities, as are clusters of contiguous municipalities.

*C.M.A. for which unpublished data were supplied by the Dominion Bureau of Statistics.

TABLE IV (continued)

City	Population (1951)	Location	Component Municipalities or Census Metropolitan Areas (C.M.A.)
Hamilton	259,685	heartland	Hamilton C.M.A.
Joliette	16,064	"	Joliette
Jonquière	21,618	northern periphery	Jonquiere
Kingston	33,459	heartland	Kingston
Kitchener-Waterloo	56,858	"	Kitchener, Waterloo
Lethbridge	22,947	western periphery	Lethbridge
London	121,516	heartland	London C.M.A.*
Magog	12,423	"	Magog
Medicine Hat	16,364	western periphery	Medicine Hat
Moncton	27,334	eastern periphery	Moncton
Montreal	1,395,400	heartland	Montreal C.M.A.
Moose Jaw	24,355	western periphery	Moose Jaw
New Waterford	10,423	eastern periphery	New Waterford
Niagara Falls	22,874	heartland	Niagara Falls
North Bay	17,944	northern periphery	North Bay
Orillia	12,110	heartland	Orillia
Oshawa	41,545	"	Oshawa
Ottawa	281,908	"	Ottawa C.M.A.
Owen Sound	16,423	"	Owen Sound
Pembroke	12,704	"	Pembroke
Penticton	10,548	western periphery	Penticton
Peterborough	38,272	heartland	Peterborough
Fort William-Port Arthur	66,108	western periphery	Port Arthur, Fort William
Prince Albert	17,149	western periphery	Prince Albert
Quebec	274,827	heartland	Quebec C.M.A.
Regina	71,319	western periphery	Regina
Rimouski	11,565	eastern periphery	Rimouski
Rouyn	14,633	northern periphery	Rouyn

TABLE IV (continued)

City	Population (1951)	Location	Component Municipalities or Census Metropolitan Areas (C.M.A.)
St. Catharines	37,984	heartland	St. Catharines
St. Hyacinthe	20,236	"	St. Hyacinthe
St. Jean	19,305	"	St. Jean
St. Jérôme	17,685	"	St. Jerome (Terrebonne)
St. John's	67,749	eastern periphery	St. John's C.M.A.
St. Thomas	18,173	heartland	St. Thomas
Saint John	78,337	eastern periphery	Saint John C.M.A.*
Sarnia	34,697	heartland	Sarnia
Saskatoon	53,268	western periphery	Saskatoon
Sault Ste. Marie	32,452	northern periphery	Sault Ste. Marie
Shawinigan	26,903	heartland	Shawinigan Falls
Sherbrooke	50,543	"	Sherbrooke
Sorel	14,961	"	Sorel
Stratford	18,785	"	Stratford
Sudbury	42,410	northern periphery	Sudbury
Sydney	31,317	eastern periphery	Sydney
Thetford Mines	15,095	heartland	Thetford Mines
Timmins	27,743	northern periphery	Timmins
Toronto	1,117,470	heartland	Toronto C.M.A.
Trail	11,430	western periphery	Trail
Trenton	10,085	heartland	Trenton
Trois-Rivières	64,741	"	Trois Rivieres, Cap-de-la-Madeleine
Truro	10,756	eastern periphery	Truro
Valleyfield	22,414	heartland	Valleyfield (Salaberry-de)
Vancouver	530,728	western periphery	Vancouver C.M.A.
Victoria	104,303	western periphery	Victoria C.M.A.*

TABLE IV (continued)

City	Population (1951)	Location	Component Municipalities or Census Metropolitan Areas (C.M.A.)
Victoriaville	13,124	heartland	Victoriaville
Welland	15,382	"	Welland
Windsor	157,672	"	Windsor C.M.A.
Winnipeg	354,069	western periphery	Winnipeg C.M.A.
Woodstock	15,544	heartland	Woodstock

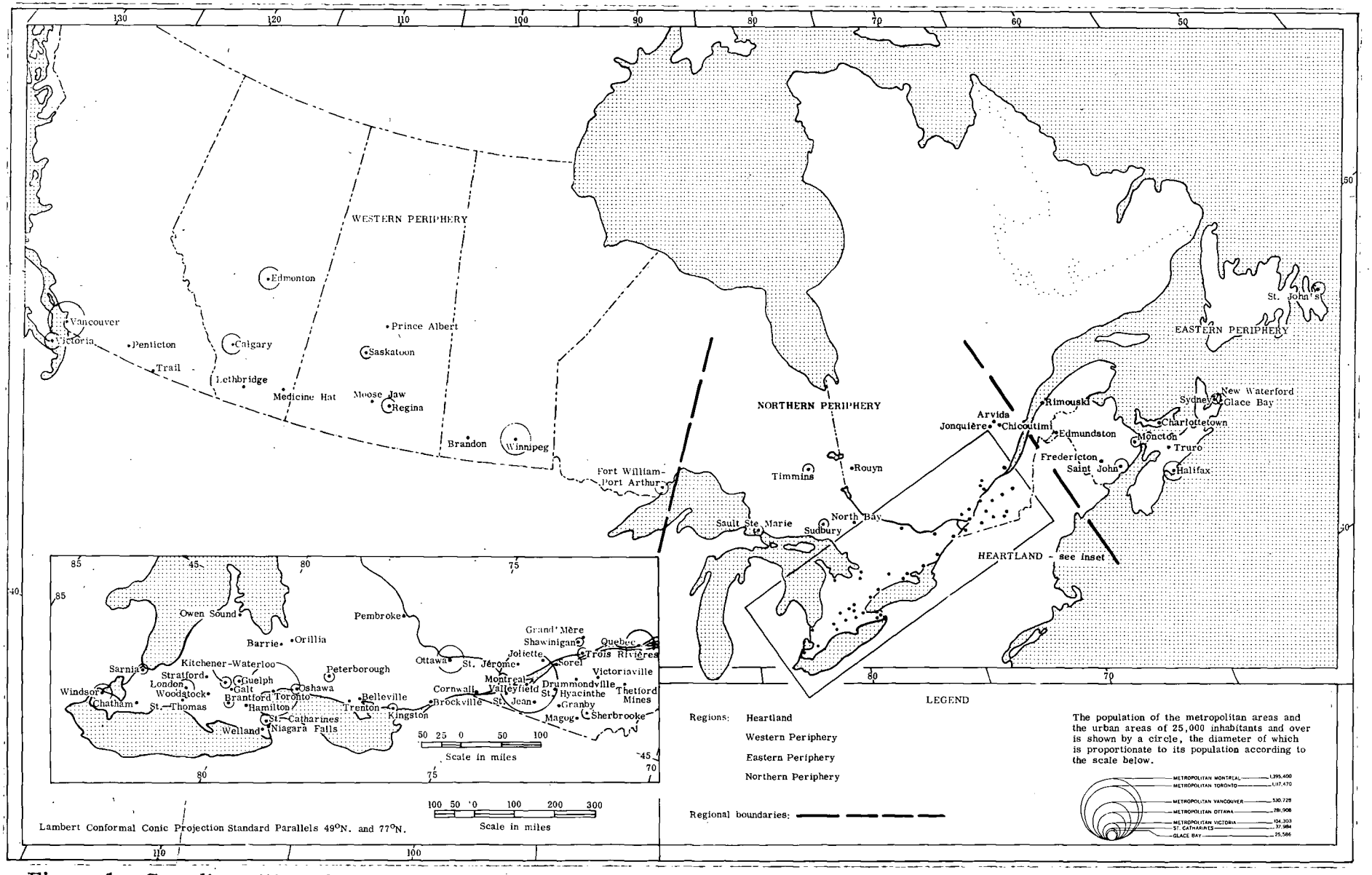

Figure 1. Canadian cities of 10,000 population and over, 1951.

serious limitation. The facts revealed in the study can be considered as "cross-sectional" views; they reveal the functions of Canadian cities at a particular point in time.

The 1951 Census of Canada breaks down the services performed by the labour force into twelve industry divisions which are further broken down into major groups. The first column of Table V lists all the census industry divisions and major groups which are relevant for this study. The second column of the table presents the city functions derived from the census categories for use in the study. Those census categories representing "rural functions" (functions which require broad surfaces for their performance) were omitted as urban activities since their inclusion in a city's employment structure depends on the arbitrary positioning of city boundaries. The "Not Stated" category was also omitted. The remaining census categories, and the respective functional classes derived from them, represent broad groups in the employment structure of the city. Although highly aggregated these categories are sufficiently detailed to distinguish in reasonably specific terms the functional character of cities. Also, by using these categories it was possible to draw on the techniques and findings of American studies in determining functional profiles because the classes can be equated with

TABLE V

CENSUS INDUSTRIAL CATEGORIES AND CITY FUNCTIONAL CATEGORIES USED IN THE STUDY

Census Industry Divisions & Major Groups significant to the study[a]	City Functions recognized in the study
Agriculture	Omitted
Forestry and Logging	Omitted
Fishing and Trapping	Omitted
Mining, Quarrying and Oil Wells	Extraction
Manufacturing	Manufacturing
Electricity, Gas, and Water	Public Utilities
Construction	Construction
Transportation, Storage, Communication	Transportation
Trade	
Wholesale Trade	Wholesale Trade
Retail Trade	Retail Trade
Finance, Insurance, and Real Estate	Finance, Insurance and Real Estate
Service	
Community Service[b]	Community Service
Government Service[c]	Government Service
Recreation	Recreation
Business Service[d]	Business Service
Personal Service[e]	Personal Service
Not Stated	Omitted

[a]Dominion Bureau of Statistics, Ninth Census of Canada: 1951. Labour Force, Vol. IV, Tables 17 and 21 (Ottawa: Queen's Printer, 1953).

[b]"Community Service" includes labour force in education, health, religion and welfare work. Includes government personnel and persons employed by private agencies doing work in health, welfare and educational fields.

[c]"Government Service" includes labour force employed in work peculiar to public service only.

[d]"Business Service" includes labour force employed in accounting, advertising, engineering and scientific services, labour and trade organizations, law, and other business services.

[e]"Personal Service" includes labour force employed in barbering and hairdressing, dry cleaning and laundry, restaurants, motels and hotels, private households, undertaking, photography, and other personal service.

those used in similar studies carried out in the United States.

Methods of analysis. To meet the objectives of the study the analytical techniques selected had to make it possible to:

(1) determine the importance of a function in a city relative to its importance in all cities.

(2) determine the importance of a function relative to other functions in a city.

(3) determine the degree of functional specialization in a city.

None of the studies discussed fulfills all these requirements; however, by combining some of the techniques that have been developed, it was possible to meet the three requirements enumerated. The Ullman-Dacey method of city functional study conforms most closely to theoretical concepts; it was adopted as the basis of the method utilized in this study. Despite their advances these authors did not, as had earlier analysts, devise a measure of the importance of a function in a city relative to its importance in all cities; consequently, Nelson's use of the standard deviation was applied to achieve this end.

The "standards" of city functional structure established for this study are based on Ullman and Dacey's

minimum requirement profiles. When possible, the minimum requirement values calculated by these authors were used in this study as they are thought to be more representative of the "normal" situation than similar values for Canadian cities. Ullman and Dacey's values are based on random samples of American cities and take into consideration a great many more cities than can be considered when Canadian cities form the basis of the values.

In this study, as in all studies based on the minimum requirement approach, employment over and above the minimum employment necessary to keep the city viable is equated with basic activity. Functional importance was determined by the amount of "excess" employment in a function.

To determine the importance of functions in a city relative to their importance in all cities, mean values of excess employment for all functions were calculated and the standard deviations obtained. The amount of excess employment for each function in a city was then stated in terms of standard deviations--a function might have an excess employment value less than one standard deviation, between one and two, or over two standard deviations above the mean. By ranking functions in terms of standard

deviations of excess employment, a technique for measuring functional importance using relative values was obtained. This allowed a comparison to be made of the relative importance of different functions among cities, and provided a way of determining a city's distinctive functions. This system is similar to that used by Nelson in determining distinctive functions, except that only basic activity, rather than total city activity, was used in the measurement.

Ullman and Dacey's method of identifying the dominant function in cities was used. The importance of functions relative to other functions in a city was determined by ranking activities according to their percentage share of total city excess employment. The function having the largest percentage share was presumed to be the dominant activity.

City functional specialization was determined in relative terms by using a specialization index devised by Ullman and Dacey. This index is based on the distribution of city excess employment among the various functions; the index value depends on the degree of "evenness" or "unevenness" in the distribution.

Summarizing, the methods outlined here in general form make possible the determination of a city's distinctive

functions, dominant function, and degree of functional specialization, three characteristics which had to be determined to meet the objectives of the study.

CHAPTER II

THE RELATIVE IMPORTANCE OF URBAN FUNCTIONS IN CANADIAN CITIES

Because cities are multifunctional it is desirable to study them not only in terms of their dominant functions, but also in terms of their relative strength in all the functions cities perform. This is best accomplished by examining systematically the role of urban functions in all cities.

It was the purpose in this chapter to develop a measure giving the importance of a function in a city relative to its importance in all cities and, using this measure, to determine, describe, and analyze the distribution of relative importance for functions among cities. The methods of Ullman and Dacey, and Nelson, outlined in the preceding chapter, were utilized to develop the measure.

In the first part of the chapter, the measure of functional importance is described. In the second section certain observations regarding the proportions of city labour force in different functions are made, and the reactions of functions to changes in city size are noted.

The balance of the chapter deals with the distribution patterns of functional relative importance.

I. A MEASURE OF FUNCTIONAL IMPORTANCE

The "standards". Minimum requirement profiles were used as "standards" in this study. For each of the eighty cities under study the percentage of the urban labour force[1] in each of thirteen census categories was calculated. The cities were then divided on the basis of population into four arbitrarily determined size-groups:

group one:	10,000 - 19,999	population	35 cities
" two:	20,000 - 29,999	"	15 cities
" three:	30,000 - 99,999	"	17 cities
" four:	100,000 & over	"	13 cities

For every function (census category), the percentage figure for the city with the minimum per cent employed in each city group was noted. For example, the lowest proportion of city labour force employed in manufacturing for the cities of group one is 2.7 per cent (New Waterford); of group two, 5.2 per cent (Glace Bay); of group three, 11.8 per cent (Regina); and of group four, 12.4 per cent

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[1]Urban labour force is defined as total labour force minus the labour force in the "Agriculture", "Forestry and Logging", "Fishing and Trapping", and "Not Stated" categories of the 1951 Census of Canada industry classification.

(Halifax). Table VI shows the minimum percentages employed in cities of the varying size-classes for each of the functions (census categories) recognized. Ullman and Dacey consider such values to represent the empirical minimum requirements for a viable city, that is, the service or nonbasic sector of city activity[2].

As noted in the review of the literature minimum requirement values are modified by changes in city size. In order to relate these values to city size, Ullman and Dacey plotted the minimum values in their city groups for each activity against the logarithm of city population and calculated linear regression equations for the plotted points.[3] By reading minimum requirement values off the regression lines extreme values representative of "abnormal" cities are avoided. Also, by using the regression lines, the values are determined according to a city's exact population rather than by a broad population class. This procedure has been followed in this study. The minimum requirement values given in Table VI were plotted against

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[2]Ullman and Dacey, "The Minimum Requirements Approach to the Urban Economic Base," Papers and Proceedings of the Regional Science Association, VI (1960), 177.

[3]When minimum requirement values were plotted against the logarithm of population, Ullman and Dacey found that the plotted points closely fit a straight line.

TABLE VI

MINIMUM PERCENTAGES EMPLOYED IN CANADIAN CITIES OF VARYING SIZE CLASSES, 1951

Function (Census Category)	Cities (population in thousands) 10.0-19.9 (35 cities)	20.0-29.9 (15 cities)	30.0-99.9 (17 cities)	100 & over (13 cities)
	- per cent of city urban labour force* -			
Extraction	0.0	0.0	0.0	0.0
Manufacturing	2.7	5.2	11.8	12.4
Public Utilities	0.4	0.5	0.6	0.8
Construction	1.8	3.3	4.0	5.8
Transportation, etc.	2.4	3.2	3.6	5.1
Wholesale Trade	0.4	1.0	1.5	3.0
Retail Trade	4.2	8.3	9.1	10.3
Finance, Insurance, & Real Estate	1.1	1.1	1.7	2.5
Community Service	4.7	5.3	5.1	5.7
Government Service	1.9	1.6	2.5	3.0
Recreation	0.2	0.4	0.4	0.4
Business Service	0.2	0.3	0.6	1.2
Personal Service	4.4	4.0	4.2	5.4
Total	24.4	34.2	45.1	55.6

Source: Calculated from the Ninth Census of Canada, 1951

*Urban labour force is defined as total labour force minus the labour force in the "Agriculture", "Forestry and Logging", "Fishing and Trapping" and "Not Stated" categories of the 1951 Census of Canada industry classification.

the logarithm of city population and linear regression equations were calculated for the plotted points. The values as given by the regression equations are considered to represent the "expected minimum requirements" for cities. The term "expected" is used because, by definition, some of the city minimum values will fall below those given by the regression lines.[4]

Because the minimum city-labour-force percentage values identified, and the regression lines based on them, depend on how the cities are grouped into population size-classes, a second grouping of cities, using different class intervals, was made and regression equations calculated for the minimum city percentage values subsequently selected. This was done to ascertain the effect of arbitrarily grouping cities in determining minimum percentage values. Six classes were used in the second grouping scheme in contrast to the four used in the original scheme. Emphasis in the second scheme was placed on differentiating at the higher population levels. Where in the first grouping scheme, cities above 30,000 population were divided into only two classes ("30,000--99,999" and "100,000 & over)

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[4]Regression lines represent the "average" fit, therefore the extremely high and low point values on which lines are based, will not fall on the lines.

in the second grouping, cities over 25,000 were divided into four categories. The classes used in the second scheme were:

group one:	10,000 - 14,999	population	18 cities
" two:	15,000 - 24,999	"	27 cities
" three:	25,000 - 49,999	"	14 cities
" four:	50,000 - 99,999	"	8 cities
" five:	100,000 -299,999	"	9 cities
" six:	300,000 & over	"	4 cities

Once the equations for the regression lines had been calculated, they were graphed. The Ullman—Dacey regression equations for those activities having equivalence in the Canadian and American censuses were also plotted; six of the thirteen functions recognized are in this category. The diagrams in Figure 2 show the relationship of the regression lines to each other for twelve of the thirteen functions. Because "extraction" has minimum requirement values of zero in all city-size classes, regression lines were not needed to determine minimum values for this function.

