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An Analysis of Spatial Trends and Factors Associated with Population Growth for Small Towns in Southwestern Ontario, 1961-1976

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AN ANALYSIS OF SPATIAL TRENDS AND FACTORS ASSOCIATED WITH POPULATION GROWTH FOR SMALL TOWNS IN SOUTHWESTERN ONTARIO 1961-1976

By

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ABSTRACT

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An attempt to discover and analyze the emerging trends of urban growth represents a problem of immediate concern for geographers. However, much of this research has been concerned primarily with large urban areas. This thesis is an attempt to learn more about the dynamics of small town population change and thus, concerns itself with determining the emerging trends of small town population growth.

Specifically, the thesis investigates the differential growth patterns for selected small towns in Southwestern Ontario for the 1961-1971, and 1971-1976 periods to ascertain precisely some of the factors associated with population growth and decline, and for presenting findings that may contribute to existing theory of small town population change.

Initial analysis of the spatial patterns of small town growth rates revealed that distinct regional and temporal variations exist within the study area. Small towns are shown to be experiencing increased rates of growth relative to larger urban areas in the study area and in the province. In terms of relative population change, the trend has been upward, indicating that small towns as places of residence have become more popular. The spatial redistribution of population through net migration was found to be the predominate process influencing the population growth of small towns during the 1961-1976 period. Declining fertility rates in

the province are shown to have impeded the growth of small towns in the study area.

To examine possible associations between small town functional profiles and their respective rates of growth, small towns were measured individually on a wide range of selected functional variables for 1971. Factor analysis was performed to sort out each functional profile. The resulting factor score profiles were subsequently used in a grouping analysis whereby optimal hierarchical groupings of small towns were derived for 1971 based on their functional profiles.

The grouping analysis revealed that hierarchical groups of small urban areas, based on their functional profiles for 1971, did not account for variations in selected population growth indicies. Consequently, functional complexity and diversity are not considered to be a major factor associated with variations in small town population growth.

A general linear model was then developed to better account for variations in small town growth rates. The model includes variables which represent four general types of data; i) demographic, ii) economic, iii) locational (accessibility), and iv) employment structure. Using multiple linear regression, estimated linear equations were generated for each of the two study periods.

This analysis produced several notable results. Although the regression equations were shown to poorly reflect variations in the growth of small towns, they did reveal that locational (accessibility), economic, and functional factors accounted for a significant proportion of the variation in small town growth rates. The low levels of explained variance accounted for by the regression procedures suggested that the structural profile of a community taken at one point in time (1971), did not prove to be an optimal means of accounting for variations in growth rates among small towns. It is suggested that perhaps dynamic measures of growth determinants may be more useful in this regard. The results of the regression procedures also appear to reflect random growth patterns inherent in the social change approach to urban systems growth.

With respect to possible planning implications, the thesis contributes one major point. Small towns are set within a context of uncertainty as the parameters directing population growth and migration flows have become very complex and unpredictable. As a result, planning policies should be designed in a flexible manner in order to adapt to rapidly changing conditions.

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CHAPTER I

Introduction

The tendency for Canada to become increasingly urbanized has been widely documented. Attempts to discover some order and explainable pattern of change which accompany the growth of urban areas has long been a research concern of geographers. However, one of the occupational hazards of this research has been its heavy dependence on statistics and images from past periods. Bourne (1978a) notes that, as a result of this dependence, emerging trends tend to be overlooked until they are obvious, and thus firmly established. Inevitably we find ourselves analyzing processes of the past rather than those of the present or future; processes which may have changed their form or even their direction. Consequently, when attention is directed to planning for future urban growth on the basis of these analyses, the resulting errors of interpretation may result in the design of inappropriate planning strategies.

Around the beginning of the 1970's a number of the industrial nations' major urban centers of population concentration began to experience a decline in the in-movement of persons from the outlying and peripheral regions of those nations. This decline has continued, and in fact in many western countries the decline has gone so far as to create a net flow of population out of the major conurbations back into the peripheral and predominantly rural regions.

In this dramatic reversal of the long established trend toward urban concentration, nonmetropolitan areas are found to be growing at rates exceeding those of the metropolitan areas. What this population turnaround portends for the character and stability of small towns[1] is still uncertain. The suddenness of this development, and the even more intriguing fact that it has occurred simultaneously among many industrialized countries makes this topic of special interest to geographers.

Several reasons can be cited for choosing to study small urban places. One is the previously mentioned dramatic population turnaround and its uncertain impact on the character and stability of small towns. Another is the scarcity of small town research. Much research pertaining to urban growth has been concerned primarily with large urban areas. Findlay (1977) states that research on small urban places is seldom exhaustive and is often speculative. In addition, because of its regional and problem-specific nature, existing literature tends to have limited application, causing many authors to make overgeneralizations from the evidence produced. Questions remain even today about whether small towns are growing or declining relative to larger urban areas.

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[1] Although the population size of small towns varies within the literature, they are generally defined as having populations less than 10,000.

Fuguitt and Beale (1976) contend that the widespread reputation of small towns as declining may to some extent have represented an impression from their business trends. Johansen (1974) has shown that, from 1950 to 1970, small towns of fewer than 2,500 people had an average decline of nearly a third in the number of consumer business establishments, but that the same places increased in population by an average of one ninth. Thus, it appears that residential functions of smaller communities have taken a contrary course from their business functions. The decline in the number of business establishments does not necessarily preclude population growth nor retail sales decline in a period where there are more retired people and a greater propensity to live in one place and work in another. The result has been the development of a set of possibly irrelevant myths and stereotyped images concerning places occupying the lower end of the urban continuum.

The topic assumes greater importance when it is considered that, because of their relatively simple economic structure, small urban places may be more sensitive to external influences than places of greater functional complexity. There is also great danger, because of their relative obscurity in the total urban system, that important changes and trends may be discovered belatedly. In either case, it seems that analyzing the dynamics of small town population change might constitute a significant contribution to regional planning procedures.

Thus, scarcity of research, the need for an updated examination of small town population change, academic curiosity, and possibilities for practical application of information gained from research on small urban places are motivating factors for this thesis.

Purpose of the Study

An attempt to discover and analyze the emerging trends of urban growth represents a problem of immediate concern for geographers. The purpose of this thesis is to examine in detail the differential growth patterns for selected small urban places to ascertain precisely some of the factors associated with population growth and decline, and for presenting findings that may contribute to existing theory of small town population change.

The major research hypothesis which provides the focus of this thesis is that changes in the parameters (i.e., resource development, industrial location, residential preferences, and mobility) directing urban growth have altered the growth patterns of small urban places. In Southern Ontario, over the last decade, significant changes have occurred in parameters that are known to affect the growth of small towns. Although in a very general sense it is known what has happened to small towns in Southern Ontario, no specific evidence has been advanced as to whether all small towns have been equally affected by these changes or whether their effects have been concentrated among particular centers. If the latter is indeed the case, then this may be explainable in terms of the functional roles assumed by small urban places.

Although many authors have reported on the demise and growth of selected small communities, there have been relatively few empirical analyses of factors associated with changes in population in these towns which have considered the functional role of the community. By focusing on small urban places and their respective roles in a modern space economy, it will be possible to analyze the population dynamics of small towns to determine the direction in which the small town component of the urban system appears to be evolving in Southern Ontario.

Research presented in this thesis differs from previous works in one major aspect. Previous research has been dominated by the central place perspective of a community which in reality is only part of the reason for the existence and vitality[2] of small urban places. This paper will attempt to incorporate the major functional characteristics which contribute towards the growth of small towns.

Accounting For Variations in Small Town Growth Rates

One of the most perplexing problems in small town research is to account for their differential growth rates within one urban system or between several regional subsystems. One approach to this problem has been the construction of elaborate conceptual models tracing the growth

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2 The term "vitality" will be used throughout this paper to refer to the economic health of a community.

and development of national urban systems over space and through time (Ray, 1968; and Simmons, 1978). On the other hand, specific empirical investigations into the relationships between the growth of a small town and its locational, economic, and demographic characteristics have provided a viable alternative. This thesis represents one part of a continuing inquiry into the second problem, namely the identification of the key factors influencing the differential growth rates for small towns.

Studies which search for the key factors associated with variations in small town growth rates can be identified primarily by their common use of population change as a basis of a methodological approach. In these studies population change is used as the dependent variable in bivariate and multivariate analyses which introduce demographic, economic, and spatial variables in an effort to explain regional differences in small town rates of growth.

In the literature there has been a growing appreciation of the problems associated with the analysis of diverse growth patterns among small communities. This is reflected not only in the number of studies carried out on this topic, but also in the emphasis put on methodology, as single variable empirical studies have evolved into multivariate statistical tests.

One of the earliest studies on small town growth variations was that conducted by Radcliffe (1942). In his study, Radcliffe discovered that an inverse relationship existed between town size and growth rate. Similar findings were reported by Brunner (1951). Duncan and Reiss (1956) in their work with American census data concluded that: size of community, location with respect to dominant centers, regional location, and type of functional specialization accounted for significant variations in growth among American communities.

Later, during the 1960's a shift to multivariate statistical techniques occurred, which had the advantage of being able to weigh factors individually and compositely in order to ascertain their significance and relative importance. (Hodgson, 1972; Davidson, 1972; Tarver and Beale, 1968,1969) are typical of those studies using multiple regression as a methodology for identifying variations in small town rates of growth. It is found that initial population size and accessibility are the most significant factors in this regard.

From the literature reviewed, it became apparent that attempts to link small town population change with demographic, economic, and spatial variables have proved to be modestly successful.