Comparison of the two sets of regression lines derived from Canadian data suggests that the effects of arbitrarily determining the city-size classes are, for the most part, not particularly significant. For most activities the lines are remarkable similar. There is one trait, however, in which the two sets of lines appear to differ consistently--the degree

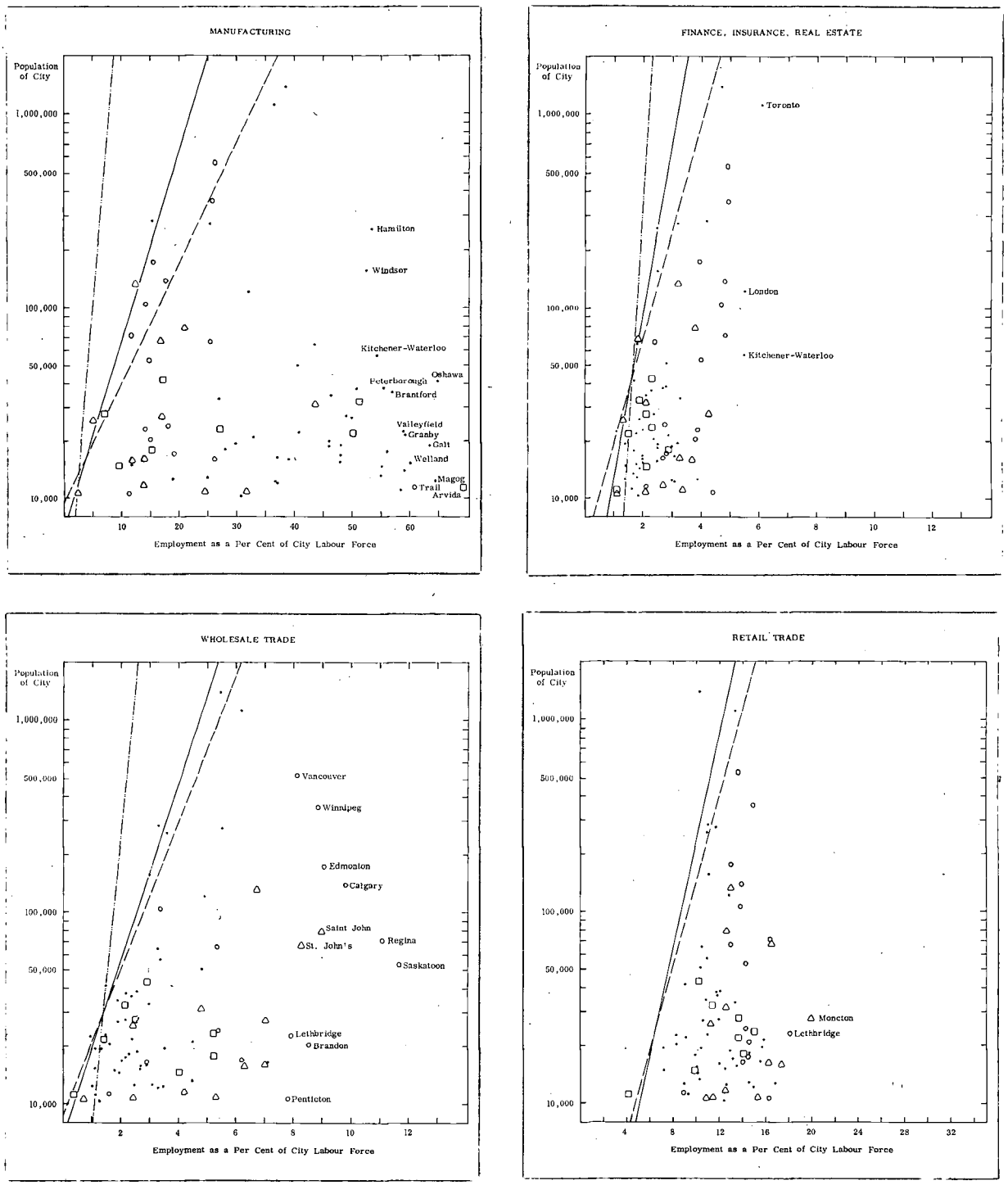


Figure 2. The relationship of functional importance to city size, and regression lines showing "expected minimum requirement values" for functions.

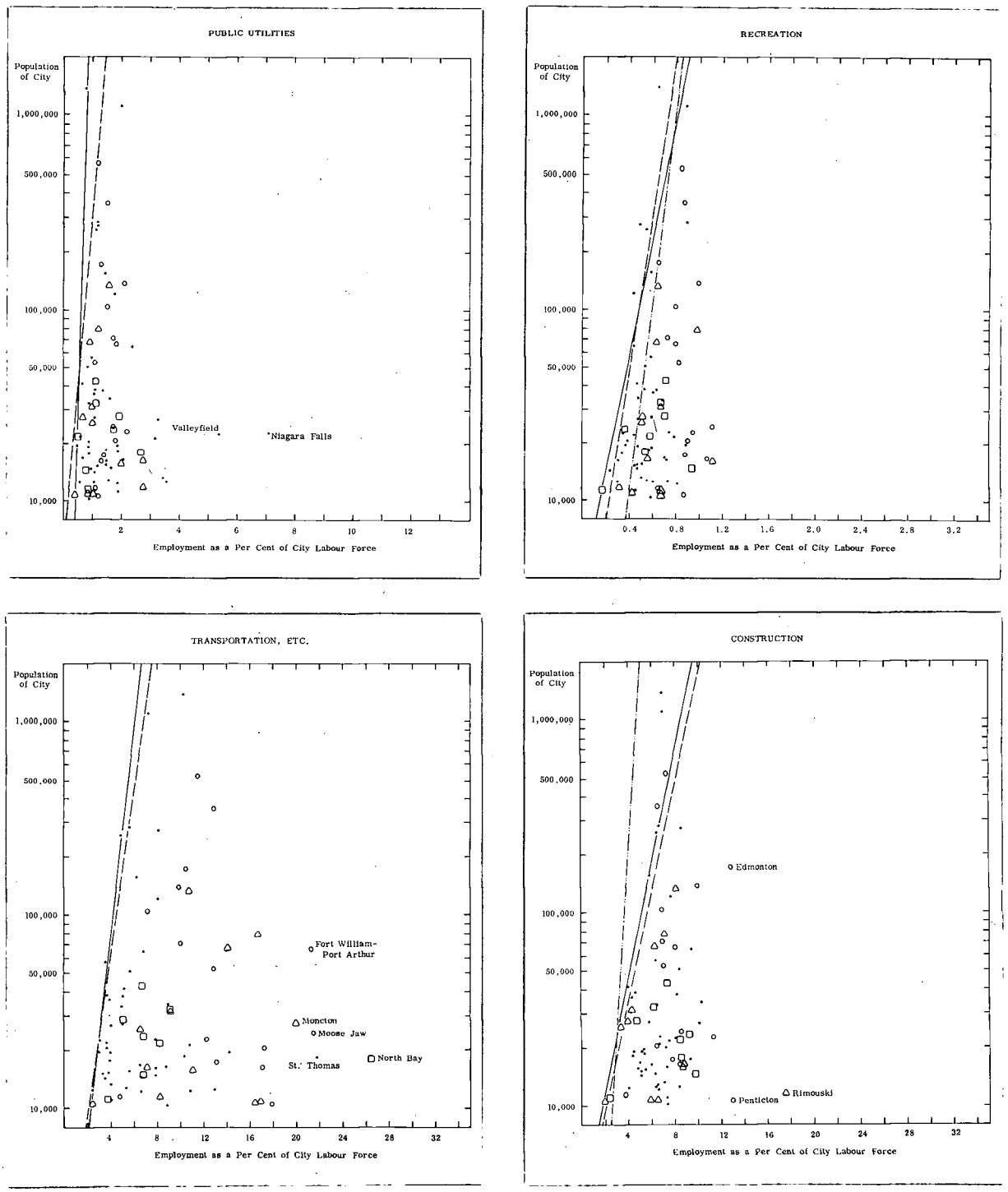
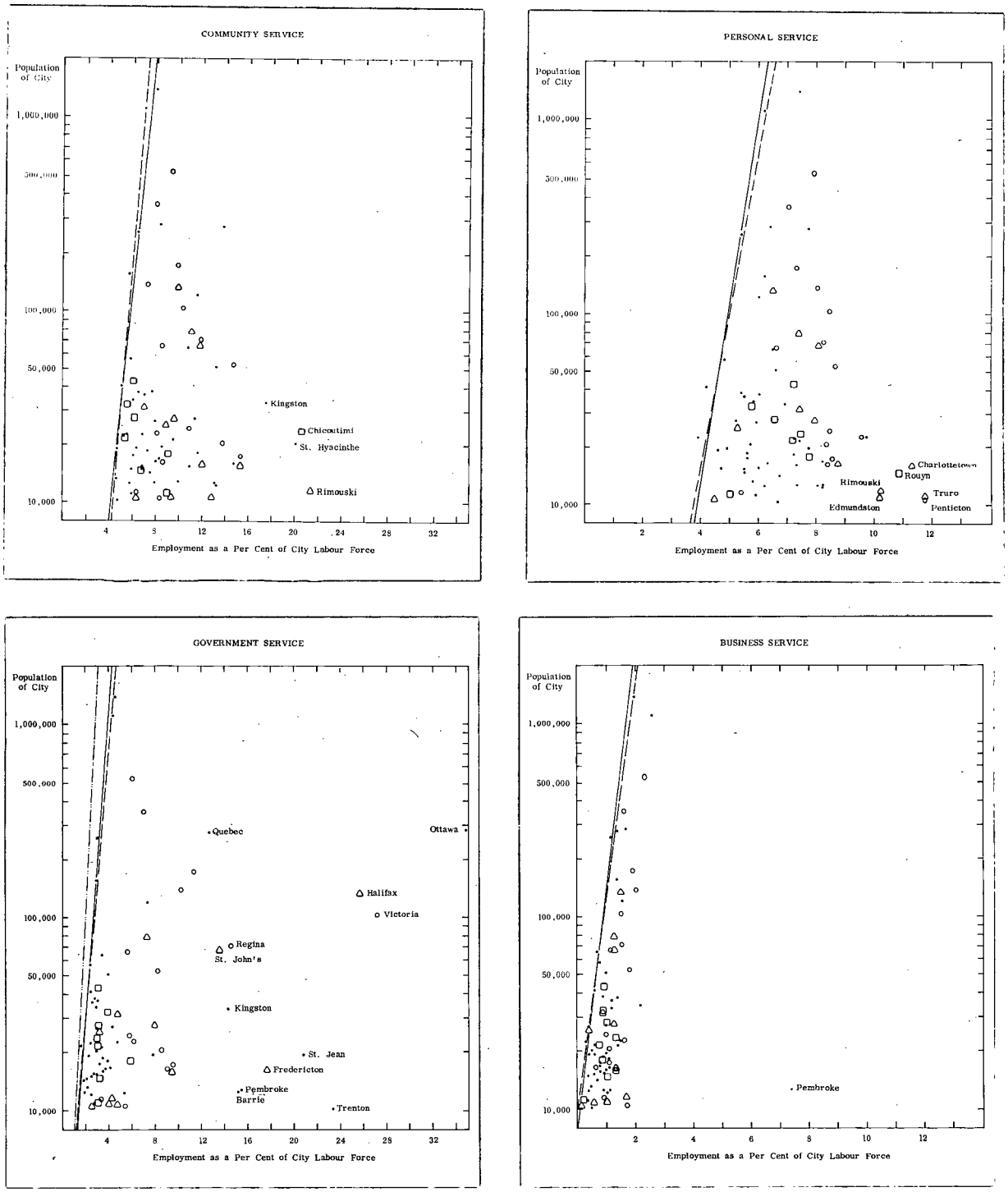


Figure 2. (continued)



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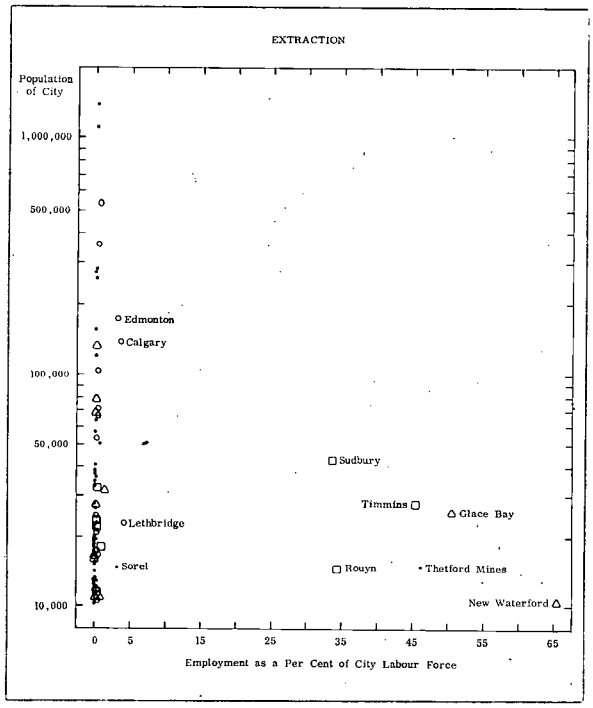

Cities*

•---Heartland
o---Western Periphery
△---Eastern Periphery
□---Northern Periphery

* See Figure 1 for the locations of cities and regional boundaries

Regression lines giving "Expected Minimum Requirement Values"

Ullman - Dacey values: ——·——·——
Canadian values
four city classes: ————————
six city classes: — — — — —

FORMULAE OF THE LINEAR REGRESSION EQUATIONS GIVING THE "MINIMUM REQUIREMENT" VALUES FOR EMPLOYMENT IN FUNCTIONS FOR CITIES OF ALL POPULATION SIZES.

Note: All equations are of the form: $\log y = a + b x$. Where y is city population and x is the minimum requirement value of employment in percent of city labour force.
Solving for x:

$$x = \frac{\log y - a}{b}$$

The y-intercept and slope values of the regression equations for each of the functions are:

Function	y-intercept (a)			slope (b)		
	"four class" city-grouping scheme	"six class" city-grouping scheme	Ullman and Dacey	"four class" city-grouping scheme	"six class" city-grouping scheme	Ullman and Dacey
Manufacturing	3.8071	3.9606	3.2200+	0.0990	0.0627	0.3526+
Finance, Insurance and Real Estate	3.2286	3.7194	0.8338	0.8615	0.5480	2.3162
Wholesale Trade	3.9057	3.9153	2.2731	0.4387	0.3887	1.5671
Retail Trade	2.6033	2.9154	-8.4238*	0.2741	0.2245	1.0238*
Public Utilities	1.6145	3.5569	no data*	5.5067	1.8372	no data*
Recreation	3.5199	2.9993	1.9892	3.0080	4.0420	5.0020
Transportation etc.	2.7558	3.0976	0.4990*	0.5255	0.4141	1.1490*
Construction	3.4673	3.4081	1.7307	0.2935	0.2791	0.8861
Community Service	1.5092	0.6507	no data*	0.5964	0.7588	no data*
Personal Service	0.2929	0.7439	no data*	0.9572	0.8488	no data*
Government Service	2.8289	3.0521	2.4616	0.8018	0.6932	1.2651
Business Service	3.8772	3.9566	no data*	1.2576	1.0936	no data*
Extraction	no calculation	no calculation	no calculation	no calculation	no calculation	no calculation

*: Ullman and Dacey values are not applicable to Canadian census data because classification procedures are different in the Canadian and American censuses for these functions.

+: The American census categories "durable" and "nondurable" manufacturing used by Ullman and Dacey are together equivalent to the Canadian category "manufacturing".

Figure 2. (continued)

of slope. The regression lines based on the "four-class" scheme are steeper for ten of the twelve functions. This is due, it is suggested, to the limited number of large Canadian cities, their wide dispersal, and the subsequent lack of "city-systems" involving many large cities. Because there are so few big cities in Canada and because they are scattered across the country, they function in relative isolation and hence are more diversified than cities of similar size in well-integrated "city-systems" such as the Manufacturing Belt of the United States. In such city-systems exchange among cities reaches large proportions and the propensity for interdependence is high. Opportunities for functional specialization are much greater for a city in such a system than for a city operating in relative isolation where functional activity is largely between the city and its hinterland and where exchange between the city and other cities is relatively insignificant. In the highly specialized city of the system, concentration on one or few functions means that only "token activity" or the minimum activity necessary to keep the city viable needs to be maintained in other functions. In contrast, the non-system city must be more self-sufficient because it cannot depend to the same degree on other cities for assistance, and because it must be much more concerned with the needs of its hinterland.

This situation is not conducive to the maintenance of only minimum requirements in functions. Such a situation, it is suggested, exists for most large Canadian cities, hence the possibility of finding only the minimum activity necessary to keep a city viable is remote for these large centers. This will cause the "minimum" city percentage values for employment in the higher population classes of the city-grouping schemes to be greater than they possibly should be.

The minimum percentage values given by both city-grouping schemes for the smaller cities are thought to be reasonably valid. For cities up to 50,000 population, it is considered that "city-systems" do exist in Canada--for example, the city-system of southern Ontario. The possibilities for specialization and interdependence are greater for these cities than for the large centers; therefore, the probability of some cities having minimum employment values approximating the "actual" minimum requirement values is considered reasonably high for these smaller centers. This thesis would appear to be substantiated by the fact that the regression lines for the four and six-class city-grouping schemes correspond fairly closely for most functions at the lower population levels.

At the higher population levels the validity of the minimum percentage values comes into question. In light of

the previous discussion, the minimum values identified can be expected to be higher than the "actual" values at these population levels. The effects of the "high" values will be greater in the six-class city-grouping scheme than in the four-class scheme because the former has more classes at the higher levels of population than the latter. Because of this feature, the "expected minimum requirement" values given by the regression equations based on the four-class scheme have been given priority. Not only is less emphasis placed on the higher population levels in the four-class scheme, but by using fewer classes, each class contains more cities, thus the problem of basing a minimum value on an exceedingly small group of cities is avoided.

For reasons similar to those stated in the previous discussion, the Ullman-Dacey equations are considered to have a greater validity than either set of equations based on Canadian data. Because there are many American cities at all population levels, Ullman and Dacey were able to select at random a standard number of cities at several population levels giving them a more "balanced" sample than can be obtained using Canadian cities. Also, cities equivalent in size to the largest Canadian cities are found in American city-systems. The problem of determining minimum requirements based on "non-system" cities is,

therefore, avoided when using American data. It is hypothesized that the probability of obtaining minimum employment values very close to the "actual" minimum requirement values for a city is much greater using the American data than the Canadian data, especially at the higher population levels. This hypothesis would appear to be borne out by comparison of the regression lines in Figure 2. For the six functions where the Ullman—Dacey values are applicable, the regression lines based on the American data are steeper than similar lines derived from Canadian data. The Ullman—Dacey equations give lower "expected minimum requirement" values at the higher population levels than do the equations based on Canadian data. In addition, the divergence between the American and Canadian values increases with population increase, indicating the increasing effect of the high "minimum" employment percentage values in the large Canadian cities.

The Ullman—Dacey regression lines, therefore, are considered more representative of the "actual" minimum requirements than similar equations based on Canadian city values. The United States with its much larger number of cities for which minimum values of employment may be selected, and its "city-systems" which include cities the size of most of the larger Canadian centers, provides a

more favourable area from which to draw representative values. Differences in the urban socio-economic environment of Canada and the United States are not considered to be of sufficient significance to invalidate the application of American values to the Canadian situation[5]. The same economic functions are performed, using similar technology, in the cities of both countries and the social mores of urbanites are not greatly different in the two nations. Where the Ullman—Dacey values were not applicable, the regression equations based on the "four-class" city-grouping scheme were utilized; this occurred for six of the twelve functions for which regression lines are required. Figure 3 shows the regression lines selected in determining the "expected minimum requirements" for functions. The values given by the equations were used as "standards" in rating the importance of functions in and among cities.

The measure. Only basic activity, as given by employment above the "expected minimum requirement", was used to determine the importance of a function, and the measure

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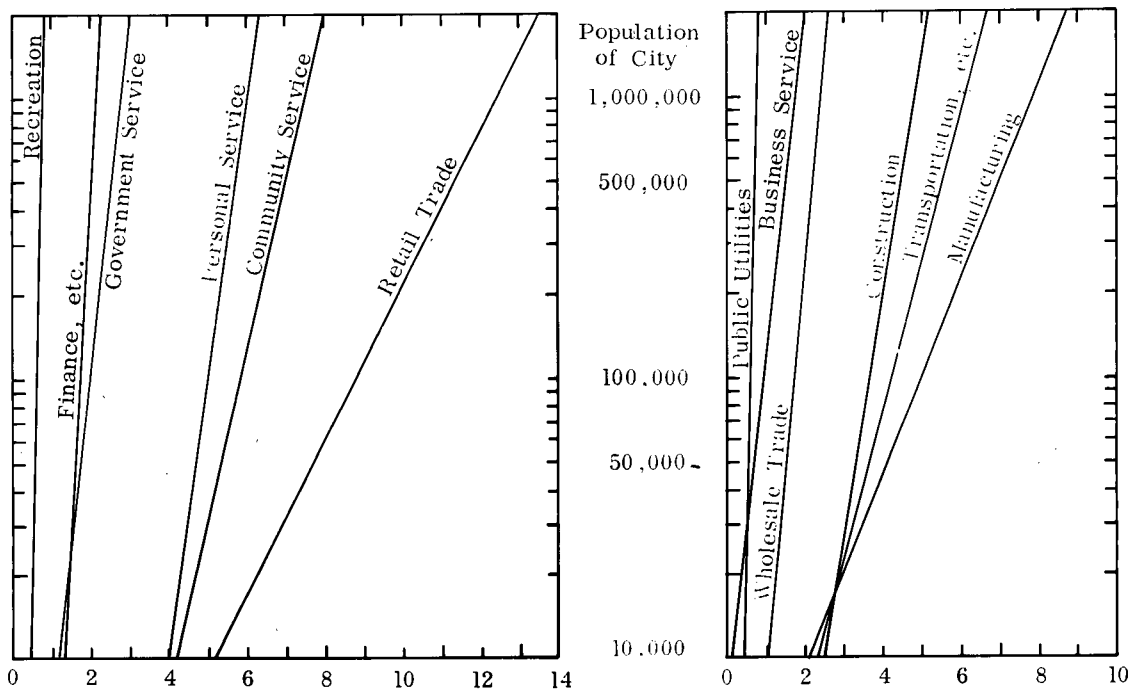
[5]A precedent is not being established by applying Ullman and Dacey's regression equations to Canadian data. Trotier used Morrissett's "k-values" in analyzing Canadian census data for Quebec cities. Louis Trotier, "Some Functional Characteristics of the Main Service Centers of the Province of Quebec," Cahiers de Geographie de Quebec, No. 6 (April-September, 1959), 243-59.