(i) Functional Role Considered

Several researchers have recognized that the functional role of a community is an important factor accounting for variations in their growth rates (Duncan and Reiss, 1956; and Drimmie (1978).

(Hart, 1976; Butler and Fuguitt, 1970; Beale, 1976; and Drimmie, 1978) are typical of those studies which have determined that recent increases in small town growth around major urban areas has actually resulted from an extension of the commuting fields associated with these larger urban areas. Improved accessibility, increased affluence, and a general dissatisfaction with living conditions in large urban areas have combined to cause a substantial number of urbanites to take up residence in smaller communities while retaining their jobs in the larger city.

Urbanites have become increasingly desirous of rural residential settings which are still within easy access of urban amenities (Fuguitt and Zuiches, 1975). While Tarver and Beale (1968) noted this trend in the American South as early as the mid-1960's, Morrison (1975) showed that dramatic population increases have occurred between 1970 and 1973 in nonmetropolitan counties throughout the United States in which 10 percent or more of the work force commuted to jobs in metropolitan areas. Finkbeiner (1978) in a study of rural and small town population change for Southern Ontario during the 1971-1976 period noted that significant population growth has occurred in small communities surrounding the Ottawa and Toronto metropolitan areas. Graber (1974), Dahms (1977), and Gessaman and Sisler (1971) provide additional evidence which revealsthe importance of the dormitory function in accounting for variations in small town growth rates.

However, not all such growth in small communities is linked to the dormitory function. For example, Haren (1972) demonstrated in his study that industrial decentralization has increased employment opportunities in small towns. Haren revealed that approximately 20 percent of the American total gains in manufacturing employment rose from new plant locations or expansions in rural small towns. Further evidence of growth in American nonmetropolitan areas attributable to industrial decentralization is presented in a study by (Erickson, 1976). Erickson attributes increased population growth in nonmetropolitan communities to an increased activity in the manufacturing sector. Hansen (1973) notes that recent capital investments in industries concentrated in a few areas of the nonmetropolitan Southern United States have caused those areas to experience rapid population growth.

The impact of this process has been to attract new residents to the nonmetropolitan areas. In addition, the presence of new employment opportunities in these areas has effectively halted the traditional out-migration of population to larger urban areas in search of employment.

Rainey (1976) provides an additional perspective on the importance of town role when he points out that a significant proportion of the recently added population in many small communities receive pensions. Beale (1976) also noted this trend when he discovered that much of the rapid growth in nonmetropolitan counties was related to retirement. Morrill (1978) notes that environmental amenities associated with retirement are increasingly becoming important factors of small town growth. The result is that the elderly are significantly adding to the population growth of selected small communities.

Beale (1976) found that many American counties with a strong dependence on agriculture continue to be characterized by net out-migration. Marshall and Smith (1978) noted a similar trend for small towns in Southern Ontario. Previous research has shown that small towns in rural regions emerged largely as service centers, and residential centers for people engaged in primary occupations. Many of these communities have experienced fluctuations of growth and decline in population and business activity in response to employment changes in the primary occupations which eventually reduced the market population for small town services (Johansen and Fuguitt, 1979; and Johansen, 1974).

Bannister (1975, 171) speculates on the future of small towns.

> "...The central place roles of towns fixed the structure of many urban hierarchies and trading networks, but the decline of rural service functions has changed the basis for interaction. The future for small towns close to large metropolitan communities may be good, but for less accessible places it is often bleak. The difference lies in an ability to adapt to declining rural demand and technological change by adopting new roles as dormitories and specialized production centers."

From the literature reviewed it becomes quite evident that the functional role assumed by small communities is and will continue to be an important factor accounting for variations in their population growth rates.

(ii) Identifying Small Town Types and Functions

Researchers, faced with an array of numerous urban centers have expended much time and energy attempting to order and classify them on the basis of their functions. All urban places contain functions which produce goods and services that contribute to their existence. These functions have been divided into two major components. The basic component or city-forming functions refers to the goods and services produced within a settlement but sold beyond the settlement region; the nonbasic component or city-serving functions refers to the goods and services produced within a settlement but sold within the settlement region (Tiebout, 1962).

Of the two types of functions identified, it is generally recognized that the city-forming or basic functions of an urban place provide the better part of the economic income required for its existence and vitality. Consequently, they have received a great deal of attention from academics studying urban systems. Harris and Ullman (1945) have categorized the basic functions into three groups. The first group includes those urban places which provide goods and services for their tributary areas and are commonly referred to as central places. The second group comprises those urban places that form nodes along major transportation routes providing "break-of-bulk" and other services related to the movement of goods and people. The third group includes those urban centers which perform a single specialized function based upon a particular attribute of the urban place or its location. These specialized functions include such activities as resource development, manufacturing, and tourism.

Previous attempts to study small urban places on the basis of functions have been dominated by the central place aspect of basic functions. Central place studies have concerned themselves primarily with the spatial and/ or hierarchical organization of trade centers and therefore consider locational characteristics in addition to the tertiary functional characteristics of urban areas.

Research by Berry and Garrison (1958) in Snohomish County, Washington is generally recognized as one of the most comprehensive studies in central place research, and is typical of the considerable body of literature relating to settlement size, function, and arrangement and, more specifically that urban places are arranged in a hierarchical class-system. Additional research of this approximate description include those by (Brush, 1953; Bracy, 1953; and Muncaster, 1972).

The goal of the research reported above is to provide empirical evidence regarding postulates of central place theory. Small towns, because of their relatively uncomplicated structure, are examined for purposes of expediency and simplification. Therefore, as Findlay (1977) notes, the study of small towns is not the objective of these works; they are a means to an end rather than the end itself.

Another group of studies investigating small urban places which operates within the general context of central place theory, not to investigate implications of the theory itself, but rather, uses it as a vehicle for analyzing specific settlement patterns. Hodge (1965), for example, considers the changing form of the system of trade centers in the Province of Saskatchewan. The analysis is also designed to provide the potential for predicting future trade center performance. Other studies of a similar description include those by Borchert and Adams (1963) and Fast (1972). These types of studies are limited in scope to specific regions which closely approximate the Christallerian "uniform plain" landscape. However, to analyze and interpret population change accurately for various types of small towns one must recognize the fact that small urban places form part of a highly complex and integrated urban system.

The limitations posed by central place studies have caused attempts to apply central place theory to the analysis of small town growth to overly exaggerate the role of market oriented activities. As a result, these studies are limited in scope because they do not emphasize the ideas presented by industrial location, transportation accessibility, and migration theories.

Harris (1943), and Nelson (1955) provide alternative approaches to examining small town types in which they have attempted to group urban centers on the basis of their total functional characteristics. These classification systems are very similar in that they identify a type of urban center according to the activity or function of greatest importance within the city. However, while these classification techniques based on the total functional characteristics which contribute towards the vitality of an urban place better approximate reality than the central place hierarchical studies, they were never directly applied to the study of small urban places. Harris and Nelson both applied their techniques to urban places with a minimum population of 10,000. In addition, a major criticism of these classification techniques is that they were carried out for their own sake rather than to test a theory or as base points for future research. A more detailed description and discussion of the Harris and Nelson classification techniques is presented in Chapter IV.

A major goal of this study will be to identify the functional profiles of small towns and to establish a hierarchial grouping of those towns which are characterized by similar functional profiles. These results will provide the basis for determining the degree of association between the functional profiles of small towns and their respective rates of growth.