All equations are of the form: $\log y = a + bx$; where y is city population and x is the "expected minimum requirement value". The y-intercept and the slope of the equations are:

Function	y-intercept (a)	slope (b)
Manufacturing[1]	3.2200	0.3526
Public Utilities[2]	1.6145	5.5067
Construction[1]	1.7307	0.8861
Transportation[2]	2.7558	0.5255
Wholesale Trade[1]	2.2731	1.5671
Retail Trade[2]	2.6033	0.2731
Finance, etc.[1]	0.8338	2.3162
Community Service[2]	1.5092	0.5964
Government Service[1]	2.4616	1.2651
Recreation[1]	1.9892	5.0020
Business Service[2]	3.8772	1.2576
Personal Service[2]	0.2929	0.9572

[1]Equation after Ullman and Dacey.

[2]Equation based on the "four-class" city-grouping scheme of Canadian cities.

Figure 3. Selected "expected minimum requirements" for twelve functions, based on regression lines.

was taken in relative rather than absolute terms. Four classes of functional importance were recognized in the study. They are defined in terms of standard deviation values of excess employment in a function. For each function, Class I includes all cities whose value of excess employment in the function under consideration is equal to the mean value of excess employment for the function, plus a value of over two standard deviations above the mean. Class II includes all cities whose values of excess employment exceed the mean by between one and two standard deviations, and Class III includes all cities whose excess employment value in the function is between the mean and one standard deviation above the mean. Class IV includes all cities where excess employment values are below the mean excess employment value for the function. Table VII shows the values determining the classes of importance for each function.

Cities were rated in each function in terms of the classes of functional importance. An activity was considered "distinctive" in the functional profile of a city when the city qualified for one of the first three classes of functional importance. Cities have as many "distinctive" activities as they have excess employment values qualifying them as being of Class I, II, or III in functional importance. A function

TABLE VII

VALUES OF EXCESS EMPLOYMENT FOR DETERMINING CLASSES OF FUNCTIONAL IMPORTANCE

Function	Mean value of excess employment*	Standard deviation of excess employment*
	per cent of city labour force	
Extraction	3.76	12.49
Manufacturing	30.91	18.25
Public Utilities	1.04	1.01
Construction	3.85	2.28
Transportation, etc.	5.56	5.11
Wholesale Trade	2.63	2.34
Retail Trade	5.52	2.91
Finance, etc.	1.22	0.92
Community Service	4.23	3.63
Government Service	5.06	6.31
Recreation	0.15	0.14
Business Service	0.65	0.81
Personal Service	2.63	1.74

*Both the mean values and the standard deviations were calculated on the basis of all eighty cities. In the calculations, an excess employment value of zero was assigned to cities in those few instances where city excess employment values are negative.

TABLE VII (continued)

Function	Class IV (mean value of excess employment)	Class III (between mean value and one standard deviation above the mean)	Class II (between one and two standard deviations above the mean)	Class I (over two standard deviations above the mean)
	per cent of city labour force			
Extraction	<3.8	3.8 - 16.2	16.3 - 28.7	28.8+
Manufacturing	<30.9	30.9 - 49.2	49.3 - 67.4	67.5+
Public Utilities	<1.0	1.0 - 2.0	2.1 - 3.1	3.2+
Construction	<3.8	3.8 - 6.1	6.2 - 8.4	8.5+
Transportation, etc.	<5.6	5.6 - 10.7	10.8 - 15.8	15.9+
Wholesale Trade	<2.6	2.6 - 5.0	5.1 - 7.3	7.4+
Retail Trade	<5.5	5.5 - 8.4	8.5 - 11.3	11.4+
Finance, etc.	<1.2	1.2 - 2.1	2.2 - 3.1	3.2+
Community Service	<4.2	4.2 - 7.9	8.0 - 11.5	11.6+
Government Service	<5.1	5.1 - 11.4	11.5 - 17.7	17.8+
Recreation	<0.15	0.15- 0.29	0.30- 0.43	0.44+
Business Service	<0.65	0.65- 1.46	1.47- 2.27	2.28+
Personal Service	<2.6	2.6 - 4.4	4.5 - 6.1	6.2+

was not considered "distinctive" in the structure of a city when the city qualified only for the Class IV rating of importance.

By mapping the ratings of cities for each function a picture of the distribution of the relative importance of functions was gained. Because the measure is in relative terms, it was possible to compare the distribution patterns of different functions as well as examine the relative importance of individual functions among cities. In section three the distribution patterns are described and analyzed.

II. FUNCTIONS AND CITIES

R.U. Ratcliff was quoted in Chapter I as stating that manufacturing, trade and extraction are the fundamental activities of man leading to urbanization in an industrial state. The case for manufacturing and trade (including its inseparable associate, transportation) is well stated by the average percentage distribution of employment among functions for the cities under study (Table VIII). Nearly 60 per cent of the urban labour force in the "average" city is occupied in these functions. Manufacturing alone accounts for over one-third of the employment. The case for extraction, however, is not apparent from the mean percentage values; it accounts for only 3.8 per cent of the labour force in the

TABLE VIII

THE MEAN PERCENTAGE DISTRIBUTION OF URBAN LABOUR FORCE AMONG FUNCTIONS IN CANADIAN CITIES

Function	Mean percentage value	Standard deviation
Manufacturing	34.6	18.0
Retail Trade	12.4	2.7
Community Service	9.2	3.8
Transportation, etc.	8.9	5.3
Personal Service	7.0	1.7
Construction	7.0	2.4
Government Service	6.7	6.4
Wholesale Trade	4.0	2.6
Extraction	3.8	12.5
Finance, etc.	2.8	1.1
Public Utilities	1.6	1.0
Business Service	1.1	0.9
Recreation	0.6	0.2

average city. This value, in any event, is not too meaningful since the standard deviation is over three times the mean value.

The original urbanizing functions--social and administration activities--although shown to be subordinate to the economic functions in terms of employment, still maintain important positions in the average city profile. Together community and government service account for 15.9 per cent of employment in the average city. The remaining 20 per cent of average city employment is taken up by what may loosely be called ancillary urban activities. These functions --finance, business and personal service, entertainment, construction, and public utilities--are by their very nature essentially secondary activities. In some instances, however, they do emerge as primary functions in cities.

While the mean percentage distribution of employment among functions provides a useful way to examine the positions of functions in a general fashion, it is not entirely satisfactory for detailed study. Three reasons for this are apparent: (1) the standard deviations for most functions (Table VIII) are quite large indicating a large degree of variability around the mean values; hence relatively non-representative mean values, (2) it is known that city

functional profiles change with city size; by using the mean employment distribution for all cities to gauge the position of functions, these changes are obscured, and (3) by using total city employment as a basis of study, "abnormal" functional values, usually representative of functions with very high "export" values attributable in most cases to the uniqueness of city location, are included in the base. Such inclusions tend to give skewed values for functions. This latter point is closely related to that raised in the first statement regarding variability around the mean functional values.

To avoid the use of relatively non-representative values and to reflect changes in functional structure due to city-size differences, the positions of functions in city profiles were studied in terms of expected minimum requirement values for three city-size levels. In addition to avoiding the influence of unique city locations on the base values, the use of expected minimum requirement values as references gives additional precision to the problem. The question to be answered--what are the positions of activities in the city functional profile--is refined and restated as: what are the positions of functions in maintaining the city, that is, what is their role as "city servers". This significant refinement is introduced because minimum requirements

represent the nonbasic or city-serving sector of city activity. J.W. Alexander has stated that ".... the nonbasics 'cloud the picture' ...." when attempts are made to identify a city's service to its region.[6] Conversely, it may be argued that the basics "cloud the picture" when attempting to determine the role of functions as city servers. The discussion to follow deals with the position of functions in city functional profiles as city servers. Later sections deal with the analysis of distinctive and dominant functions, that is, the role of functions as city builders.

In Table IX is presented the relative positions of functions as city servers in city functional profiles at three population levels. Preliminary study of this table suggests that the rankings of functions are very similar to those presented in Table VIII (page 83) where functions are ranked by mean values. For example, the same activities are found in the six top positions in each of the ranking lists. In fact, there is a significant correlation between the average ranking of functions based on minimum require-

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[6] J.W. Alexander, "The Basic-Nonbasic Concept of Urban Economic Functions," Economic Geography, XXX (July, 1954), 251.

TABLE IX

THE POSITION OF FUNCTIONS AS "CITY-SERVERS"*: FUNCTIONS RANKED BY DECREASING "EXPECTED MINIMUM REQUIREMENT VALUES" FOR CITIES WITH POPULATIONS OF 10,000, 100,000 AND 1,000,000 INHABITANTS

City of 10,000 population	City of 100,000 population	City of 1,000,000 population
Retail Trade	Retail Trade	Retail Trade
Community Service	Community Service	Manufacturing
Personal Service	Manufacturing	Community Service
Construction	Personal Service	Transportation
Transportation	Transportation	Personal Service
Manufacturing	Construction	Construction
Finance	Government Service	Government Service
Government Service	Finance	Wholesale Trade
Wholesale Trade	Wholesale Trade	Finance
Public Utilities	Business Service	Business Service
Entertainment	Public Utilities	Public Utilities
Business Service	Entertainment	Entertainment
Extraction	Extraction	Extraction

*City-serving activity is defined as activity directed towards the servicing of the city's own needs. The ranking of functions is based on expected minimum requirement values given by the regression equations presented in Figure 3.

ments and the ranking of functions by mean values.[7] This would appear to indicate that a general relationship exists between the positions of functions in city functional profiles as city servers and their positions in profiles in undifferentiated roles as both city servers and city builders. The implication is that the same general structure of relative importance exists for functions regardless of

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[7]In order to compare rankings of functions based on mean employment values with those based on minimum requirement values, the "average ranking" of functions for the city functional profiles in Table IX was calculated. This was done by weighting functions by their rank values in the three ranking lists, adding the three values for each function, and listing the functions by the sum of the three rank values. The function with the highest sum, in this case extraction with a value of thirty-nine (it ranked thirteenth in each list), falls at the bottom of the average ranking. The activity with the lowest sum is placed at the top of the ranking. Retail trade ranked first in each of the three lists in Table IX giving it a sum of three, the lowest of any function. The average ranking of functions is:

1. Retail Trade	7. Government Service
2. Community Service	8. Finance, etc.
3. Manufacturing	9. Wholesale Trade
4. Personal Service	10. Public Utilities
5. Transportation, etc.	11. Business Service
6. Construction	12. Recreation
	13. Extraction

Kendall's coefficient of rank correlation was calculated for the two ranking schemes. A coefficient value of 0.795 was obtained with a normal deviate of 3.72 indicating that a significant correlation exists between the two schemes.

whether the city-service or the city-forming roles of functions are considered. Comparison of the tables also reaffirms the leading positions of trade, manufacturing, and community service since they occupy the top ranks in both ranking schemes. The position of extraction is exceedingly weak in Table IX, indicating that it is completely unimportant as a city-serving function. Since it ranks higher by mean values, it probably can be considered primarily a city-forming activity.

By examining separately the ranking of functions for the three population levels in Table IX, additional characteristics of functions and cities are revealed. There are a total of twelve changes in the relative positions of activities in the table associated with shifts in city size. Eight occur with the shift from a population level of ten thousand to one of one hundred thousand, and six with the population change from one hundred thousand to one million. Only two activities maintain the same relative position regardless of city size; retail trade and extraction.

Retail trade dominates the city-serving profile at all population levels reflecting perhaps the essential role of trade as a prime urbanizing force. The urban center as an economic entity is composed of numerous specialized units.

Trade among these units is basic to city survival. Intra-city as well as intercity exchange is necessary for the city to become and remain viable. Extraction ranks last at all population levels in the ranking of functions. Such a position would appear to contradict Ratcliff's observation regarding the forces responsible for urbanization. Indeed, the position of extraction as a city-serving function is non-existent, but the overwhelming dominance it displays in the functional structure of some cities when total city activity is considered (see Figure 2) demonstrates that it is an important urban function, albeit a wholly basic (city-forming) one.

Of the functions altering their relative positions, manufacturing experiences the greatest shift. It rises from the sixth rank for the lowest level (10,000) to the third for the one hundred thousand population level and finally to the second rank for the highest population level (1,000,000). Four other functions (government and business service, wholesale trade and transport) experience rises in relative position with increasing population although not of the same magnitude as manufacturing. Six functions undergo decreases in relative position with increasing population. Two of these, personal service and

financing drop one position with each population increase, while community service drops only with the last increase (100,000 to 1,000,000). Construction, public utilities and entertainment decline with the first population shift, but retain their new positions with the last increase in population.

One suspects that at least some of these shifts in relative position are due in part to the differing qualities of functions in their capacity to "expand" their service to a larger population using the same employment unit. One employee in retail trade, for example, may be able to service, say from one to fifty persons, whereas an employee in finance may be able to handle from one to five hundred persons. In this example, it might be said that retail trade is relatively "inelastic" while finance is very "elastic" in respect to the amount of servicing one employment unit can achieve. At the lower population levels the minimum requirement values for functions will fall within a relatively narrow range because basic services must be maintained even if underemployment is experienced. As population increases the "expansion potential" of functions is more fully exploited and, because the expansion capacity differs among functions, an increasing spread among

minimum requirement values will occur. One other reason for the shifts in position may be due to the highly aggregated nature of the functions used in the study. It is possible that the "content" of the functional groups--retail trade, manufacturing, etc.--varies with city size and thus influences the ranking of functions. The service provided the city of one million by the manufacturing function may well differ from that performed for the city of ten thousand by the same function.

Despite these two hypotheses, both of which require further investigation to be substantiated, the total effect of the shifts in the relative positions of functions seems to imply that there are some distinct differences in the make-up of the "city-service" structure in cities of different size. Such differences are especially noticeable between city sizes of ten thousand and one hundred thousand population. The role of the city as an "economic entity" appears to be played down somewhat at the lower population levels, and functions associated with urbanization prior to industrialization--community and personal service--occupy dominant positions. As city size increases the functions representing the more purely economic role of the city--manufacturing, transportation and business service--come to

the fore and the social functions lose some of the importance they enjoyed at lower population levels. It seems that the role of the city as an "economic mechanism" is approximated more closely at the higher than at the lower population levels in terms of city-service structure.

While changes in the ranking of activities in city functional profiles have been discussed, no reference has yet been made to the actual changes the minimum requirement values experience with changing city size. Study of Figure 3 (page 78) shows that there are different rates of change associated with each function. All functions except extraction, however, show an increase in minimum requirement value with population increase; retail trade and manufacturing experience the greatest increases judging by the slope values in Figure 3. These increases have a fundamental effect on the functional structures of centers because the total minimum requirement values of cities increase with city-size increases. Whereas only one-quarter of the city labour force (24.99%) is required to maintain a city of ten thousand, 40 per cent is required for the city of one hundred thousand and over half (55.51%) of the city labour force is required for a city of one million.

Two consequences, one the corollary of the other,

result from the reactions of minimum requirement values to changes in city size. First, functional specialization can be expected to occur more frequently and be of greater magnitude in small cities than in big ones. Because the total minimum requirement increases as population increases, a much smaller proportion of city labour force is available for basic activity in a big city than in a small one--45 per cent in a city of one million population in contrast to 75 per cent in a city of ten thousand population. The small city, therefore, with its large block of "unattached" labour force that can be directed into one or few export functions, has a far greater potential for specialization than the big center. Secondly and conversely, the big city, by being able to accommodate such a large proportion of its labour force in city-serving functions, relies to a lesser degree on "outside" activity than the small center; thus it is more self-sufficient. Ullman and Dacey believe that the trend in minimum requirement values where large cities have higher total minima than small cities, is consistent with theory, ".... since the larger the city the larger the number of specialties that can be supported and the more self-contained the city can be."[8] Morrissett, taking

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[8]Ullman and Dacey, op. cit., 180.

a somewhat different tact, also concludes that big cities approximate self-sufficiency more closely than small cities.[9] He states that for the manufacturing functions which he studied only one out of fourteen is ubiquitous in cities of ten thousand population, whereas nine out of the fourteen are ubiquitous for cities of one million.[10] He concludes that "the fact that all but a few industries are ubiquitous in large cities is another way of saying that big cities appear to be more nearly self-sufficient than small cities."[11] Defining the terms "sporadic" and "ubiquitous" in a way similar to Morrissett's[12] and applying these criteria to data on Canadian cities reaffirms Morrissett's conclusions. At the ten thousand population level seven of

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[9]Morrissett, "The Economic Structure of American Cities," Papers and Proceedings of the Regional Science Association, IV (1958), 245.

[10]Ibid. Morrissett defined the terms sporadic and ubiquitous quantitatively as follows: "if the "k-value" of an industry is less than one-fourth of the national percentage, the industry will be called sporadic; and if the ratio is one-fourth or greater, it will be termed ubiquitous."

[11]Ibid.

[12]Quantitative definitions of the terms sporadic and ubiquitous as applied to data on Canadian cities: If the expected minimum requirement value of a function is less than one-third of the average percentage for the cities studied, the function is called sporadic; and if the ratio is one-third or greater, it is termed ubiquitous.

the thirteen functions studied are classed as sporadic, but at the one million level only two functions remain sporadic.

In brief, analysis of the trends for minimum requirement values of functions reveals that: (1) the probability of functional specialization decreases with increasing city size, (2) the probability of functional diversification increases with increasing city size, and (3) self-sufficiency in cities increases as city size increases.

To summarize, the relative positions of activities in the functional profile of cities have been discussed in terms of mean values of total city employment, expected minimum requirement values, and in light of city-size differences. The reaction of minimum requirement values to city-size changes has been noted and its effect on city functional structure has been described. The findings, based on quantitative data, generally coincide with qualitative observations made by earlier analysts, as well as with quantitative results of other similar studies.

Trade and manufacturing were found to be the dominant functions in both the total functional structure of the city and in the city-serving profile, although manufacturing, and some other economic functions, were found to be weaker as city servers at the lower population

levels. The social functions, although secondary to the economic activities, are still significant in the functional profile especially in the small cities. There are some significant changes in and influences on city functional structure associated with changing city size. These are:

(1) the large city is more purely an "economic mechanism" than the small city judging from the shifts in the ranking positions of functions with city-size changes.

(2) there is a greater capacity and potential for functional specialization in small cities than in large ones.

(3) large cities are more diversified and self sufficient than small ones.

III. THE DISTRIBUTION OF THE RELATIVE IMPORTANCE OF FUNCTIONS IN CANADIAN CITIES

Alexandersson has noted that the distribution pattern of urban activities can be grouped into two broad classes: sporadic and ubiquitous. For convenience, the distribution patterns of functional relative importance examined were grouped into these two classes for discussion purposes. As stated in Chapter I, sporadic activities can normally be considered basic or city-forming functions. The ubiquitous

activities, except when possessing abnormally high values in city employment profiles, are usually service or city-serving functions. In those isolated cases when ubiquitous activities do have atypically high values in cities, they should be considered basic functions.

Because of the highly aggregated nature of the functional groups used in this study--thirteen categories in contrast to Alexandersson's thirty-six--it was not possible to apply Alexandersson's criteria in classifying activities as being either sporadic or ubiquitous. His reasoning, however, was followed when allocating functions to the classes. It was assumed that the ubiquitous functions will appear in relatively constant proportions in cities except when they take on city-forming status. In contrast, the sporadic activities can be expected to range greatly in their relative importance from city to city. These assumptions led to the combined use of (1) the coefficient of variation of city employment in functions[13], and (2) the scatter diagrams given in Figure 2, (pages 69-72), in classifying functions as being either sporadic or

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[13]The coefficient of variation for city employment in a function is the standard deviation for employment in the function as a percentage of the arithmetic mean for employment in the function.

ubiquitous.

Functions	Coeff. of Variation
Extraction	332.2
Government Service	95.5
Business Service	75.6
Public Utilities	65.6
Wholesale Trade	64.8
Transportation, etc.	59.1
Manufacturing	52.2
Community Service	41.5
Finance, etc.	41.2
Construction	34.2
Recreation	33.3
Personal Service	24.2
Retail Service	21.6

The activities considered by Ratcliff to be the principal urban functions--manufacturing, trade (and transportation), and extraction--rank high as sporadic, hence basic, functions when "sporadic" is defined in terms of a high degree of variation from a constant level. However, three activities, usually considered as service functions and as having ubiquitous distributions, have higher rankings than wholesale trade, transportation and manufacturing. Examination of the scatter diagrams in Figure 2, (pages 69-72), shows that two of these functions--business service and public utilities--have high coefficient values because on the few occasions when atypically high percentage values occur for them the values are so very high, they have increased the coefficient of variation markedly. Except for these isolated instances when extremely high values appear (once for business service,

six times for public utilities), the distribution patterns in the scatter diagrams for these two functions resemble the patterns of activities with much smaller coefficient of variation values. For this reason these activities were classified as ubiquitous functions. Government service, although having a tendency to appear in similar proportions in many cities (Figure 2, page 71) was considered to have too many deviations (abnormally high values) not to be classed as a sporadic activity.

The dictionary meanings of "sporadic" and "ubiquitous" cannot be applied strictly here. Perhaps different terms should have been selected. However, because the reasoning behind the classification of functions as being sporadic or ubiquitous has been outlined, the exact terms applied were not considered of great importance. Because the functional categories used are highly aggregated, the classification of functions as sporadic or ubiquitous should be considered in relative rather than in absolute terms. The classification of activities used is outlined below:

"Sporadic" Functions	"Ubiquitous" Functions
Extraction	Business Service
Wholesale Trade	Public Utilities
Transportation, etc.	Community Service
Manufacturing	Finance, etc.
Government Service	Construction
	Recreation
	Personal Service
	Retail Trade

The distribution patterns of functional relative importance in cities are discussed in terms of the Canadian "heartland" and "periphery". This regional framework, already introduced on page 4 and in Figure 2 (pages 69-72), is a useful conceptualization when analyzing city functional character at the national level, because the distributions of cities within the two regions differ so greatly.

The Distribution of the Relative Importance of the Sporadic Functions

Extraction. Of all the distribution patterns, that of extraction best fits Alexandersson's definition of a sporadic pattern. Extraction appears as a distinctive function in only seven cities; it is completely absent in twenty-six centers and accounts for less than 1 per cent of city labour force in forty-two others. In six of the seven cities where it is distinctive, however, it rates as "Class I" meaning that it accounts for at least 28 per cent of city employment; only manufacturing requires a higher excess employment value for a Class I rating of "distinctiveness" and no city achieves it. Five of these cities are located in the northern and eastern periphery zones, and one is in the heartland. Because extraction, in each case mining, is also the dominant function for the cities, further

discussion of them is postponed to Chapter III. The seventh city where extraction is a distinctive function (Class III) is in the western periphery--Lethbridge. Only 4 per cent of this city's labour force is in extraction (coal mining) giving little evidence of the fact that mining was the initial city-forming function in the city. Lethbridge, like the modern "pioneer" towns of Kitimat and Thompson, was developed as a company town in 1885 in conjunction with the exploitation of coal deposits used to supply the Canadian Pacific Railway.

The fact that extraction is absent in one-third of the cities, and accounts for less than 5 per cent of the labour force in a city where it provided the basis for city formation brings into question the position of the function as a principal urban activity. The fact remains though, that extraction requires the concentration of people and machines in a small area, thus creating an urban situation. The type of urban center associated with this function, however, is usually quite different from that associated with the other principal urban activities. It is wholly site oriented because extraction activities are inevitably oriented to the immobile natural site of the resource. The necessity of placing a high priority on site factors often

means that the situational aspects for other city-forming activities are unfavourable, thus tending to limit the size of the center while increasing the propensity for specialization.

Cities over ten thousand population in 1951 accounted for only one quarter (27.5%) of the Canadian labour force in extraction, in contrast to 80 per cent of the nation's labour force in wholesale trade, and 68 per cent of the national employment in manufacturing. Extraction, then, can be considered most important as a city-forming activity in urban centers under ten thousand population. As the size of the center increases, the relative importance of extraction tends to drop at a very fast rate, other city-forming activities becoming the mainsprings of urbanization.

Manufacturing, wholesale trade and transportation. The distributions of relative importance for these important city-forming functions illustrate the essential elements, not only of city functional character, but also of Canadian economic geography; they demonstrate clearly the effect of distance on the economy of Canada. Two of the distributions are almost identical, those of wholesale trade and transportation. The important elements in both patterns are: (1) the almost complete lack of "distinctiveness" in the

heartland, and (2) the almost unbroken high rating of relative importance in the periphery. Less than ten of the forty-five heartland cities have either function showing as a distinctive activity. In contrast, in the western periphery, transportation and wholesale trade do not occur as distinctive functions in only three of the fifteen cities.

A complete transposition takes place with the manufacturing distribution (see Figure 4). Manufacturing appears as a distinctive function in only five of the thirty-five peripheral cities while it is distinctive in thirty-two of the heartland cities. That is, there is an exceedingly high, almost exclusive, concentration of manufacturing relative importance in the heartland. In the periphery it simply does not rate as a distinctive function except in purely resource-oriented manufacturing centers.

These almost diametrically opposed patterns (manufacturing versus wholesale trade and transportation) provide some indications of the differing characteristics of these functions. Trade and transportation, while requiring the concentration of facilities and people for their performance, are functions of space (distance). They are concerned with the collection, transfer, and distribution of goods. They can be expected, therefore, to reach their highest levels of relative importance in those areas where

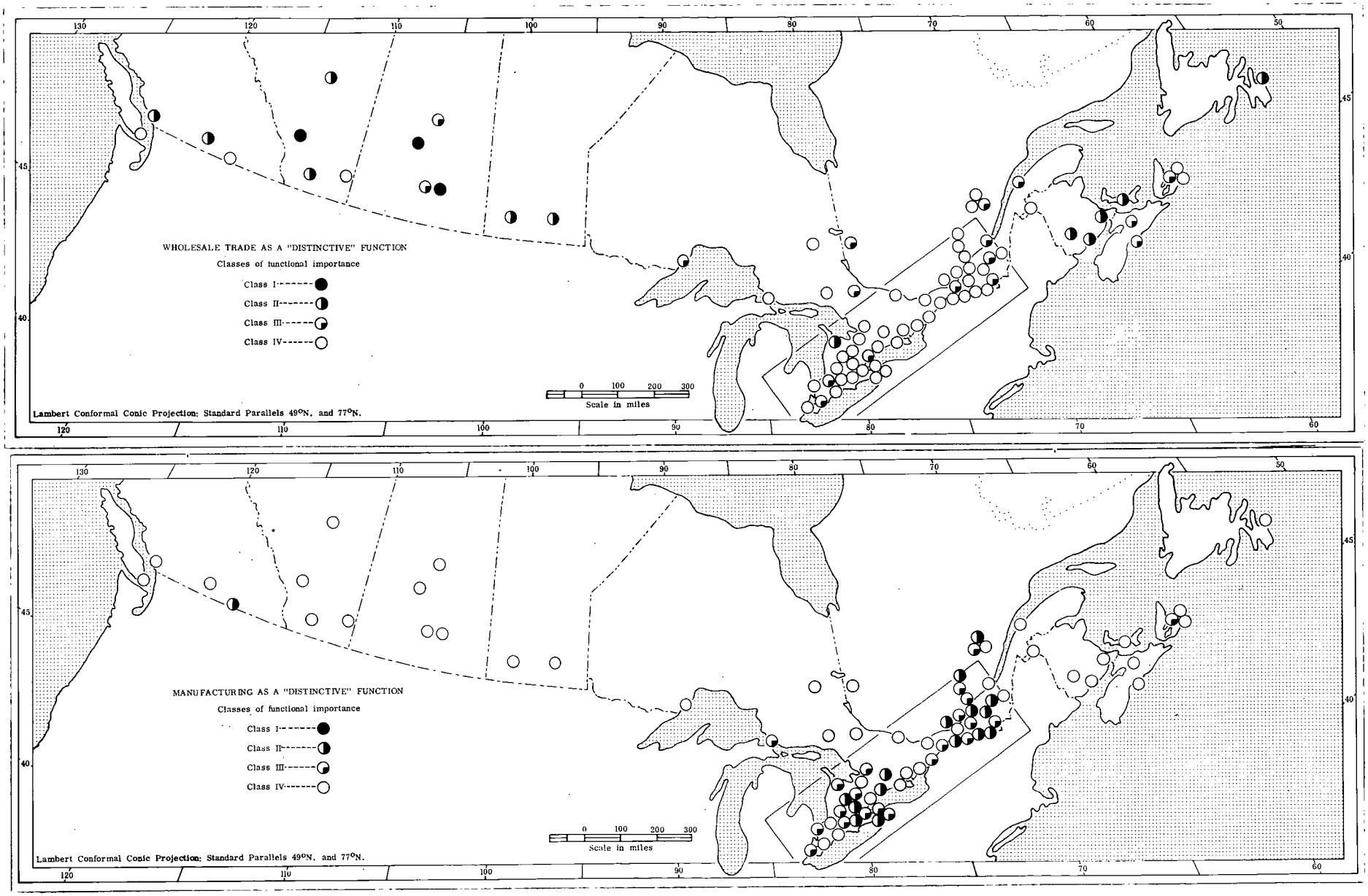

Figure 4. The distribution of wholesale trade and manufacturing as "distinctive" functions in Canadian cities.

extensive activities (rural functions as defined in Chapter I) are of prime importance. Such is the situation in the eastern, and especially, the western periphery. A very large proportion of the total "economic energy" generated in these zones is "consumed" in overcoming the great distances associated with extensive activities such as the wheat-production and ranching functions of the brown and dark brown soil regions of the Great Plains. The cities in these zones, as the loci of the "economic energy", reflect in their functional profiles this involvement with distance.

Manufacturing, on the other hand, is focused on adding value to goods through their conversion, and obtaining a net return by so doing. To maximize the net return, the costs of assembling inputs and distributing outputs must be kept minimal, but also, so must be the cost of the conversion process itself. This latter objective introduces factors not directly involved in wholesale trade and transportation, such as economies of agglomeration, and internal and external scale economies. Economies that accrue through agglomeration and economies of scale tend to promote the concentration of manufacturing activity in areas where large populations (easy access to markets) and other manufacturing activities (allows specialization and gives more opportunities for substitution) are located. Only when

the costs of assembling inputs is high in relation to total costs, when no substitutes are available, or when the weight-loss is high in the manufacturing process will resource or input location factors override those factors favouring market-oriented locations.

Such influences tend to propagate population concentrations already established and give such concentrations of people and economic activity a self-generating capacity. This feature perhaps more than any other factor, is responsible for the continued growth of economic activity in the heartland. The initial causes of concentration in the heartland were: (1) relatively easy access from the Old World and the United States' "core", (2) the availability of resources demanded in world markets--fur and timber, and (3) the existence in the heartland of a favourable resource base for agriculture. The growing agricultural population demanded manufactured goods; this demand was met by imports initially, but because the inputs for many manufacturing processes were found in the heartland, local manufacturing soon developed in response to the local market. A "cyclical" relationship developed between rural and urban activities in the heartland with growth in one sector allowing expansion in the other. Because of the excellent

locational relationships existing in the heartland among the factors involved in urbanization--a good agricultural base, the existence of energy resources and raw materials, a large labour supply (and market), and port facilities, all within a relatively small area--the heartland has been able to extend its market area to the other regions of Canada and become the focal point of the nation. The distributions of relative importance of wholesale trade and transportation, and manufacturing in the nation's cities tell this story more clearly than any of the other distribution patterns. The functional profiles of cities are very reliable indicators of regional character.

Government service. Only in the capital cities and "garrison towns" does this function assume city-forming status, and even then it is often secondary to the economic activities as a city builder. For example, government service does not have a distinctive role in either Winnipeg or Toronto--both capital cities. It attains Class I ratings (excess employment value over 17.8 per cent of city labour force) in the larger cities only in the national capital, and in the provincial capitals where both legislative and military functions are

located (Victoria and Halifax). Class I ratings of relative importance also exist for the garrison towns of St. Jean (military college) and Trenton (air force base). Class II ratings are found in the provincial capitals of Fredericton, Regina, and St. Johns, and in the military and administrative centers of Kingston (military college and penal institution), Pembroke (army camp), and Barrie (army camp). Except for three centers, the twelve remaining cities where government service is distinctive (Class III) are located in the periphery. Of the three in the heartland one is a provincial capital--Quebec City, and the other two are regional service centers on the edge of the main manufacturing zone of southern Ontario--Belleville and London.

This function, like transportation and wholesale trade, tends to be relatively more important in the peripheral cities, illustrating again the concern of these cities with the problem of distance and large, relatively sparsely populated hinterlands. The administration functions "consume" proportionately more "energy" in the periphery where friction of distance is high, than in the highly developed heartland where settlement is relatively dense and easy access exists to all areas.

The Distribution of the Relative Importance of the Ubiquitous Functions

As expected there are no distinct gaps or concentrations in the distribution patterns of the ubiquitous activities. The great contrasts existing between the periphery and the heartland in the patterns of relative importance for the sporadic functions are not found. Some slight differences in functional relative importance, above that created by ubiquitous functions assuming city-forming status, are, however, exhibited by the distributions and serve to illustrate some significant differences in city functional structure within regions, especially the heartland.

The distribution patterns of functional relative importance in the heartland for the ubiquitous functions--for example, retail trade and recreation, (see Figure 5)--when compared with the pattern for manufacturing, (Figure 4, page 105), serve to illustrate the "binodal" nature of the region's urban structure. The manufacturing pattern indicates two areas of concentration in the heartland. One consists of the cities near Montreal, the other of the cities at the western end of Lake Ontario. The patterns for the ubiquitous functions show that,

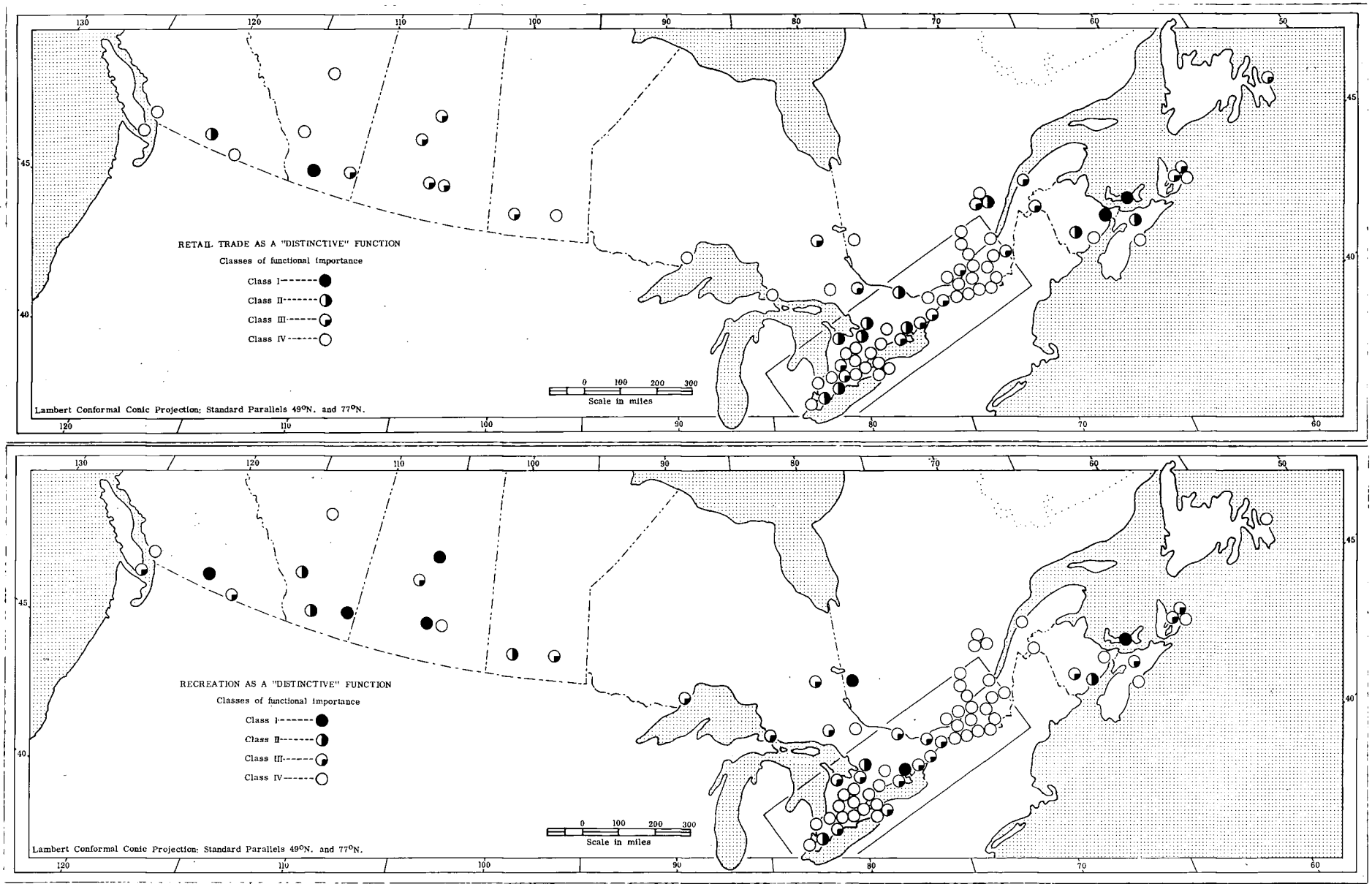

Figure 5. The distribution of retail trade and recreation as "distinctive" functions in Canadian cities.

generally, the importance of these activities is highest in the cities outside the manufacturing "cores". In the cities making up the manufacturing concentrations, the ubiquitous activities tend to have low ratings of relative importance except for the few instances when they attain strong city-forming status.

These distributions reflect some important characteristics of the heartland's economy and the nature of the cities in this region. Manufacturing within the heartland is shown to be highly concentrated in two areas, and the cities making up these "cores" have very few functions other than manufacturing showing up as distinctive in their profiles. The heartland cities falling between and beyond the two manufacturing "cores", however, demonstrate a significant degree of "distinctiveness" in the ubiquitous functions. Moreover, included in this latter city group are most of the few heartland cities where wholesale trade and transportation show as distinctive functions. These cities are in fact very similar in functional structure to the majority of the peripheral cities where servicing a hinterland is the principal raison d'etre of the city. The cities in the manufacturing "cores" on the other hand, are the basic units in "city-systems" where intercity and

intracity interaction is often relatively more significant than city-hinterland activity.

The relatively few times ubiquitous functions take on city-forming status are of interest simply because they are exceptions to the general situation. Although it is not possible to comment on all the occasions that the ubiquitous, city-serving functions assume a city-forming capacity, some of the more outstanding ones are mentioned.

Two of the best examples of this phenomenon are given by the business service and public utilities functions. Seventy-nine of the eighty cities have less than 3 per cent of city labour force in business service. One city, however, Pembroke, has over 7 per cent of its labour force in business service, making this function very significant, in relative terms, in the city's functional profile. Pembroke has a relatively high concentration of employment in engineering and scientific service. The city is located in the Ottawa Valley where the exploitation of white pine provided the impetus for settlement and made Pembroke a major administrative center (county seat) as well as an important wood-processing city. The administrative function of the city is further reflected through the significant business service employment rate. The city is a site of a district forester's

office, and nearby is a large forest research station, as well as an important military establishment. There is also a major provincial fish hatchery and bird sanctuary proximate to the city. In addition the city is the headquarters of engineering firms associated with forestry operations, and legal surveying.

The distribution of relative importance for the public utilities function follows closely that of business service. The function appears in an almost standard and unspectacular proportion in all cities but a few located in the heartland. The two most outstanding exceptions are Niagara Falls and Valleyfield, both associated with well-known hydro power generating sites: Niagara Falls and Beauharnois. In these instances the public utilities function is definitely a basic activity. The other heartland cities with high ratings for public utilities are all associated with hydro power, either its generation, transmission, or administration. Barrie, for example, is one of the nine regional offices for Ontario Hydro.

The few times that community service attains relatively high ratings in city functional profiles serve to illustrate, to a very limited degree, the duality that exists in Canadian culture. The three cities having the

highest ratings for this function are located in Quebec, and seven of the top fifteen cities in community service are found in predominantly French-speaking areas. Educational and especially religious activity would appear to be very important (in relative terms) in the functional structure of cities within the realm of French Canadian culture. In St. Hyacinthe, for example, over 38 per cent of the employment in community service is in religious activity. Although the point cannot be pursued very far on the limited evidence presented here, it is thought that a closer approximation of the "cathedral" town will be found in Quebec than in any other province.