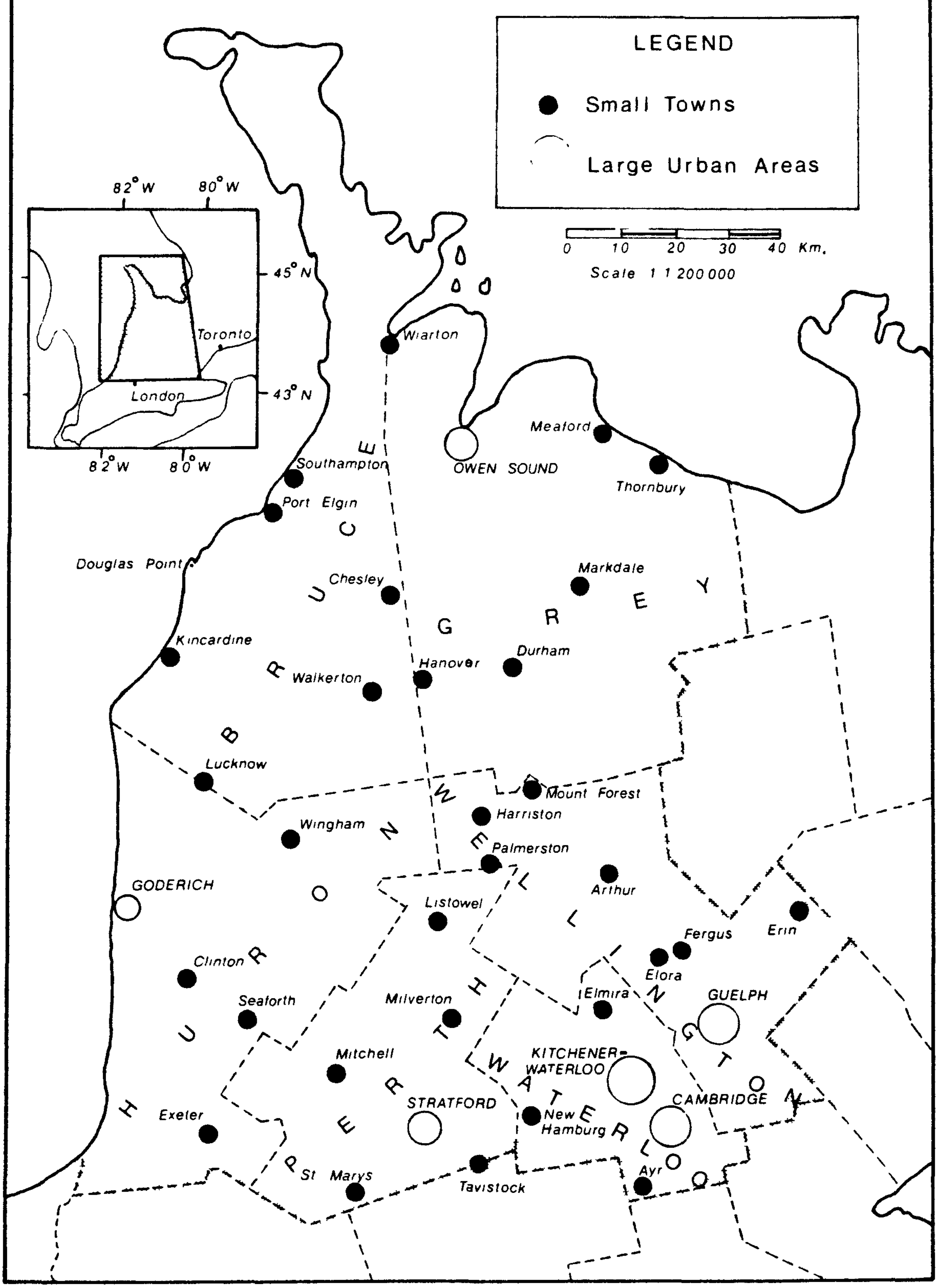
Delimiting the Study

Before beginning to analyze the dynamics of small town population change, a few brief comments must be made concerning the study area, the towns selected, and the data used.

The study area lies in the central and northern parts of the peninsula of Southern Ontario, as shown in FIGURE 1. The precise limits of the study area are defined by the

FIGURE 1

THE STUDY TOWNS



Counties of Bruce, Grey, Huron, Perth, Wellington, and Waterloo. These counties were chosen initially because they contain a system of small towns exhibiting a varied and diverse economic base; supported primarily by agriculture, manufacturing, resource development, and tourism. Other important attributes of this region include; the vast amount of urban data available and the fact that there are definite regional variations in growth related to the region's variation in economic base. In addition, the area is large enough to enable meaningful results to be extracted and yet has the admirable quality from a research point of view, of being of a manageable size.

The small towns for the study have been defined as those incorporated centers whose population was between 1,000 and 5,000 during the 1961 Census of Population. The upper limit is arbitrary; the lower limit corresponds with the Census of Canada definition of "urban" and, as such, is the point at which reasonably complete statistical profiles become available. For the purpose of determining emerging trends of small town population change, the time periods under consideration are the 1961-1971 and 1971-1976 intercensal periods.

An attempt has been made to ensure that the towns be of approximately the same relative size, and that data be used that are both uniform and at the same time sensitive enough to reflect the dynamics of small town population change throughout all parts of the study area. The bulk of the relevant data was extracted from the 1961-1976 Federal

Censuses, and the 1967-1976 Ontario Provincial Industrial Surveys.

The Organization of the Thesis

The presentation of the thesis has been divided into four main parts each of which constitutes a chapter of the thesis.

In Chapter II, the spatial and temporal patterns of small town growth are analyzed for the 1961-1971 and 1971-1976 study periods. This analysis has been done to provide an introductory overview of the general growth patterns which characterize the small towns in the study area in relation to the growth performance of urban areas in the study area and the province.

In Chapter III, the components (Natural Increase, and Net Migration) of population change for the small towns are identified. This analysis is presented in order to ascertain precisely the relative impacts that each component has on the direction of small town population change.

In Chapter IV, concern is directed toward establishing whether an association or relationship exists between the functional profiles of small towns and their rates of growth. The chapter is divided into four sections. First, the background literature is discussed, with particular reference to classification studies. Second, the techniques used to determine the functional profiles and a hierarchical grouping of similar functional profiles for small towns are discussed. Third, the functional dimensions and a hierarchical grouping of small towns with similar functional profiles are established. Fourth, each functional group of small towns is examined with respect to their growth rates in order to determine the degree of association between each group of small towns and their rates of growth.

Chapter V, which is the most important chapter in the thesis, examines the factors which are hypothesized as being associated with variations in small town growth. This chapter is divided into four sections. First, the background literature is discussed, with particular emphasis on popular urban growth determinant hypotheses. Second, the statistical technique used to establish an association between small town rates of growth and selected growth determinants is discussed. Third, the analyses and results are presented and discussed. Fourth, the implications and effectiveness of the analyses are discussed.