With the exception of the "finance, insurance and real estate" function, the remaining ubiquitous activities attain atypically high values only in a few peripheral cities. As expected, the cities where finance, etc. attains the greatest importance are in the heartland. Toronto, as the financial heart of the nation, has the highest rating in Canada for this function. The two insurance centers of London and Kitchener-Waterloo closely follow. Retail trade and recreation maintain their ubiquitous characteristics throughout, showing no extremely high atypical values for any city. Generally though they

are more significant in the peripheral cities than in those of the heartland. Personal service is very distinctive in a few peripheral cities, but again it is insignificant in the heartland. The one remaining function, construction, is unlike other city functions in that the proportion of the labour force employed in the construction industry is in large part determined by the current growth or expansion of a community. Its importance indicates the dynamics of growth more than the actual functional relationships of a city. An outstanding exception to this thesis is found in one city, although it is primarily one of scale. Edmonton has a high rating of "distinctiveness" for construction. In large part this is due to the high growth rate in the city brought on by petroleum and natural gas discoveries in its hinterland, but some of it is due, it is suggested, to the situation of Edmonton in relation to northern development. Edmonton is the "gateway to the Arctic" and as such is the home office of many construction firms and residence of workmen concerned with northern construction. These two factors have led to construction's high rating in Edmonton.

The distribution patterns of relative importance for the ubiquitous functions, by themselves, do not reveal any

significant variations at the national level in city functional character. However, when used to supplement similar patterns for the sporadic activities, they act to refine the overview of city functional performance, especially in the heartland.

Summary: "Heartland", "Periphery" and Canada's Urban Geography

The foregoing discussion has shown that the distribution patterns of relative importance for urban functions in Canada are characterized by extreme unevenness. The heartland, enjoying excellent locational relationships for many manufacturing processes--the key urban function--is the site of urban concentration. The region contained 52 per cent of Canada's population in 1951, yet it occupies only 2.5 per cent of the nation's land area[14]; forty-five of the eighty cities studied are in the heartland. Indicative of the different densities existing in the two regions is the average road distance between cities. Cities in the heartland are, on the average, 280 miles apart by road, while those in the western periphery are separated by

[14]The percentage values were derived by determining the population and area of all census divisions that make up the heartland, and comparing the total values for the heartland with the national figure. Source: the 1951 Census of Canada.

an average road distance of 740 miles[15]. Whereas great concentration of economic activity, financial power, and population exist in the heartland, the periphery is characterized by huge sparsely settled areas, giving it almost vassal status in its relationship with the heartland. The distribution of relative importance for the manufacturing, wholesale trade and transportation functions illustrate, in a very definite manner, the fundamental difference existing between the majority of the peripheral cities and most of the heartland cities. The periphery, because of its involvement with the friction of distance, must devote much more of its "economic energy" to overcoming this friction than must the heartland where distal friction is relatively inconsequential. These fundamental differences in situational characteristics, reflected by the high rating of "distinctiveness" for wholesale trade and transportation in the peripheral cities, and manufacturing in the heartland cities, provide the basic empirical evidence supporting the concept of "heartland" cities and "peripheral" cities.

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[15]Average road distances were derived by determining the road distance between cities using mileage charts on official provincial and oil company road maps.

A more detailed account of the concentration of activity in the heartland can be found in, D.W. Slater, "Trends in the Industrial Location in Canada," Resources for Tomorrow Conference Background Papers, Vol. I (Ottawa: The Queen's Printer, July, 1961), pp. 410-11.

Concentrations in national distribution patterns of socio-economic phenomena, although evident in spectacular fashion in Canada, are not peculiar to this country alone. E.L. Ullman has delineated and described the "core" and "fringe" areas of the United States. He states that the American core, located in the northeastern part of the nation, has 43 per cent of the nation's population and 52 per cent of the total national income although it occupies only 7 per cent of the land.[16] A.E. Smailes in his studies of urban phenomena in Britain refers to the "hour-glass" shaped area of maximum urban concentration:

> "The most striking feature [of the distribution of urban centers in England and Wales] is that a great majority of towns are concentrated within a belt extending north-west from the south-east coast and London region to the industrial areas of Lancashire and West Yorkshire. A large proportion of the urban groups is found clustered in areas within forty miles radius of central London and central Manchester . . . In fact, the form of the main area of concentration may be likened to an hour-glass, with its main axis running through London and Manchester and its waist about Northampton.[17]

Similar concentrations of population are also found in continental Europe; for example, the Po Valley of Italy,

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[16]Edward L. Ullman, "Regional Development and the Geography of Concentration," Papers and Proceedings of the Regional Science Association, IV (1958), 181.

[17]Arthur E. Smailes, "The Urban Mesh of England and Wales," Transactions and Papers of the Institute of British Geographers, (1946), 89.

the basins of the Seine and Meuse in France and the Rhine and Elbe in Germany.

To describe the distribution of urban functions in terms of a "heartland" and a "periphery" or a "core" and a "fringe" seems reasonable because concentrations of population such as those outlined above have been shown to be intimately associated with urban functions, especially manufacturing.[18] Ullman states that 70 per cent of the United States industrial employment is located in the American core.[19] Smailes claims that ". . .the industrial population in Britain is the major determinant of the arrangement of urban centres."[20] He further states that:

> The peculiarly uneven distribution of towns and cities that is characteristic of Britain is directly attributable to the high degree of localization of the natural foundations of the industrial and commercial life of this country. The distribution of the industrial population is thus seen as cause rather than effect of the urban pattern.[21]

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[18]This statement must be qualified to the extent that it applies only to industrialized countries. Population concentration and urbanization are not necessarily closely associated in non-industrialized nations.

[19]Ullman, loc. cit.

[20]Smailes, oc. cit., 90.

[21]Ibid.

Allan Rodgers in portraying graphically the variation in the distribution of the manufactural employment in Italy has shown the coincidence of the important manufacturing areas with the densely populated core area of Italy-- the Po River basin.[22]

The close association of population concentration and urbanization, in the industrialized countries at least, is really self-evident, especially when recalling Ratcliff's definition of urban activities: ". . .activities that require the concentration of people, buildings, and machines within relatively small areas."[23] Urbanization thus leads automatically to concentrations of human activity, and hence to unevenness in the distributions of socio-economic phenomena. The examples of concentration cited above, together with the evidence presented for the Canadian scene where city functional structure was shown to vary fundamentally between regions, provide strong support for the "heartland-periphery" concept and its application to the analysis of urban character at the macro or national scale.

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[22]Allan Rodgers, "Regional Industrial Development with Reference to Southern Italy," Essays on Geography and Economic Development, Norton Ginsburg, ed., Department of Geography, University of Chicago, Research Paper no. 62 (Chicago: University of Chicago Press, 1960), Chap. IX, pp. 143-73.

[23]R.U. Ratcliff, Urban Land Economics (New York: McGraw-Hill Book Company, 1949), p. 20.

CHAPTER III

THE DOMINANT FUNCTIONS AND SPECIALIZATION OF CANADIAN CITIES

In the preceding chapter urban functions were studied systematically in order that their relative importance in all cities could be assessed. In this chapter dominant activities in cities are discussed, and city specialization as shown by an index developed by Ullman and Dacey is examined. Finally, a discussion of city types and their distribution is presented.

Section one of the chapter deals with the techniques utilized in identifying dominant functions and determining city specialization. In the second and third sections the distribution of cities by dominant activities and degree of specialization, respectively, are examined. The fourth and final section includes the discussion of city types and their relationship to factors of location.

I. MEASURES OF FUNCTIONAL DOMINANCE AND SPECIALIZATION

Functional dominance. As described in Chapter I the dominant function of a city is here defined as the activity having the largest share of total city excess

employment. The identification of dominant functions involved the utilization of techniques described in Chapter II. As outlined in Chapter II excess employment values were calculated when identifying distinctive activities in cities. These values, calculated by subtracting a city's expected minimum requirement values from the city's actual employment values for functions, were further applied to determine dominant activities. The excess employment values for all activities within a city were added to give total city excess employment. The percentage share of this total associated with each function was then calculated and the function having the largest share was considered to be the city's dominant activity. The activity identified need not necessarily be a distinctive function in addition to being the dominant one, although the probability of this being so is high. Again, because only basic activity (excess employment) is used, this method of determining dominant functions would appear to be superior to methods based on total city employment where the included ". . .nonbasics 'cloud the picture'. . .".[1]

Functional specialization. The problem of determining the degree of functional specialization in cities is closely

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[1]J.W. Alexander, "The Basic-Nonbasic Concept of Urban Economic Functions," Economic Geography, XXX (July, 1954), 251.

related to that of identifying distinctive and dominant activities. Norms or standards must be established against which the specialization of individual cities can be measured, and units of measurement must be developed.

Several methods of determining functional specialization have been devised, most of which have used census employment data as source material. The most common standards or reference levels against which individual cities or other areal units are compared in evaluating specialization include the distribution of employment among selected economic activities for a nation, the average employment distribution in selected activities for all cities or areas under study, and equal distribution of employment in all activities selected.

P.S. Florence and associates used the national employment profile as a base when calculating specialization indices on a state level in the United States.[2] The employment structure of each state (percentage distribution of employment in all economic activities) was compared to that of the United States--the nation--using the latter as

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[2]P.S. Florence, W.G. Fritz, and R.C. Gilles, "Measures of Industrial Distribution," Industrial Location and National Resources, U.S. National Planning Board (Washington, D.C.,: U.S. Government Printing Office, 1943).

a frame of reference for a balanced structure. Deviations between the state and national values for individual economic activities were summed, disregarding positive and negative signs, and the resulting total was taken as a specialization index.

Both J.W. Webb[3] and A. Rodgers[4] have used average employment values in selected activities for the cities under study as base levels in constructing specialization indices. Webb's index is similar to Florence's in that it is the sum of all a city's functional indices. As described in Chapter I, Webb's functional indices are weighted location quotients based on mean values of employment in all functions for the cities he studied. If a city has a specialization index of unity in Webb's system, the employment structure of the city conforms absolutely to the mean employment profile for the cities studied. As the index increases in value, specialization increases. Rodgers has developed an index whose value ranges from zero to one thousand; specialization increasing with

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[3]J.W. Webb, "Basic Concepts in the Analysis of Small Urban Centers of Minnesota," Annals of the Association of American Geographers, XLIX (March, 1959), 55-72.

[4]A. Rodgers, "Some Aspects of Industrial Diversification in the United States," Economic Geography, XXXIII (January, 1957), 16-30.

with increase in the index value. An index of zero indicates that the employment distribution in the city is identical to the mean employment distribution for all cities under consideration. Absolute specialization is indicated by an index value of 1000. This value indicates that the entire employment in a city is in one function. In using the mean employment structure as the base of their specialization indices, these analysts are assuming that the mean structure is the "balanced" city structure.

Equal distribution of employment among functions was used as a base in the study by R.C. Tress.[5] He used equal employment in twelve major industrial groups as a basis for least specialization (or absolute diversification) and computed the deviation of a city's employment profile from this base as an indicator of the degree of specialization. Rodgers states that this is ". . .relatively meaningless because an index constructed on such a base [equal employment in each function] would vary tremendously based on the kinds and numbers of industrial groups measured."[6]

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[5]R.C. Tress, "Unemployment and Diversification of Industry," The Manchester School, IX (1938), cited by A. Rodgers, "Some Aspects of Industrial Diversification in the United States," Economic Geography, XXXIII (January, 1957), 18.

[6]A. Rodgers, "Some Aspects of Industrial Diversification in the United States," Papers and Proceedings of the Regional Science Association, I (1955), B-2.

Each of these standards has some serious conceptual faults. First, it is questionable whether any of the bases represent "balanced" employment structures. Secondly, as stated by Rodgers, ". . .no area can be a microcosm of the nation as a whole";[7] therefore, the comparison of individual cities with the national employment profile or with the average employment structures for all cities under study is probably not a completely valid means of determining specialization. In reality specialization, and its antonym diversification, are difficult to define in this context, as is a "balanced" structure. The particular "employment mix" representative of a balanced profile probably differs with city location and size, and the national economy.

Because of the difficulties encountered when using the described standards, a different approach was taken in determining specialization in this study. A specialization index developed by Ullman and Dacey based on the expected minimum requirement profiles of individual cities was adopted.[8] This index assigns values to cities on the basis of the distribution of total city excess employment among the city

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[7] Ibid., B-3.

[8] E.L. Ullman & M.F. Dacey, "The Minimum Requirement Approach to the Urban Economic Base," Papers and Proceedings of the Regional Science Association, VI (1960), 189.

functions. Ullman and Dacey have designed their index so that large deviations (concentrations in one or very few functions) are accentuated. The formula[9] for determining the index value is:

$$S = \sum_i \left[\frac{(P_i - M_i)^2}{M_i} \right] \Big/ \frac{(\Sigma_i P_i - \Sigma_i M_i)^2}{\Sigma_i M_i}$$

where: "S" is the index of specialization, "i" refers to each of the thirteen functions, "P_i" to the percentage of total city urban labour force employed in each of the "i" functions, "M_i" the expected minimum requirement for each function, and "Σ_i" the sum of all the functions.

An index value of unity indicates that the distribution of excess employment among functions is of the same magnitude as the distribution of total minimum requirement employment among functions. That is, if a city's expected minimum requirement values for each function are multiplied by a common factor, the product in each case would be the city's actual employment percentage value for the respective functions. For example, if the census industrial categories are aggregated into five functional classes, a city would have a specialization index of one, if the conditions in Example A (page 129) held. In this case the actual city employment values exceed the expected minimum values by a factor of 2.5 in each function. Excess employment is

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[9] Ibid.

EXAMPLE A

Function	M_i	P_i	P_i-M_i (excess employment)	$(P_i-M_i)^2$	$\frac{(P_i-M_i)^2}{M_i}$	$\frac{(\Sigma_i P_i-\Sigma_i M_i)^2}{\Sigma_i M_i}$	Specialization Index
			Per cent of City Urban Labour Force				
a	10.0	25.0	15.0	225.00	22.5	90.00	$\frac{90.00}{90.00} = 1.00$
b	5.0	12.5	7.5	56.25	11.25		
c	2.0	5.0	3.0	9.00	4.50		
d	15.0	37.5	22.5	506.25	33.75		
e	8.0	20.0	12.0	144.00	18.00		
Total expected minimum requirement value	40.00	100.0	60.0	$\Sigma_i \left[\frac{(P_i-M_i)^2}{M_i}\right] = 90.00$			

distributed among the functions in the same proportions as the total minimum requirement employment is distributed among them.

The distribution of excess employment would appear to provide a reasonable base reference when measuring specialization. The use of an unrealistic standard such as the national employment structure or the average employment profile for cities under study is avoided, and because excess employment is determined as a function of city size, the effect of changing city size is allowed for. Also, by assigning an index value of unity to cities whose distribution of excess employment is of the same magnitude as that for the total minimum requirement employment, and increasing the value of the index as deviation from this pattern increases, a rational plan of action is followed. It seems logical to expect the distribution of excess employment among functions in "diversified" or "well balanced" cities to follow closely the distribution of the minimum requirement employment. Similarly, deviation from this format would indicate a tendency towards an "unbalanced" city structure and hence specialization. City functional specialization as given by an index based on the Ullman-Dacey type is discussed in Section III.

At this point, it is necessary to digress and present some comments on Ullman and Dacey's application of their specialization formula. These analysts appear to have misinterpreted their own index. They state that ". . .a city with its excess distributed evenly above each of the 14 minima represents the most diversified or least specialized city."[10] They also state that, "The higher the number [the index value] the more specialized [the city]; the lower the more diversified."[11] This would mean that a city whose excess employment was distributed evenly among its functions would have the lowest index value. Examination of the properties of the index reveals that this is not so. This is made evident by comparing the following example of city functional values where excess employment is distributed evenly among functions, to the earlier example (page 129) where the excess employment is distributed in constant proportions relative to the minimum requirement values. The minimum requirement values are the same for both examples; this assumes that the cities in examples "A" and "B" are equivalent in population.

In the earlier example ("A") the index value is

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[10] Ibid., 190.

[11] Ibid.

EXAMPLE B

Function	M_i	P_i	P_i-M_i (excess employment)	$(P_i-M_i)^2$	$\frac{(P_i-M_i)^2}{M_i}$	$\frac{(\Sigma_i P_i-\Sigma_i M_i)^2}{\Sigma_i M_i}$	Specialization Index
			Per cent of City Urban Labour Force				
a	10	22	12	144	14.4	90.0	$\frac{142.8}{90.0} = 1.58$
b	5	17	12	144	28.8		
c	2	14	12	144	72.0		
d	15	27	12	144	9.6		
e	8	20	12	144	18.0		
Total expected minimum requirement value	40	100	$\Sigma_i \left[\frac{(P_i-M_i)^2}{M_i}\right] = 142.8$				

unity, but in the later example ("B"), it is 1.58, suggesting that "B" is more specialized than "A" even though excess employment is distributed evenly among functions for "B". These findings are at variance with Ullman and Dacey's statement regarding excess employment distribution. Observation of city characteristics suggests that to expect the city of example "A" to be less specialized would appear rational since it is unlikely that equal amounts of excess employment would be found in all activities in the least specialized cities. Because the minimum requirement values vary among activities it is to be expected that excess employment values will also vary from function to function in the least specialized city. Equal amounts of excess employment in all activities, of necessity, indicates that some functions will be relatively more important than others because the base from which excess employment is measured differs among functions. For example, if all activities in a city have excess employment values of 5 per cent, the function whose minimum requirement value is 1 per cent will be relatively more important in the city than the function whose minimum is 4 per cent; hence, there is a trend towards specialization when excess employment values are identical for all functions.

Ullman and Dacey appear to have overlooked one other significant item when applying their index. At one point the specialization index formula calls for the division of the square of a function's excess employment value $[(P_i-M_i)^2]$ by its minimum requirement value $[M_i]$. As long as $M_i > 0$ the formula operates satisfactorily; however, in the case of one function--extraction--$M_i = 0$ regardless of city size. This is true of both Ullman and Dacey's study and the present study. Since the relationship "$X \div 0$" is undefined (mathematically impossible) it is not possible to apply the formula in the case of extraction in a mathematically correct manner.

Ullman and Dacey appear to have equated the relationship $[(P_i-M_i)^2 \div M_i$; when $M_i = 0]$ to zero. Apart from being mathematically incorrect this practice, although not altering index values significantly for cities where extraction is unimportant, does give very misleading index values for cities where extraction is significant. The index values for extraction centers are much lower than they should be. To avoid this problem in this study, an arbitrary value of 0.01 per cent of city labour force was assigned as the minimum requirement value for extraction, regardless of city size, when calculating specialization

indices. By using 0.01 rather than zero, the high specialization of typical mining centers is reflected by the specialization index; at the same time the arbitrarily selected value (0.01) is small enough to avoid serious distortion of index values for non-extraction centers. The following example illustrates this point. In case "A", the minimum requirement value for extraction is zero; in case "B" it is 0.01. All other values are the same in both cases.

Comparison of the two cases shows the need for assigning a value other than zero as the minimum requirement value of extraction. In case A, where the minimum value is zero, extraction is ignored by the formula, giving an unrealistically low index value. Extraction is taken into account in case B and the index subsequently reflects the sample city's great specialization in this function.

II DOMINANT FUNCTIONS OF CANADIAN CITIES

Manufacturing is the dominant function in sixty-one of the eighty cities. This high frequency of occurrence demonstrates in a dramatic way the overwhelming importance of this activity as a city builder. Because the function appears dominant so often, two classes of dominance are recognized: "Manufacturing I", and "Manufacturing II".