Finally in Chapter VI, a summary and research conclusions are presented followed by a series of future research suggestions.

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CHAPTER II

Pattern of Growth

During the past several decades most of the population increase in Southern Ontario has been absorbed by large urban areas. By 1976 approximately 73 percent of the total population was living in urban areas of 10,000 or more persons.

This trend of urbanization is of course not unique to Southern Ontario. Historically, economic activities have been attracted to large urban areas because of the economics of agglomeration associated with concentration, and people were drawn to cities because they offered improved incomes and a diversity of career and life-style options. Recently; however, the centripetal forces that have been at work in the urbanization process are now tending to be offset--at least in part--by several countervailing tendencies. One is the widespread feeling that the quality of living in big cities is deteriorating (Walzer and Schmidt, 1977). On the more positive side there are at least two centrifugal forces favoring smaller urban areas. One is the extension of urban fields[3], that is, interdependent rural-urban living spaces extending up to a hundred miles or more from metropolitan areas. The other is the decentralization of manufacturing from metropolitan to nonmetropolitan areas (Hansen, 1973).

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3 The concept of urban field was first proposed by John Friedmann, in collaboration with John Miller, in "The Urban Field," Journal of the American Institute of Planners, Vol. 31, No. 4 (November 1965), 312-320. If one were to center the urban field on a city of intermediate metropolitan size, its physical reach would extend for approximately two hours driving distance from this center.

Whatever the validity of the traditional beliefs in the market system, it has become increasingly apparent that there is now a widespread public movement towards small towns as an alternative to large urban areas (Beale, 1975; Bannister, 1975; Berry, 1976; Bourne, 1978a, 1978b; Johansen and Fuguitt, 1979). This reversal of the long established trend toward urban concentration has caused renewed growth of nonmetropolitan areas in Canada and in the United States (Fuguitt and Beale, 1976). Consequently, this readjustment has resulted in the growth of many small towns, but on the other hand, the transfer of activities to these selected growth nodes has resulted in the relative and absolute decline of other small communities. This state of inequality often has costly consequences, for example, the decline of small towns may not only bring about a severe loss of private and public investments, but it may also bring inflationary pressures to bear on rapid growth areas (Brozowski and Romsa, 1971). In addition, the cost of maintaining accepted levels of social, economic, and physical facilities in both declining and rapidly growing centers may be extremely high.

There can be little doubt that population is a major factor in many facets of urban-economic development. Population change tends to alter the structure and direction of a community. The impact may be reflected in a number of ways, for example, in the pace and pattern of investment and consumption, demand for jobs, demand for housing, income levels, etc. In short, there are few major development issues where population does not enter into consideration--the management of municipal and regional economics, the organization of settlement patterns, and the planning of social services. In light of these considerations, it is important that emerging trends of small town growth patterns be identified.

The purpose of this chapter is to describe, for the periods 1961-1971 and 1971-1976 the settlement patterns of, and the population adjustments occurring among small towns in the study area in response to the general increase in urban population, and, further to identify any growth disparities.

General Urban Settlement Patterns

In 1961, Ontario's urban population numbered 4,823,529 million; in 1971, it totaled 6,343,620 million; and in 1976 reached a total of 6,708,510 million--representing an increase of approximately 39 percent during the 15 year period, (TABLE 1). This rate of increase has generated increasing public interest, not so much concerning its total magnitude, but more importantly, about how the additional urban population is distributed throughout the province.

Within the study area, the total urban population grew from 296,177 in 1961 to 470,036 in 1976, representing an increase of 59 percent, (TABLE 1). In fact, for both study periods the average urban growth rate for the study area exceeded that of the province, (TABLE 2).

TABLE 1

Population Profile for the Study Area and Ontario

for 1961, 1971, 1976

	1961				1971				1976			
Population	Study Area	%	Ontario	%	Study Area	%	Ontario	%	Study Area	%	Ontario	%
Total	467,114	100	6,236,092	100	589,812	100	7,703,100	100	665,469	100	8,264,455	100
Urban	296,177	63.4	4,823,529	77.3	411,683	69.8	6,343,620	82.3	470,036	70.6	6,708,510	81.2
Rural	170,937	36.6	1,412,563	22.6	178,129	30.2	1,359,480	17.7	195,433	29.4	1,555,945	18.8
1,000-4,999	72,263	15.5	384,553	6.2	74,103	12.6	402,815	5.2	70,185	10.5	379,020	4.6
5,000-9,999	6,411	1.4	247,317	4.0	17,309	2.9	312,440	4.0	36,255	5.5	285,150	3.5
10,000-99,999	217,503	46.5	1,232,704	19.8	203,305	34.5	1,502,510	19.5	231,726	34.8	1,102,855	13.3
100,000 and Over	-------	----	2,958,955	47.4	116,966	19.8	4,125,855	53.6	131,870	19.8	4,941,485	59.8

Source: Census of Canada, 1961, 1971, and 1976, Population: Geographic Distributions, Ottawa.

TABLE 2

Annual Percentage Urban Growth Rates for the Study Area and Ontario: 1961-1971 and 1971-1976

	1961-1971	1971-1976
Ontario	3.15	1.14
Study Area	3.80	2.84

Although both the study area and the province have experienced significant declines in their respective rates of urban growth, the annual rate of urban growth for the study area has remained approximately 1.7 percent higher than that for the province during the 1971-1976 period.

The pattern of urban settlement within the study area has undergone some noticeable changes during the 15 year period between 1961 and 1976. The proportion of residents living in urban areas increased slightly from 63 percent in 1961 to 70.6 percent in 1976, however, the study area's share of urban residents remains approximately 10 percent lower than that of the province, (TABLE 1). The region's lower proportion of urban population is reflected in the fact that the Counties of Bruce, Grey, and Huron continue to be important agricultural producing regions dominated by low density rural populations, (TABLE 3).

The proportion of urban population residing in small towns of 1,000 to 4,999 persons declined from 15.5 percent in 1961 to 10.5 percent in 1976, (TABLE 1). Much of this decline can be attributed to the fact that 5 of the initial 31 small towns, representing a total population of 28,870,experienced

TABLE 3

Rural-Urban Population Distributions

for the Study Area: 1961, 1971, 1976

County		1961	1971	1976
Bruce	Rural	28,028	29,815	34,720
	Urban	15,008	17,575	22,755
Grey	Rural	31,982	32,900	36,290
	Urban	30,023	33,505	35,890
Huron	Rural	35,679	33,360	34,615
	Urban	18,126	19,590	21,390
Perth	Rural	24,473	25,400	26,515
	Urban	32,979	37,575	39,765
Waterloo	Rural	28,771	25,015	26,210
	Urban	147,983	229,665	262,925
Wellington	Rural	29,605	31,620	36,730
	Urban	55,097	76,960	87,005

Source: Census of Canada, 1961, 1971, 1976, Population: Geographic Distributions, Ottawa.

absolute population increases of sufficient magnitudes to move them into the 5,000 to 9,999 population category after 1971.

The average size of the urban areas in the study area increased 46 percent during the period from 1961 to 1976, from approximately 7,800 to 11,400 inhabitants. The median size, on the other hand, has remained smaller and relatively stable, increasing from 2,437 in 1961 to 2,831 in 1976. The smallness of the median in relation to the average reflects the fact that small towns are more numerous than larger ones in the study area, (APPENDIX A).

The Dynamics of Small Town Population Change

Population change for each small town in relation to population change for larger urban areas is analyzed in terms of two measures: compound rates of change and shift share.

Simple absolute and percentage measures, because of their limited application have not been utilized here to describe and compare population changes among both small towns and larger urban areas contained in the study region. Absolute measures are limited in the context of this chapter because they tend to understate the growth of small towns while overstating the growth of larger urban areas. Percentage measures on the other hand tend to do the converse; they overstate the growth of small communities and understate the growth of larger urban areas. Consequently, looking at only the simple absolute and percentage changes for urban areas often tends to distort the overall picture.

(i) Rates of Small Town Population Change

The rate of population growth adopted for this analysis is that proposed by Gibbs (1971, 107-108) and put to use by Robson (1973) and Marshall and Smith (1978) in their studies of urban growth. The measure is:

$$r = \frac{(P_2 - P_1) \ / \ t}{(P_2 - P_1) \times .5} \times 100 \ ;$$

where (r), the rate of change, is a function of the mathematical relationships among the population size at one point in time (P_1), population size at a later point in time (P_2), and the number of years over the period (t), (Gibbs, 1971). This average arithmetical formula expresses change in population numbers on an annual basis $(P_2 - P_1) / t$ as a percent of the average population size $(P_2 - P_1) \times .5$ over the period of time (t). The estimated mid point population is a closer approximation to the changing base from which increments or decrements from the population occur because population change is a continuous and not a discrete phenomenon. Rates of growth calculated in this manner closely approximate true exponential growth rates. The principal advantage of this technique is that it is well suited for comparing urban areas with respect to growth regardless of variations in their population size or the number of years in the growth periods. In addition, these rates have a nearly normal distribution and thus do not exhibit the extreme skewness that is characteristic of conventional growth rates, (see FIGURES 6 and 7).

The major problem posed in the application of this technique, however, is that the growth of an urban area can be measured in either or both of two directions--<u>vertical</u> (growth with town size remaining constant) or <u>horizontal</u> (growth with an extention of urban boundaries). Although attention has been given to the problem posed by municipal annexations or horizontal growth, no attempt has been made in the paper to estimate population increments resulting from the annexation of small amounts of unincorporated territory by small towns. This problem may be overlooked by simply regarding such minor boundary changes as lagged responses to population growth (Marshall and Smith, 1978).