CASE A

Function	M_i	P_i	(P_i-M_i)	$(P_i-M_i)^2$	$\frac{(P_i-M_i)^2}{M_i}$	$\frac{(\Sigma_i P_i-\Sigma_i M_i)^2}{\Sigma_i M_i}$	Specialization Index
			Per cent of City Urban Labour Force				
extraction	0.00	25.00	25.00	625.00	? (0)	56.33	98.58÷56.33 = 1.75
b	10.00	12.00	2.00	4.00	0.40		
c	15.00	18.00	3.00	9.00	0.60		
d	20.00	25.00	5.00	25.00	1.25		
e	3.00	20.00	17.00	289.00	96.33		
Total expected minimum requirement value	48.00	100.00		$\Sigma_i\left[\frac{(P_i-M_i)^2}{M_i}\right]$ = 98.58			

CASE B

Function	M_i	P_i	(P_i-M_i)	$(P_i-M_i)^2$	$\frac{(P_i-M_i)^2}{M_i}$	$\frac{(\Sigma_i P_i-\Sigma_i M_i)^2}{\Sigma_i M_i}$	Specialization Index
			Per cent of City Urban Labour Force				
extraction	0.01	25.00	24.99	624.50	62450.00	56.30	62548.58 ÷ 56.30 = 1,110.99
b	10.00	12.00	2.00	4.00	0.40		
c	15.00	18.00	3.00	9.00	0.60		
d	20.00	25.00	5.00	25.00	1.25		
e	3.00	20.00	17.00	289.00	96.33		
Total expected minimum requirement value	48.01	100.00		$\Sigma_i\left[\frac{(P_i-M_i)^2}{M_i}\right]$ =	62548.58		

Included in the first class are all cities where 50 per cent or more of total city excess employment is accounted for by manufacturing. In the second class are all cities where manufacturing is dominant, but accounts for less than 50 per cent of total city excess employment. Only five other functions register as dominant activities, "sharing" the remaining nineteen cities. Extraction is dominant in six cities, transportation in five, government service in five, retail trade in two, and community service in one. Table X gives the dominant function of each city. Of the sporadic functions, only wholesale trade fails to appear as a dominant activity. As expected, a dominant rating comes to very few ubiquitous functions (two), and only three of the eighty cities have such functions as their dominant activity.

The pattern of functional dominance in cities (Figure 6) substantiates the observations made in Chapter II on the role of functions in cities; simultaneously, it emphasizes even more the unique position of manufacturing among the urban functions. It reflects the heavy concentration of manufacturing in the heartland. Thirty-one of the thirty-six cities with ratings of "Manufacturing I" are located in the heartland and all of these, save two, are in either one or the other of the two manufacturing nodes

TABLE X

SPECIALIZATION INDEXES AND DOMINANT FUNCTIONS OF CANADIAN CITIES

City Periphery: Heartland	Specialization Index	Dominant Function
Charlottetown	1.16	Retail Trade
(Lethbridge*)	1.25	" "
Rimouski	1.36	Community Service
Prince Albert	1.40	Manufacturing II
Brandon	1.41	Transportation, etc.
Penticton	1.44	"
Saskatoon	1.51	Manufacturing II
Moncton	1.55	Transportation, etc.
Moose Jaw	1.56	"
Saint John	1.67	Manufacturing II
Chicoutimi	1.72	"
St. John's	1.75	"
Truro	1.77	"
(Calgary*)	1.77	"
(Edmonton*)	1.80	"
Fredericton	1.86	Government Service
Barrie	1.87	Manufacturing II
Medicine Hat	1.97	"
Winnipeg	2.00	"
Belleville	2.04	"
Fort William-Port Arthur	2.08	"
Regina	2.09	Government Service
Quebec	2.11	Manufacturing II
St. Thomas	2.14	"
Kingston	2.17	"
London	2.17	"
Chatham	2.26	"
North Bay	2.35	Transportation, etc.
Edmundston	2.35	Manufacturing II

*The regular index value is very high because of the extraction function; this function, however, accounts for less than 5 per cent of city labour force. Because of this, a special index was constructed. It is similar to the regular index except that extraction has been omitted in its compilation.

TABLE X (continued)

City Periphery: Heartland	Specialization Index	Dominant Function
Vancouver	2.40	Manufacturing II
Brockville	2.71	"
Owen Sound	2.73	"
Orillia	2.74	"
Joliette	2.88	Manufacturing I
Pembroke	3.41	Manufacturing II
Toronto	3.51	Manufacturing I
Trois Rivières	3.52	"
Sherbrooke	3.61	"
Niagara Falls	3.62	"
Trenton	3.63	Manufacturing II
Stratford	3.87	Manufacturing I
Sarnia	3.90	"
Montreal	3.92	"
St. Hyacinthe	3.96	"
Victoria	4.01	Government Service
Woodstock	4.14	Manufacturing I
Cornwall	4.16	"
Guelph	4.22	"
Jonquière	4.40	"
Shawinigan	4.53	"
St. Catharines	4.56	"
Sault Ste. Marie	4.70	"
Sydney	5.21	"
Kitchener-Waterloo	5.36	"
Windsor	5.41	"
Peterborough	5.42	"
Halifax	5.46	Government Service
St. Jean	5.55	Manufacturing I
St. Jérôme	5.56	"
Victoriaville	5.59	"
Brantford	5.67	"
Hamilton	5.88	"

TABLE X (continued)

City Periphery: Heartland	Specialization Index	Dominant Function
(Sorel*)	6.05	Manufacturing I
Drummondville	6.24	"
Granby	6.28	"
Grand'Mère	6.34	"
Valleyfield	6.39	"
Welland	6.54	"
Trail	6.86	"
Galt	7.14	"
Oshawa	7.50	"
Magog	7.56	"
Ottawa	7.84	Government Service
Arvida	8.96	Manufacturing I
Sorel**	10.93	
Lethbridge**	11.69	
Edmonton**	14.96	
Calgary**	17.21	
Rouyn	612.92	Extraction
Sudbury	918.63	"
Thetford Mines	1139.76	"
Timmins	1400.66	"
Glace Bay	1697.89	"
New Waterford	1952.46	"

*The regular index value is very high because of the extraction function; this function, however, accounts for less than 5 per cent of city labour force. Because of this, a special index was constructed. It is similar to the regular index except that extraction has been omitted in its compilation.

**Normal specialization index values.

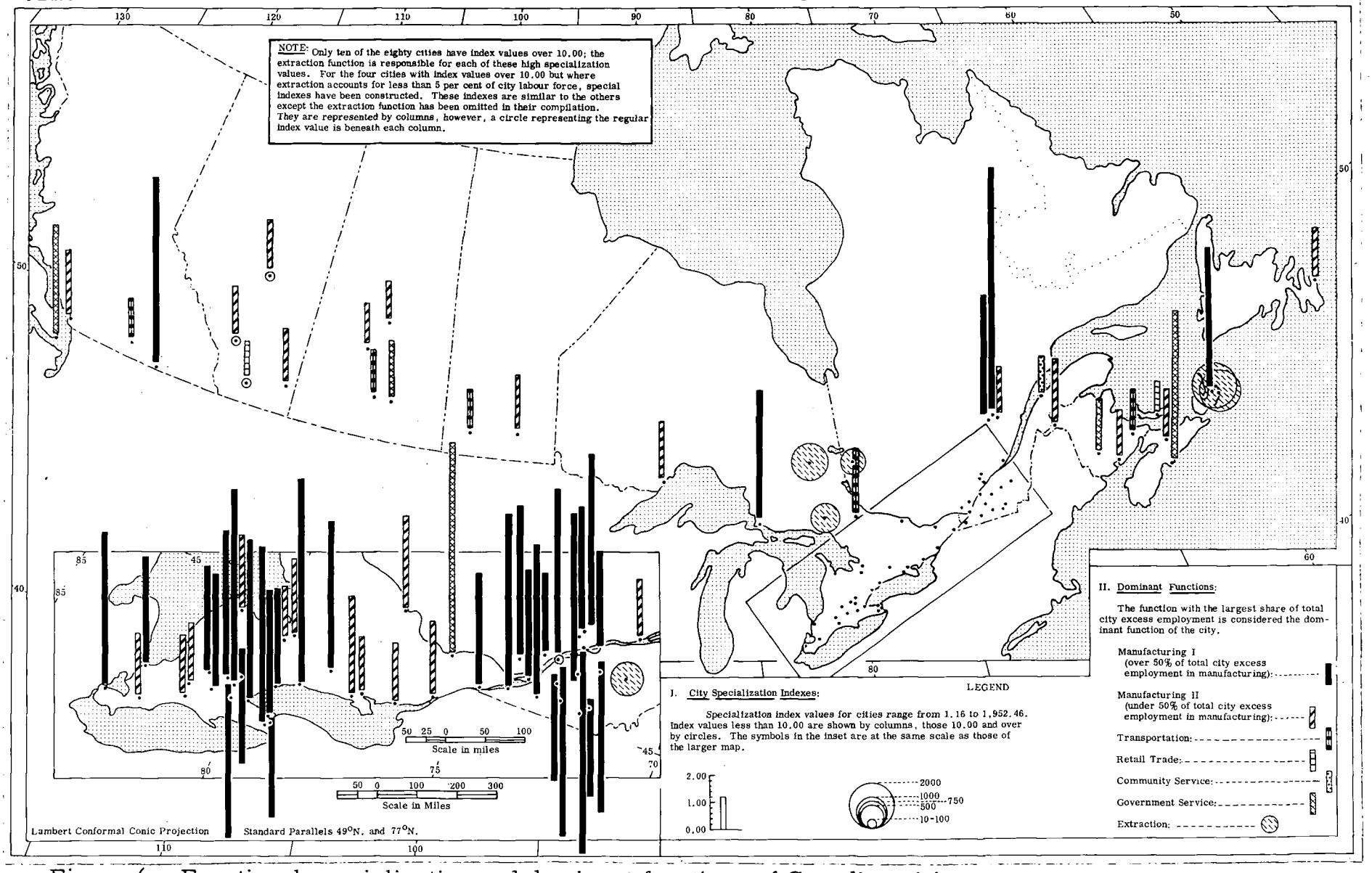

Figure 6. Functional specialization and dominant functions of Canadian cities.

within this region. In addition, it reveals a new element not shown by the distribution patterns given in Chapter II: manufacturing is the dominant function in many of the peripheral cities, although not distinctive in them. This means that even in cities which are relatively isolated and concerned primarily with servicing a hinterland, manufacturing still accounts for the largest share of basic employment. It is hypothesized that most of this manufacturing employment will be accounted for by industrial activity that is purely market-oriented, and producing for the final consumer market. Industries that use local, ubiquitous materials such as water, whose products are highly perishable, where the manufacturing process involves weight gain, or where the size of market for one minimum-sized plant is small (governed by the internal scale economies of the manufacturing process) will make up the bulk of the manufacturing activity in most of the peripheral cities. Such industries as baking, soft drink, and ice cream manufacturing are representative of this group. It is not possible to say with certainty that a fundamental difference exists between most heartland and periphery cities in the kinds of manufacturing activity associated with each because manufacturing was not broken down on the basis of relationships of inputs and outputs to resources and

markets. If such a grouping of the industries making up the manufacturing category was made, however, it is thought that the hypothesis would stand; market-oriented manufacturing associated with the final stages of production will take up a proportionately larger share of city manufacturing activity in the periphery than in the heartland where the industries associated with the earlier and especially the intermediate stages of production for both final and non-final markets will be relatively more important.

As has been indicated, the heartland cities with "Manufacturing I" ratings are highly concentrated in two zones. These two city clusters represent the manufacturing heart of Canada. Because the cities of these clusters are highly specialized, (illustrated in Chapter III), it is assumed that a high degree of industrial linkage has developed among the industries at both the intercity and intracity level; all types of industrial activity occurs from blast furnace activity, to electronics manufacturing and food processing. The cities within these "systems", although dominated by manufacturing, differ from "Manufacturing I" cities in the periphery in that the "manufacturing mix" within the heartland cities is much more diversified.

Cities with large proportions of their total excess employment in manufacturing are the exception in the periphery. They differ markedly from most peripheral cities in that they normally are not concerned with hinterland servicing, at least not as a primary function. These manufacturing cities, with the mining centers, stand apart from the other peripheral cities, and, although based on different activities, have many traits in common with the extraction centers. The most outstanding trait, perhaps, is the tendency for both types of centers to be "one-industry cities" where the dependence on one industrial activity is extremely high. Without exception the peripheral cities with ratings of "Manufacturing I" are associated with primary, resource-oriented industries. That is, industries involved in the initial processing of crude materials where there is a considerable loss of weight and often a high rate of fuel consumption in the processing.

The cities with "Manufacturing II" ratings are, for the most part, regional capitals or transportation centers where functions other than manufacturing provide the best indicators of the functional role. Because manufacturing, as an undifferentiated functional category, enjoys a position of such overwhelming importance, its dominance tends

to blanket the distinct and unique features of city functional profiles, thus giving an almost uniform and colourless impression of city functional structure. When studying the functional roles of cities, distinctive activities must be considered as well as dominant functions. This is especially true when manufacturing is the dominant, but not a distinctive activity in a city as is the case in most cities with ratings of "Manufacturing II". If the most distinctive functions of this group of cities are examined, the importance of the "central place" and "transport" functions soon becomes apparent. Wholesale trade, finance, recreation and community service rank high as distinctive functions followed closely by retail trade, and government service. Transportation ranks high as a distinctive function in some "Manufacturing II" cities and serves to isolate those instances where cities owe their existence primarily to transport functions although having manufacturing as the dominant activity. Fort William-Port Arthur provides the classic example of a city that has built up an important manufacturing function based on a transport break-in-bulk point. A listing of cities with their dominant and distinctive functions is given in the appendix.

It is observed in Figure 6 that only two of the

forty-five heartland cities do not have manufacturing as their dominant functions; one is the national capital, the other an extraction center. The remaining seventeen cities with functions other than manufacturing being dominant are in the periphery. They are either regional capitals or transportation centers, or a combination of both, except for the extraction centers. Such a distribution is to be expected in light of the previous discussions on the fundamental economic differences existing between the heartland and periphery.

To summarize, the distribution of dominant functions tells much the same story as those of the distinctive functions. It portrays in dramatic fashion the importance of manufacturing in the heartland, delineating clearly the two clusters of manufacturing cities in this region. It also reinforces the thesis that the peripheral cities are primarily concerned with functions associated with distance. This is indicated by the number of cities in the periphery with central place and transport functions as their dominant activities.

The distribution pattern also introduces a significant additional element: manufacturing is dominant in many cities, both in the heartland and the periphery, which are essentially

regional capitals. Study of this phenomenon has led to the hypothesis that the kind of manufacturing activity found in regional capitals is fundamentally different from that of the manufacturing cities making up the "city-systems". The hypothesis suggests that manufacturing activity associated with final stages of production, and producing for the consumer market is relatively more important in the regional capitals than in the "system" cities.

III FUNCTIONAL SPECIALIZATION OF CANADIAN CITIES

It was suggested in Sections I, II and III of Chapter II that city functional specialization is determined by several factors, the most important being: population size, geographic position, and the functions of the city. The application of the modified Ullman-Dacey specialization formula to Canadian cities has provided a quantified measure of city specialization which allows some of the theories regarding specialization to be evaluated.

The relationship of city specialization to dominant functions and city location. Table X (page 139), gives a listing of the cities and their specialization indexes, ranked by increasing specialization. City specialization

is also shown graphically in Figure 6 (page 142), where the length of the bars and areas of the circles are proportional to the degree of city specialization. Preliminary observation of these materials reveals that a great range in value is experienced by the specialization index--a range of almost two thousand points. Despite this wide range, however, seventy of the eighty cities have index values falling between one and ten, and another four have indexes between ten and twenty. Thus, only six cities have extremely high values. In each of these six cities extraction is the dominant function. This observation would appear to substantiate the statement that the exclusive priority necessarily placed on resource location often precludes the possibility of other city-forming activities emerging in extraction centers, thus promoting extreme specialization in extraction. In the four cities with index values between ten and twenty, extraction is again responsible for the relatively high values. In these cities, however, extraction accounts for less than 5 per cent of the city labour force, and is a distinctive function in only one of them--Lethbridge, already discussed in Chapter II.[12] In Calgary and Edmonton--

[12]Because extraction occupies such a small place in the functional profiles of these cities special indexes were derived for them. These indexes were constructed in the same manner as the regular indexes except that the extraction function was omitted. This action gives specialization values more representative of the actual profiles of these cities.

two of the remaining three cities in this category--the presence of extraction, albeit in a low position in both city functional profiles, illustrates an important aspect of these centers' functional position. They are the focal points of the western Canadian oil and natural gas industries. Almost all the employment reported for extraction in the 1951 Census of Canada for these cities is associated with oil prospecting, and crude oil and natural gas production. The centers act as the head-office locations of numerous companies in oil and gas exploration and development. Many oil drilling firms, for example, operate in the oil fields from headquarters in these cities where maintenance facilities are established and business transactions carried out. Extraction also serves to point out an important functional characteristic of Sorel, the last city having an unrealistically high specialization index due to the extraction function. There is a close relationship between Sorel and mineral exploitation on the north shore of the St. Lawrence estuary and gulf. Good harbour facilities exist at Sorel and a smelter in the city processes iron-titanium ores from the north shore. Because of this close relationship it is thought that the extraction employment registered for Sorel probably includes many

workers whose homes are in the city, but who work in north-shore mining camps.

Further examination of Table X (page 139), and Figure 6, (page 142) reveals that some clear trends exist in the association of city functional specialization with city location and dominant functions. Apart from the extraction centers, most of the highly specialized cities are "Manufacturing I" centers. These cities are of two kinds: (1) those of the well-integrated "city-systems" in the heartland, and (2) those purely resource-oriented, relatively isolated cities of the periphery. As outlined in Chapter II, the propensity for city specialization is high in "city-systems" where a high rate of city interaction allows a center to rely on other "system cities" for both needs and markets. The resource-oriented centers are highly specialized for much the same reasons as are the extraction cities. They are not located in areas with densely populated hinterlands where central place functions are required to a degree which would offset the manufacturing specialization. Further, because their industrial activity is concerned with one or few major operations, rather than many as is the case in the "city-system" cities, the likelihood of developing diversification even within the manufacturing function through industrial linkage is small.

Specialization also reaches high levels in a few government centers, notably the national capital. The reason for Ottawa's specialization is obvious. Without the government function the city would be a relatively small regional capital serving the lower Ottawa Valley. It has attained its present size solely through its government function; industrial activity is very insignificant. Victoria and especially Halifax, unlike Ottawa, are important regional capitals besides being government centers. The existence of both administrative and military activities is sufficient, however, to give these cities a high degree of specialization in government service.

Functional diversification is greatest among the cities of the periphery where serving a large hinterland is of prime importance. These activities, plus a certain degree of isolation have worked to make the centers relatively self-sufficient. Charlottetown, for example, is the least specialized city in Canada--according to the modified Ullman-Dacey specialization index. It is also one of the most isolated cities in Canada whose primary role is the servicing of a predominantly agricultural hinterland. The regional capitals of the periphery are closely followed in terms of specialization, by heartland cities with similar

functional structures. The heartland cities acting primarily as service centers tend to be slightly more specialized than their counterparts in the periphery. This occurs, it is thought, because they are closer to the national "nucleus", hence, not as isolated. The possibility of them receiving special activities such as national headquarters of large firms is greater than it is for peripheral cities. London, for example, is essentially a regional capital or service center--the principal one in southwestern Ontario. In addition, it is also an important financial and insurance center on the national level. Specialization is further promoted in the heartland service centers by their relative proximity to the specialized manufacturing centers of the "city-systems". Generally, manufacturing plays a more significant role in heartland regional capitals than those of the periphery, as indicated by the dominant functions of cities. All regional capitals in the heartland are "Manufacturing II" cities, whereas only about half of the peripheral service centers are so characterized; the balance having transportation, retail trade, or some other function as the dominant one. This greater emphasis on manufacturing in the heartland regional capitals is to be expected; first, because the heartland is the "heart" of Canadian manufacturing; secondly, because the distances between the regional

capitals and the centers of the "city-systems" are small and some "overflow" in industrial linkage can be expected to occur.

A quantitative measure of the association of city specialization with city size, "isolation", and manufacturing activity. To obtain additional quantitative evidence regarding city specialization, a rather crude technique was devised to examine the relationship of city specialization to: (1) city population, (2) city "isolation", and (3) city manufacturing activity. From previous evidence it was assumed that a causal relationship exists between city specialization and each of these factors. An easily employed technique, Spearman's coefficient of rank correlation, was used to assess the degree of association existing between city specialization and the three factors listed. Since cities had to be ranked by value for each factor, four measures had to be obtained. The modified Ullman-Dacey specialization index was used as a measure of city specialization. To measure city "isolation" the total road distance from a city to its four nearest neighbours of ten thousand

population or over was used[13]. This measure, it is readily admitted, is very crude and open to much criticism; however, because of the great amount of time and effort required to construct a better index of "general accessibility" such as population potential, the crude index was adopted. The percentage of total city excess employment in manufacturing was taken as a measure of city manufacturing.

Two sets of coefficients were calculated. One set was based on the ranking of all cities, the other on all cities except those where extraction or government service are the dominant functions--eleven cities were excluded on this count. Extraction and government centers were omitted because it is thought they represent special situations and do not reflect the general spatial-economic elements of the urban milieu to the same extent as other cities. Their location and degree of specialization are more directly related to individual factors such as: specific resource location, strategic position, and political consideration, than to the general economic fabric of the nation. The coefficient values are as follows:

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[13]The total road distance from each city to its four nearest neighbours of ten thousand population or over was found by taking road distances from mileage charts on official government and oil company road maps.

Spearman's Coefficient of Rank Correlation[a]

	Specialization and Population	Specialization and "Isolation"	Specialization and Manufacturing
All cities (80)	0.088	0.395	0.469
All cities except those where government service and extraction are dominant (69)	0.105	0.604	0.958

[a]The cities were ranked in the following manner:
(1) by decreasing degree of specialization
(2) by increasing population size
(3) by increasing total distance to the four nearest neighbours of ten thousand population and over
(4) by decreasing percentage of excess employment in manufacturing

Comparison of the values for the two sets of correlation coefficients serves to point out the special position of the extraction and government centers. The degree of correlation is much less when all cities are included in the rankings than when the government and extraction centers are excluded. This would appear to confirm the suggestion that specialization in such centers is subject to population and accessibility factors to a much lower degree than it is in other types of functional centers. In these special cities the type of activity

occupying the dominant position is the prime determinant of city specialization. For example, Ottawa, ranking fifth in population and forty-sixth in "isolation", could be expected to be a reasonably well diversified city because of its large population and moderately good accessibility. In specialization, however, it ranks as the eighth most specialized city; only the extraction centers and Arvida--a one industry, resource-oriented "company town"--are more specialized.

The coefficient values also reveal that the highest degree of association with city specialization is given by manufacturing employment, closely followed by "isolation". The close relationship between specialization and manufacturing is not unexpected because of the very prominent position this activity plays in urban functional profiles. The relatively close association between degree of city isolation and specialization is also to be expected in light of the discussion on "city-systems" and the need of regional capitals for "self-sufficiency". The unexpected development is the low degree of association existing between population size and specialization. Some of the reasons for this probably result from the nature of the indexes used to characterize city functional structure and

to measure specialization. Also the use of highly aggregated functional categories undoubtedly creates a bias because no allowance is made for diversification within categories. Such diversification will undoubtedly increase with city size. It is thought, however, that the low degree of association between specialization and population also reflects, at least to some extent, the operation of other factors in addition to city population size in the determination of city specialization. Such factors as the two noted earlier--degree of isolation and the particular "dominant function" of the city--play a very significant role in determining the degree of functional specialization of a city. For example, the regional capitals of Charlottetown, Rimouski, and Penticton--all under twenty thousand population--are much less specialized functionally than the manufacturing centers of Hamilton and Windsor or the government centers of Ottawa and Victoria--all over one hundred thousand population.

To summarize, the following statements, based on the foregoing discussions, are presented:

(1) the extraction centers are the most specialized cities, followed by the manufacturing centers.

(2) generally, city specialization is greatest in the heartland and least in the periphery.

(3) within the heartland the manufacturing cities of the "city-systems" are the most specialized, with the exception of one extraction center.

(4) some very distinct exceptions occur in the general pattern of city diversification in the periphery. These exceptions are associated with the extraction and purely resource-oriented manufacturing centers which experience extreme rates of specialization. Two government centers where both legislative-administrative and military functions are found also experience high rates of specialization.

(5) specialization in the heartland regional capitals tends to be slightly greater than in the peripheral counterparts due to the greater degree of isolation in the periphery.

Generalizing:

(1) city functional specialization is affected by the degree of isolation a city experiences. As city isolation increases, city specialization usually decreases.

(2) the particular "dominant function" of a city affects the rate of city specialization. Centers where extraction or government service are dominant often are much more specialized than would be expected from their degree of isolation and population size.

(3) while population size is a major factor governing the degree of city specialization (illustrated in Chapter II), its influence on specialization rates is often secondary to that of geographic position (isolation) and the type of dominant and distinctive functions of the city.

IV COMMENTS ON "CITY TYPES"

The data resulting from the application of the minimum requirement technique of city functional analysis to Canadian cities are presented in summary form in Table X (page 139), Figure 6 (page 142), and in the appendix. These substantive materials represent "objectives attained" in reference to the formal goals of the study. The descriptive notes presented in this section are of a supplementary and summary nature.

Reference was made in previous sections to "regional capitals", "transportation centers", and "specialized manufacturing cities", yet nowhere have these terms been defined. In this section a brief descriptive outline is presented of Canadian cities viewed in terms of these "city types". The purpose is to clarify what is meant by "specialized manufacturing city", "regional capital", et cetera, and to illustrate further the basic differences that exist between the functional positions of cities in the heartland and in the periphery. The terms used here to describe cities are of a general nature and were not applied with great precision. Only certain aspects of city functional structure were considered when grouping cities, thus the grouping scheme is fairly crude. The appendix should be consulted for full details on distinctive and dominant functions, and degree of specialization of individual cities.

Briefly, five groups of cities were identified on the basis of the importance of wholesale trade, manufacturing, and degree of specialization in cities. Obviously, other city groups exist, but different criteria are required to identify them. The criteria selected and the groups recognized are considered to be the most significant ones at the macro level where the total Canadian urban milieu is

is being viewed. The influences of the two fundamental elements determining the nature of city functional profiles --distance and concentration--are recognized when using wholesale trade and manufacturing as criteria; each function is intimately associated with one of the two elements. The percentages of a city's total excess employment (basic employment) in manufacturing and wholesale trade, respectively were used as measures of importance for the two functions. These values for each city were plotted on an isometric graph (Figure 7), together with values of city population and functional specialization to facilitate the "characterizing" of centers. So that other functions were not completely ignored, special note was made when individual cities within groups were known to have important functional positions that are not identified by the grouping criteria. In this way "transportation", "extraction", and "government" centers were identified.

An examination of Figure 7 reveals two familiar patterns: specialization generally increases with increases in the importance of manufacturing, and heartland cities are generally more specialized than the peripheral cities. Further examination brings to light several fairly distinct groups of centers. First, there are thirty-one cities with high to very high values of manufacturing importance, but

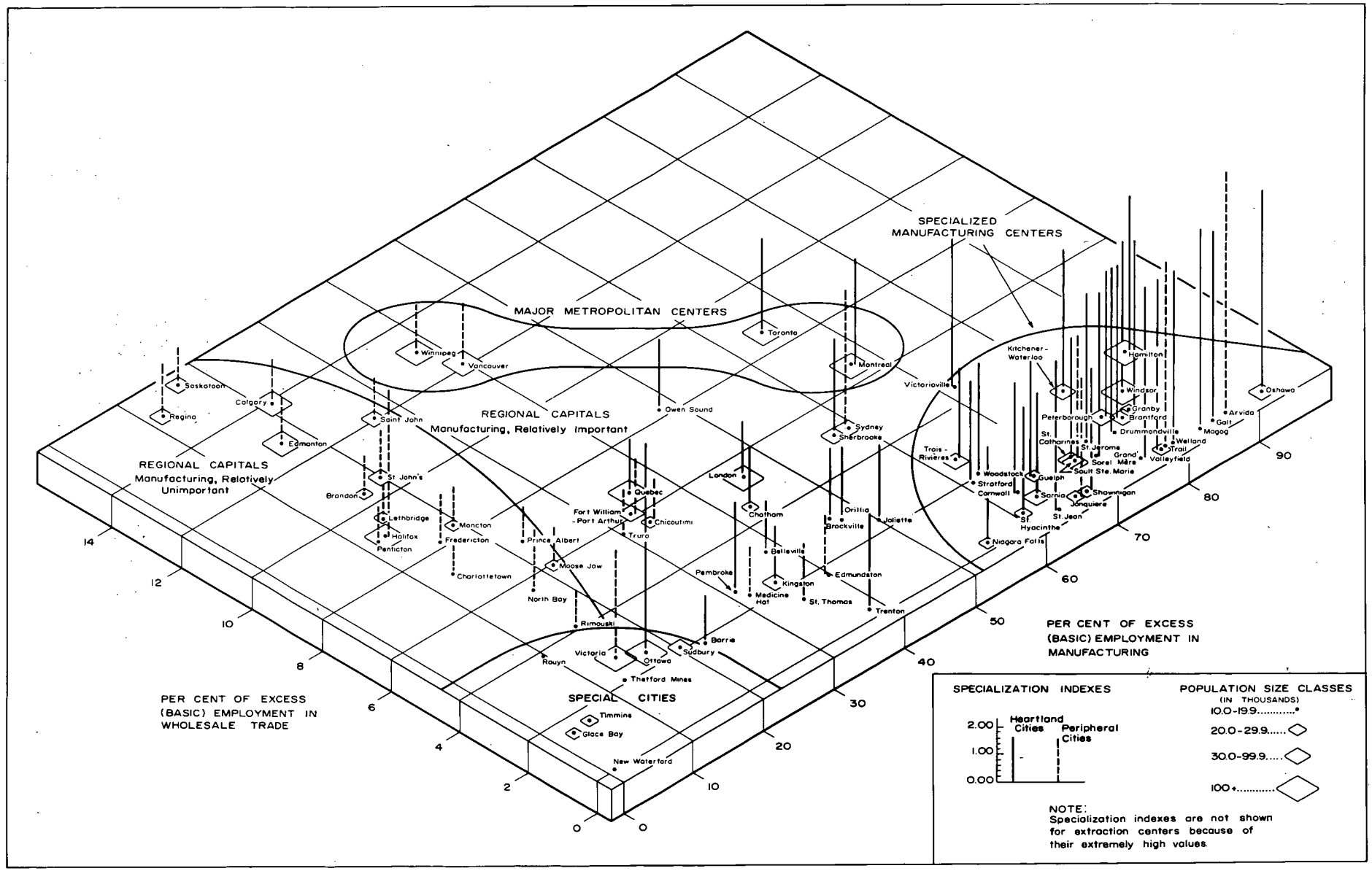

Figure 7. "City-types" in Canada.

with moderately low to low ratings for wholesale trade. Since these cities appear, for the most part, to have nearly minimal trading functions and, as a group, exhibit a high rate of specialization, they have been called "specialized manufacturing centers". All but four of these cities are located in the heartland. The four peripheral cities are resource-oriented manufacturing centers where the nature of the manufacturing processes, and either: (1) the lack of a large, densely populated hinterland that would promote central place functions, or (2) the assumption of hinterland servicing by a nearby center, have given rise to high specialization rates and a tendency for one industry to be dominant. In the heartland, it is the "specialized manufacturing centers" that make up the "city-systems". While all these cities exhibit a high specialization in manufacturing, a fair degree of variation exists within the group. Oshawa, Galt and Magog, for example, present extreme cases of manufacturing specialization. These cities are almost juxtaposed to larger centers and are, in a sense, "specialized suburbs" or components of "dispersed cities". Victoriaville and Trois Rivieres, on the other hand, are important as regional capitals, although the central place functions are definitely secondary to manufacturing in their functional profiles. The city with the

lowest rating of manufacturing importance in the group, Niagara Falls, is a tourist center as well as a manufacturing city. This feature is revealed by "distinctive" ratings for both the personal service (includes hotel, motel, and restaurant employment) and the recreation functions in this city.

Secondly, there is a group of eight cities which are very highly specialized, but have low rates of importance for both manufacturing and wholesale trade. Other functions, obviously, have the significant roles in these cities. Because this feature (high specialization rates coinciding with low value in both manufacturing and wholesale trade) is characteristic of so few cities, these centers have been called "special cities". Included in this group are highly specialized government and extraction centers. The two most specialized Canadian cities, the mining centers of New Waterford and Glace Bay, have the lowest ratings of manufacturing importance in Canada. In some ways they resemble the highly specialized centers of Oshawa and Galt in that they are components of a "dispersed city". The two cities, with Sydney and smaller suburbs, make up the iron and steel complex of Cape Breton Island. The functional structures of the cities are well integrated with one another.

The mining center of Rouyn presents an interesting case because its value of importance in wholesale trade is higher than for any other "special" city. Here is a case where a highly specialized extraction center also acts as a service center for surrounding areas.

A third group of cities is characterized by relatively high values of wholesale trade importance, low values of manufacturing importance, and generally low levels of specialization. Since city functional diversification (little specialization) and high ratings for trading functions are closely associated with hinterland servicing, the seventeen cities of this group have been called "regional capitals: manufacturing relatively unimportant". Actually, there is a moderately wide range in wholesale trade importance in this group. It is the low value of manufacturing importance combined with low specialization rates that set this group apart. The range in wholesale trade importance appears to be related to population size of city. As indicated in Figure 2 (page 69), the importance of wholesale trade in cities tends to increase with city size. This is again shown in Figure 7 where the importance of the trading function is relatively greater in the large cities than in the small ones. Despite the rather

low ratings for wholesale trade in centers such as Rimouski, Charlottetown and Prince Albert, however, these centers are quite definitely regional capitals. Although their rates for wholesale trade importance are low in comparison to those of the larger cities within the group, they are higher than those of many larger cities outside the group.

It is in these cities that the central place functions show their greatest strength in city functional profiles. Significantly, all the cities of this group are located in the periphery. These are the cities most concerned with collecting, transferring, and distributing goods. It is not surprising to find that all five cities where transportation is the dominant function are in this group. Also in the group are the two cities where retail trade is the dominant function. Several cities act as political capitals as well as regional ones. Included are Edmonton, Regina, Fredericton, and Halifax. The first three maintain functional profiles typical of regional capitals despite the government function. Halifax, however, because of the presence of a large military establishment in addition to other government activities, has a high rate of specialization. This is the only atypical specialization index in the group.

An additional four cities can be isolated on the basis of population size and relatively high values for both wholesale trade and manufacturing. They are the nation's "major metropolitan centers". The positions of these cities in Figure 7 symbolizes the two distinct groupings of Canadian cities: peripheral versus heartland "functional types". Winnipeg and Vancouver, located in the periphery are much more involved with wholesale trade (also transportation) than Toronto or Montreal, situated in the heartland. On the other hand, the latter two cities emphasize manufacturing to a greater extent than their peripheral counterparts. The implication is clear; a now familiar thesis is again stated: the problem of distance requires urban centers in the periphery to "consume" greater amounts of "economic energy" in achieving their functional objectives than is required by the heartland cities. In keeping with the position of the heartland, its metropolitan centers are the largest cities in the nation and their influence infiltrates all segments of the national economy. The influence of the two peripheral metropolitan cities, in contrast, is restricted to western Canada. The northern and eastern peripheries are essentially appendages of the heartland--as is the western periphery,

but to a lower degree--and they do not have any cities which rank as national metropolises. They do have several cities that could be described correctly as "regional metropolises"; these have been included with the "regional capitals" in this grouping scheme.

The remaining twenty cities are "mid-way", in terms of specialization and importance of wholesale trade and manufacturing, among the specialized manufacturing centers, the regional capitals where manufacturing is relatively unimportant, and the special cities. In this group of cities are found some of the best examples of the multi-functional nature of city functional structure. It is perhaps the most heterogeneous group of all because there is no outstanding trait common to all the cities within it. In the groups previously described all cities share one distinctive characteristic, be it: (1) a very high degree of specialization, (2) a high degree of manufacturing importance, or (3) a high rate of wholesale trade importance combined with low ratings for manufacturing and specialization. The lack of any real "distinctiveness" in terms of specialization, wholesale trade or manufacturing means that many of these cities must be differentiated on the basis of other functional characteristics if detailed

analysis is required. In general terms, the larger centers are regional capitals with a moderate to heavy emphasis on manufacturing, and the smaller cities, while often serving as regional capitals, do not have very significant wholesale trade functions. They are frequently involved with other types of activity such as government service and transportation functions. This group of cities has been called "regional capitals: manufacturing relatively important". The title is not entirely satisfactory because the group is heterogeneous and the name obviously does not apply to all its members; however, for lack of a better term the name was allowed to stand.

Six of the twenty centers in the group are peripheral cities. They are all important regional capitals but also have significant manufacturing functions which are based on either local resources and/or advantages accruing from transportation factors. For example, the existence of local coking coal is basic to Sydney's iron and steel complex, local clay deposits and natural gas reservoirs provide the principal materials for Medicine Hat's clay products industry, and regional forest resources feed the large pulp and paper operations in Edmundston. Fort William-Port Arthur and Truro represent cases where transportation factors are of prime importance as underpinnings

of a city's manufacturing function. Local resources are relatively unimportant in the two cities as factors in manufacturing location; the advantages accruing to break-in-bulk points and points of "centrality" (Truro is considered the "hub" of Nova Scotia) clearly provide the basis for manufacturing in these centers. The existence of flour mills and oil refineries in Fort William-Port Arthur, for example, is directly related to the break-in-bulk feature. These peripheral cities are only slightly more specialized than most of their counterparts which serve as regional capital but where manufacturing is relatively unimportant. Sydney, however, is much more specialized than the others because of its heavy emphasis on iron and steel. In this respect it resembles closely the "specialized manufacturing centers".

A fair amount of functional diversity is exhibited by the heartland cities in this group. For example, Trenton, Barrie, and Pembroke are closely associated with military camps; St. Thomas is an important railway center; Kingston is perhaps the closest approximation in Canada to an "institutional" center, having important educational, military, religious, and penal facilities; Quebec City is a political capital; and Orillia is the site of a large

mental hospital. Because of this diversity it is difficult to formulate general statements on these cities. Of note, however, is the fact that only two of the fourteen heartland cities in this group are members of the "city-systems"; the great majority are outside the "systems" and are not typified by high specialization indexes as are "city-system" centers. Even the two cities within the "systems" are highly diversified in comparison to other "system" cities. Joliette is the least specialized of the "city-system" centers, and only two other "system" cities besides Joliette are more diversified than Sherbrooke. In essence, most of these heartland cities are basically regional capitals exhibiting functional profiles not too dissimilar from those of their counterparts in the periphery. Their rates of specialization, for example, are closer to those of the peripheral service centers than to the ones of "system" cities. As stated in the preceding section, the propensity for obtaining special functions and moderately high rates of manufacturing activity is greater for the heartland regional capitals than for those of the periphery. This greater opportunity of obtaining additional city-forming functions enjoyed by the heartland regional capitals has tended to produce more complex functional structures because the additional

functions are superimposed on the basic "service-center type" of functional structure. Variety in the types of functional profiles is hence greater among the heartland regional capitals than in the periphery, even though manufacturing appears as the dominant function for all heartland regional centers.

Summary: Accepting the limitations stated on page 161, this technique of city grouping--including the graphic portrayal in Figure 7--supplies a useful means of obtaining an overview of urban character in Canada. Although it by no means allows an exhaustive analysis of city functional structure to be made, it illustrates clearly the influence of the fundamental forces affecting city functional performance in Canada: distance and concentration.

CHAPTER IV

SUMMARY AND CONCLUSIONS

I. THE CANADIAN URBAN MILIEU: AN OVERVIEW

The functional structure of cities in the Canadian "heartland" differs fundamentally from that of cities in the "periphery" of Canada. The heartland cities are functionally more specialized and emphasize manufacturing to a greater degree than do the peripheral cities. The latter cities are generally quite diversified and are inclined to have a relatively more important involvement with functions associated with distance such as wholesale trade and transportation, although manufacturing is still important in their profiles. Several highly specialized cities do, however, exist in the periphery; without exception they are associated with either the extraction function or resource-oriented manufacturing. These cities are few in number and do not represent the norm, although they are vital in the national economy.

In order to explain the dichotomous nature of city functional profiles--heartland versus peripheral cities--several hypotheses have been stated including:

(1) heartland cities are generally more specialized than peripheral cities because functional specialization decreases with increasing geographic isolation. Division of labour, the basis of city functional specialization, is a function of distance. Increasing the friction of distance increases the difficulty of attaining high rates of division-of-labour because exchange of goods is essential to a continuing system of specialized production. Specialization, therefore, decreases as distal friction increases. Relatively isolated cities cannot rely on neighbouring centers to supplement their requirements to the extent that cities in "city-systems" can. Moreover, most cities in comparatively insular positions are primarily concerned with hinterland servicing where numerous urban functions come into play. This situation tends to produce self-sufficient and diversified cities. In contrast, a city located within a cluster of cities can rely on nearby centers for both needs and markets. The friction of distance is relatively inconsequential, thus

allowing the full advantages of division-of-labour to operate and thereby promoting functional specialization. In addition, because so many cities are located within a small area, the "diversifying" effect associated with hinterland servicing is insignificant since the amount of such servicing performed by any one city of the cluster is very small.

Evidence resulting from a crude test of association between specialization and geographic isolation verified the applicability of this hypothesis to a degree. The hypothesis is not applicable, however, in the case of the purely resource-oriented manufacturing peripheral cities or the extraction centers. This situation prompted the stating of a second hypothesis.

(2) high specialization rates are experienced in peripheral resource-oriented manufacturing cities and extraction centers primarily because of: (a) the lack of additional functional opportunities, and (b) the nature of the manufacturing and extraction processes. For these cities, resource location usually received an exclusive priority in the selection of the city site. Often this feature works against the

> situational requirements of other urban functions. The desired resource site may be located in an area without a populated hinterland or where hinterland serving is adequately managed by other centers. Secondly, most resource-oriented manufacturing processes are at the primary stages of production. These stages usually require very large plants--even at the "minimum-size" level--in order to be economic. This is a consequence of high levels of wastage, high energy requirements, and relatively low unit-values of output in these manufacturing processes. For this reason many resource-oriented centers are completely dominated by one large plant, thus discouraging the development of diversification even within the manufacturing function through industrial linkage.

Variation in city functional structure has been found to be a function of distance, concentration, and type of manufacturing activity. In essence, the basic differences in city functional development stem from the simple fact that "the character of a city's functional profile reflects the character of the region the city serves". The Canadian

heartland and peripheral areas are geographic realities. They differ greatly in historical, economic, and to some degree, in cultural development. The fact that their cities reflect these differences seems like a reasonable and to-be-expected conclusion.

II. CITY FUNCTIONAL CLASSIFICATION: RETROSPECT AND PROSPECT

In terms of technique, the most significant feature of the study is that the application of a purely objective method of classification, based on census statistical data, has produced a general classification of Canadian cities which is rational in light of background knowledge of the Canadian urban milieu. There are certain weaknesses in the study scheme, however. For example, it was impossible to make any definite statements regarding the differing nature of the manufacturing activity in heartland and peripheral cities, although certain hypotheses were entertained. This was a consequence of the failure to break down the manufacturing activity into components based on the relationship of manufacturing inputs and outputs to resources and markets. Such a situation is characteristic of most classification schemes which utilize census statistics as the sole source

of data in the classification problem. In general terms, the use of census industry divisions as city functional categories in these studies, has meant that no direct relationship has been established between factors of city location and city functional characteristics. This limitation is perhaps the most serious shortcoming of this study. It stems, not from any fault of the particular classification technique applied, but from weaknesses in the traditional conceptual approaches to city classification. Too often the motivation behind the production of a classification scheme has not been made clear, thus giving the impression that the scheme has been created simply for the sake of making a classification of cities. The quantitative classification schemes developed (including the one presented in this study) have, it is concluded, placed undue emphasis on the detailed manipulations of data, at the expense of conceptual considerations as to how these studies can best be applied in advancing the knowledge of the "location-function" relationships of cities. To be sure, most classification studies have attempted to analyze and explain these relationships through cartographic portrayal, but too often this has been an isolated and secondary exercise quite divorced from the classification

scheme itself. City functional classifications developed without some basic association with location factors, tend to be sterile inventories. What is required are studies where the city functional categories imply definite locational characteristics, and which use city classification as a tool in the solution of specific problems related to the location and socio-economic characteristics of urban centers.

If city functional classification is accepted as an essential tool in the analysis of problems associated with the type and spacing of urban phenomena, two areas of investigation that would lead to improved and more flexible classification schemes suggest themselves from this study.

There are two limiting factors in the quantitative classification schemes discussed. One has been mentioned--the use of census industry divisions as city functional categories. The census groupings at the intermediate and higher levels of aggregation tend to be quite heterogeneous and arbitrary. It is obvious that the practice of using them as city functional categories, while convenient, does not give city functional groupings that have much significance in terms of location factors. For example, to know that the dominant function of a city is "manufacturing" tells one

little because this function is the dominant activity in most cities. The significant item to know is what kind of manufacturing is present in the functional profile, in terms of markets and resources. Is it resource-oriented, market-oriented or "footloose"? Is it producing for the final or non-final market? What stages of production are involved, and what is the propensity for the development of industrial linkage? The realignment of census material to give this kind of information would facilitate greatly the integration of data on city location and function.

Investigation into ways and means by which this realignment can be achieved would, it is suggested, prove to be a profitable avenue of research. Progress along these lines has already been made in the United States by researchers of Resources for the Future, Inc.[1] They have compiled a table, based on the 1947 Interindustry Relations Study of the United States Bureau of Labour Statistics, which shows industries grouped into four classes on the basis of their relationship to raw materials. These classes are:

Primary resource extractors

First stage resource users

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[1] Harvey S. Perloff et al., Regions, Resources, and Economic Growth, (Baltimore: The Johns Hopkins Press, 1960). Appendix Table L, pp. 677-680.

Second stage resource users

Industries for which resources have the most indirect significance.

Otis Duncan and associates have used these industrial groupings in their study of metropolitan centers in the United States.[2] By utilizing additional information given in the Resources for the Future table they were able to further classify industries on the basis of whether they produced primarily for a final or non-final market. While this scheme represents a significant step forward in the study of "location-function" relationships of cities, it is not readily applicable to service and cultural categories as listed in the census. Further research is required to develop groupings of these activities which will demonstrate the significant relationships that exist among functions within a city, between a city and its hinterland, and between the city and other cities. Once the realignment of the detailed census categories is achieved, it will be possible to formulate meaningful functional groups with reasonable ease.

The second limiting factor present in the quantitative city classification schemes discussed, stems from the problem of selecting "functional standards" against which the indi-

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[2]Otis Duncan et al., Metropolis and Region, (Baltimore: The Johns Hopkins Press, 1960), pp. 200-209.

vidual city profiles are evaluated. Despite the "objectiveness" of these studies, subjectivity is still very much involved when the "standards" are being established. For this reason the results of different studies vary. As an example of this, the results of a pilot study in the functional classification of Canadian cities differ from the findings given in this report. The same source material was used in both studies, and the functional categories recognized were almost identical but different classification techniques were used. A classification scheme similar to J.W. Webb's was used in the pilot study, while the minimum requirement technique was applied in the final study. The greatest variance in the results of the two studies occurs in the ranking of cities by the degree of functional specialization. Sydney, for example, ranks as the least specialized city according to the modified Webb method, but it is the twenty-eighth most specialized city (out of a total of eighty cities) when the minimum requirement technique of classification is applied. Perhaps it will never be possible to develop "standards" without the presence of some subjective elements in the considerations, indeed, it probably is not even desirable. It is desirable, however, to minimize the necessity of making arbitrary decisions, when establishing criteria. The possibility of

doing this has been greatly increased with the introduction of systems of multivariate analysis into the geographical literature. Multivariate techniques of analysis, not only allow the "testing" of variables as to their suitability as measures of city functional character, but with electronic computer facilities at hand, expand the number and types of characteristics that can be considered when typifying city functional profiles.

> . . .the distinction between our process of classification and one that makes use of simpler methods, such as dividing towns according to their chief industry, is that we have taken into account a very much wider set of characteristics and that the criteria of classification emerged from the analysis itself.[3]

This quote is from a study that has pioneered the use of multivariate analysis in the classification of urban centers. Studies such as this appear to have a great potential in the development of classifications which utilize meaningful functional categories and are sufficiently flexible to be

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[3]C.A. Moser and Wolf Scott, British Towns. A statistical study of their social and economic differences, Centre for Urban Studies. Report No. 2 (London: Oliver and Boyd, 1961). Component analysis was used in this study. Another study in this same general area is: Leslie J. King, "A Multivariate Analysis of the Spacing of Urban Settlements in the United States", Annals of the Association of American Geographers, LI (March, 1961), 222-233. King has used multiple regression analysis in an attempt to "explain" the spacing of centers. He introduced certain urban functional characteristics into his analysis.

adapted to studies where specific problems in city "location-function" relationships are being solved. Additional studies along these lines would prove worthwhile.

In so far as the Canadian macro urban scene is concerned, a specific project is suggested:

> A study which would relate the degree of city functional specialization to:
>
> (a) city manufacturing activity classified by the relationship of inputs and outputs to resources and markets.
>
> (b) "general accessibility" using "population potential" as the measure of accessibility.
>
> (c) city and hinterland populations.

Such a study would require the development of city functional categories which are related to locational characteristics, and, simultaneously, would provide an excellent opportunity for applying techniques of multivariate analysis in evaluating the degree of city specialization "explained" by the several factors listed. Such a project can be considered a logical next step in the analysis of urban "location-function" relationships at the macro scale.

While such a program was beyond the scope of this study, several significant steps towards a better understanding of both city functional classification and the Canadian urban milieu have been made in this study. The

review of the traditional classification techniques has revealed or re-emphasized the importance: (1) of dealing with cities as multifunctional entities, (2) of recognizing the dichotomous nature of urban functions (city-forming and city-serving) when classifying cities, (3) of considering the effect of changing city size on city functional structure, and (4) of analyzing the performance of functions on two distinct planes--the relative and the absolute ("distinctive" and "dominant" functions). The quantitative classification techniques have been scrutinized and the minimum requirement method as developed by Ullman and Dacey has been found to be the technique conforming most closely to theoretical concepts on city structure. However, before the method could be applied to determine city specialization it was found necessary to modify the Ullman-Dacey formula to satisfy mathematical requirements. Finally, the analysis of the distribution patterns of functional relative importance (distinctive functions), dominant functions, and city functional specialization led to the development of the "heartland-periphery" concept in the Canadian context. Cities differ fundamentally in functional structure depending on their location in either the heartland or the periphery. Part of the difference, especially

the difference in city functional specialization, is considered to be associated with the degree of geographic isolation and the role of manufacturing in the functional profile of cities.

The study has presented a comprehensive view of city functional performance at the national level in Canada using traditional techniques of city functional classification. From this overview have evolved several hypotheses which received preliminary investigation. Further analysis awaits later study employing more sophisticated and powerful techniques of investigation. This study in some respects marks a beginning in the study of the urban milieu at the national level in Canada.

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APPENDIX

APPENDIX

DOMINANT AND DISTINCTIVE FUNCTIONS, AND SPECIALIZATION INDEXES FOR CANADIAN CITIES OF 10,000 POPULATION AND OVER, 1951

WESTERN PERIPHERY

City	Specialization Index	Dominant Function	Distinctive Functions CLASS I : II : III
Lethbridge*	1.25	Retail Trade	Retail Trade Construction Wholesale Trade Finance, etc. Recreation Personal Service Extraction Public Utilities Transportation, etc. Business Service
*1.25 is the special index value for Lethbridge; extraction was omitted in its construction. The city's regular specialization index value is 11.69.			
Prince Albert	1.40	Manufacturing II	Recreation Community Service Construction Transportation, etc. Wholesale Trade Retail Trade Finance, etc. Government Service Business Service Personal Service
Brandon	1.41	Transportation, etc.	Transportation, etc. Wholesale Trade Finance, etc. Community Service Recreation Public Utilities Retail Trade Government Service Business Service Personal Service

Penticton	1.44	Transportation, etc.	Recreation Personal Service Construction Transportation, etc. Wholesale Trade Retail Trade Finance, etc. Business Service
Saskatoon	1.51	Manufacturing II	Wholesale Trade Finance, etc. Community Service Transportation, etc. Retail Trade Government Service Recreation Business Service Personal Service
Moose Jaw	1.56	Transportation, etc.	Transportation, etc. Recreation Public Utilities Construction Wholesale Trade Retail Trade Finance, etc. Community Service Personal Service
Calgary*	1.77	Manufacturing II	Wholesale Trade Finance, etc. Recreation Public Utilities Construction Government Service Business Service Personal Service
Edmonton*	1,80	Manufacturing II	Construction Wholesale Trade Transportation, etc. Finance, etc. Government Service Business Service

*1.77 is the special index value for Calgary; extraction has been omitted in its construction. The city's regular specialization index value is 17.21.

*1.80 is the special index value for Edmonton; extraction has been omitted in its construction. The city's regular specialization index value is 14.96.

Medicine Hat	1.97	Manufacturing II	Recreation Transportation, etc. Construction Retail Trade Finance, etc. Government Service Personal Service
Winnipeg	2.00	Manufacturing II	Wholesale Trade Finance, etc. Transportation, etc. Recreation
Fort William-Port Arthur	2.08	Manufacturing II	Transportation, etc. Public Utilities Construction Wholesale Trade Recreation
Regina	2.09	Government Service	Wholesale Trade Finance, etc. Government Service Public Utilities Transportation, etc. Retail Trade Community Service Business Service Personal Service
Vancouver	2.40	Manufacturing II	Wholesale Trade Finance, etc. Transportation, etc. Business Service
Victoria	4.01	Government Service	Government Service Finance, etc. Community Service Recreation
Trail	6.86	Manufacturing I	Manufacturing Recreation Business Service
Lethbridge	11.69	(	
Edmonton	14.96	(given above	
Calgary	17.21	(	

NORTHERN PERIPHERY

City	Specialization Index	Dominant Function	Distinctive Functions CLASS I : II : III
Chicoutimi	1.72	Manufacturing II	Community Service Construction Retail Trade Public Utilities Wholesale Trade Business Service Personal Service
North Bay	2.35	Transportation, etc.	Transportation, etc. Public Utilities Construction Wholesale Trade Retail Trade Finance, etc. Community Service Personal Service
Jonquière	4.40	Manufacturing I	Manufacturing Construction Retail Trade Personal Service
Sault Ste. Marie	4.70	Manufacturing I	Manufacturing Transportation Recreation
Arvida	8.96	Manufacturing I	Manufacturing Community Service
Rouyn	612.92	Extraction	Extraction Recreation Personal Service Construction Wholesale Trade Business Service
Sudbury	918.63	Extraction	Extraction Construction Recreation Personal Service

Timmins	1400.66	Extraction	Extraction Public Utilities Retail Trade Recreation

EASTERN PERIPHERY

City	Specialization Index	Dominant Function	Distinctive Functions CLASS I : II : III
Charlottetown	1.16	Retail Trade	Retail Trade Recreation Personal Service Wholesale Trade Finance, etc. Community Service Public Utilities Construction Transportation, etc. Government Service Business Service
Rimouski	1.36	Community Service	Community Service Construction Personal Service Public Utilities Business Service Transportation, etc. Wholesale Trade Retail Trade Finance, etc.
Moncton	1.55	Transportation, etc.	Transportation, etc. Retail Trade Wholesale Trade Finance, etc. Community Service Government Service Business Service Personal Service

Saint John	1.67	Manufacturing II	Transportation, etc. Wholesale Trade Recreation Finance, etc. Community Service Government Service Personal Service
St. John's	1.75	Manufacturing II	Wholesale Trade Government Service Transportation, etc. Retail Trade Community Service Personal Service
Truro	1.77	Manufacturing II	Personal Service Transportation, etc. Retail Trade Wholesale Trade Finance, etc. Community Service Recreation Business Service
Fredericton	1.86	Government Service	Public Utilities Wholesale Trade Retail Trade Government Service Personal Service Construction Finance, etc. Community Service Recreation Business Service
Edmundston	2.35	Manufacturing II	Personal Service Transportation Community Service Construction Retail Trade
Sydney	5.21	Manufacturing I	Manufacturing Transportation Wholesale Trade Retail Trade Recreation Personal Service

Halifax	5.46	Government Service	Government Service Public Utilities Construction Transportation Wholesale Trade Finance, etc.
Glace Bay	1697.89	Extraction	Extraction
New Waterford	1952.46	Extraction	Extraction Retail Trade Recreation

HEARTLAND

City	Specialization Index	Dominant Function	Distinctive Functions CLASS I : II : III
Barrie	1.87	Manufacturing II	Public Utilities Retail Trade Finance, etc. Government Service Construction Transportation, etc. Recreation Business Service Personal Service
Belleville	2.04	Manufacturing II	Recreation Transportation, etc. Retail Trade Public Utilities Finance, etc. Government Service Business Service Personal Service
Quebec	2.11	Manufacturing II	Construction Wholesale Trade Finance, etc. Community Service Government Service

St. Thomas	2.14	Manufacturing II	Transportation, etc. Retail Trade Public Utilities Community Service Recreation Business Service Personal Service
Kingston	2.17	Manufacturing II	Community Service Government Service Retail Trade Finance, etc. Recreation Business Service
London	2.17	Manufacturing II	Finance, etc. Public Utilities Construction Wholesale Trade Community Service Government Service
Chatham	2.26	Manufacturing II	Public Utilities Retail Trade Recreation Construction Transportation Wholesale Trade Finance, etc. Community Service Business Service Personal Service
Brockville	2.71	Manufacturing II	Community Service Manufacturing Transportation, etc. Retail Trade Finance, etc. Recreation Business Service Personal Service

Owen Sound	2.73	Manufacturing II	Wholesale Trade Retail Trade Manufacturing Public Utilities Transportation, etc. Finance, etc. Recreation Business Service
Orillia	2.74	Manufacturing II	Retail Trade Community Service Recreation Manufacturing Public Utilities Construction Finance, etc. Business Service Personal Service
Joliette	2.88	Manufacturing I	Community Service Manufacturing Public Utilities Construction Retail Trade Business Service Personal Service
Pembroke	3.41	Manufacturing II	Business Service Retail Trade Government Service Public Utilities Construction Community Service Recreation Personal Service
Toronto	3.51	Manufacturing I	Finance, etc. Public Utilities Wholesale Trade Business Service
Trois Rivières	3.52	Manufacturing I	Manufacturing Public Utilities Construction Community Service

Sherbrooke	3.61	Manufacturing I	Manufacturing Construction Wholesale Trade Community Service
Niagara Falls	3.62	Manufacturing I	Public Utilities Personal Service Manufacturing Recreation Business Service
Trenton	3.63	Manufacturing II	Government Service Construction Transportation, etc. Retail Trade Recreation Personal Service
Stratford	3.87	Manufacturing I	Manufacturing Public Utilities Transportation, etc. Retail Trade Finance, etc.
Sarnia	3.90	Manufacturing I	Construction Business Service Manufacturing Public Utilities Transportation, etc.
Montreal	3.92	Manufacturing I	Finance, etc. Wholesale Trade
St. Hyacinthe	3.96	Manufacturing I	Community Service Manufacturing Construction
Woodstock	4.14	Manufacturing I	Manufacturing Public Utilities Retail Trade Community Service
Cornwall	4.16	Manufacturing I	Manufacturing Retail Trade Recreation Personal Service

Guelph	4.22	Manufacturing I	Manufacturing Community Service
Shawinigan	4.53	Manufacturing I	Public Utilities Construction Manufacturing
St. Catharines	4.56	Manufacturing I	Manufacturing Construction Business Service
Kitchener-Waterloo	5.36	Manufacturing I	Finance, etc. Manufacturing
Windsor	5.41	Manufacturing I	Manufacturing
Peterborough	5.42	Manufacturing I	Manufacturing Finance, etc.
St. Jean	5.55	Manufacturing I	Government Service Manufacturing
St. Jérôme	5.56	Manufacturing I	Manufacturing Construction
Victoriaville	5.59	Manufacturing I	Manufacturing Public Utilities Construction Wholesale Trade
Brantford	5.67	Manufacturing I	Manufacturing Business Service
Hamilton	5.88	Manufacturing I	Manufacturing
Sorel*	6.05	Manufacturing I	Manufacturing

*6.05 is the special index value for Sorel; extraction was omitted in the construction. The city's regular specialization index value is 10.93.

Drummondville	6.24	Manufacturing I	Manufacturing Personal Service
Granby	6.28	Manufacturing I	Manufacturing Construction Personal Service

Grand'Mère	6.34	Manufacturing I	Manufacturing Public Utilities Construction
Valleyfield	6.39	Manufacturing I	Public Utilities Manufacturing Construction
Welland	6.54	Manufacturing I	Manufacturing Business Service
Galt	7.14	Manufacturing I	Manufacturing
Oshawa	7.50	Manufacturing I	Manufacturing
Magog	7.56	Manufacturing I	Manufacturing
Ottawa	7.84	Government Service	Government Service Finance, etc. Recreation
Thetford Mines	1139.76	Extraction	Extraction Public Utilities Retail Trade