Growth rates for each urban place were calculated for each of the two study periods, (TABLE 4). The observations for each time period are plotted in FIGURES 2 and 3, which show the annual growth rate against the population rank for each urban area. On casual inspection of these two diagrams, the first clear impression is that growth and size for small towns of this population range are virtually unrelated. This finding supports the results of recent urban growth studies by (Robson, 1973 and Marshall and Smith, 1978) which conclud-ed that urban places at the lower end of the urban continuum exhibit variable growth rates. A second observation that becomes clearly evident is that the scatter of small town growth rates became much more variable during the 1971-1976 period as many of the small towns underwent rapid rates of growth during this period.

TABLE 4

Urban Growth Rates: 1961-1971, 1971-1976

Town	1961-1971 Total Percentage Change	1961-1971 Annual Percentage Change	1971-1976 Total Percentage Change	1971-1976 Annual Percentage Change
Arthur	16.4	1.64	16.0	3.20
Ayr	22.4	2.24	4.5	.90
Chesley	- 0.2	-0.02	8.3	1.66
Clinton	-10.4	-1.04	- 0.1	-0.02
Durham	11.6	1.16	2.1	.42
Elmira	35.0	3.50	40.0	8.00
Elora	24.7	2.47	30.5	6.10
Erin	40.0	4.00	32.5	6.50
Exeter	9.6	.96	4.1	.82
Fergus	34.6	3.40	10.0	2.00
Hanover	14.0	1.40	11.7	2.34
Harriston	9.0	.90	4.7	.94
Kincardine	13.1	1.31	25.4	5.08
Listowel	15.5	1.55	9.2	1.84
Lucknow	1.5	.15	7.3	1.46
Markdale	12.5	1.25	9.6	1.92
Meaford	5.3	.53	6.5	1.30
Milverton	7.1	.71	15.5	3.10
Mitchell	12.4	1.24	7.4	1.48
Mount Forest	14.6	1.46	10.6	2.12
New Hamburg	32.0	3.20	18.7	3.74
Palmerston	17.6	1.76	5.5	1.10
Port Elgin	54.5	5.45	55.0	11.00
Seaforth	- 5.5	-0.55	- 2.3	- 0.46
Southampton	11.3	1.13	29.3	5.86
St. Marys	3.7	.37	4.1	.82
Tavistock	19.0	1.90	18.0	3.60
Thornbury	10.6	1.06	8.3	1.66
Walkerton	15.1	1.51	3.2	.64
Wiarton	3.8	.38	- 3.5	- 0.70
Wingham	- 0.3	-0.03	- 1.4	- 0.28
Goderich	6.1	.61	8.0	1.60
Owen Sound	5.8	.58	5.6	1.12
Stratford	18.0	1.80	4.6	.92
Kitchener-Waterloo	47.3	4.73	14.0	2.80
Cambridge	34.1	3.41	15.5	3.10
Guelph	40.5	4.05	11.7	2.34

Source: Compiled by author.

FIGURE 2

GROWTH RATES AND TOWN RANK, 1961-71

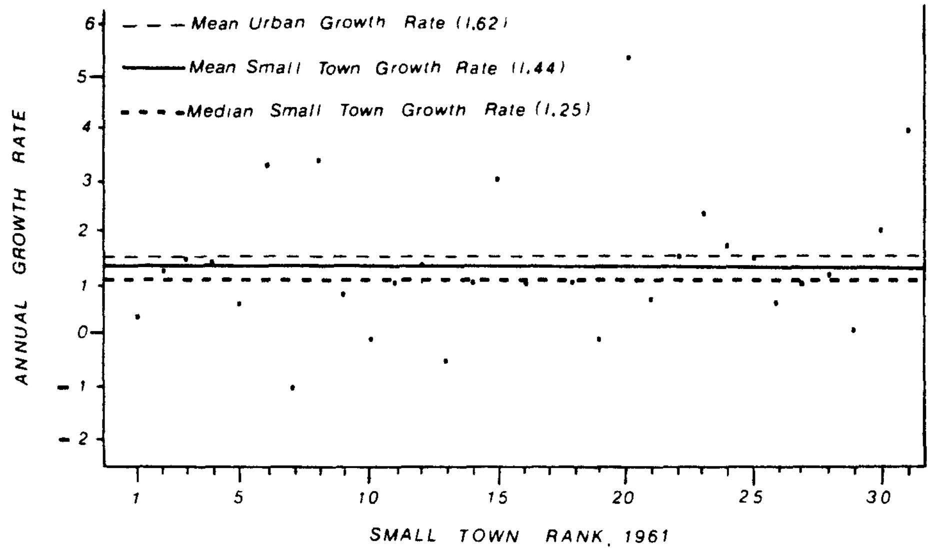
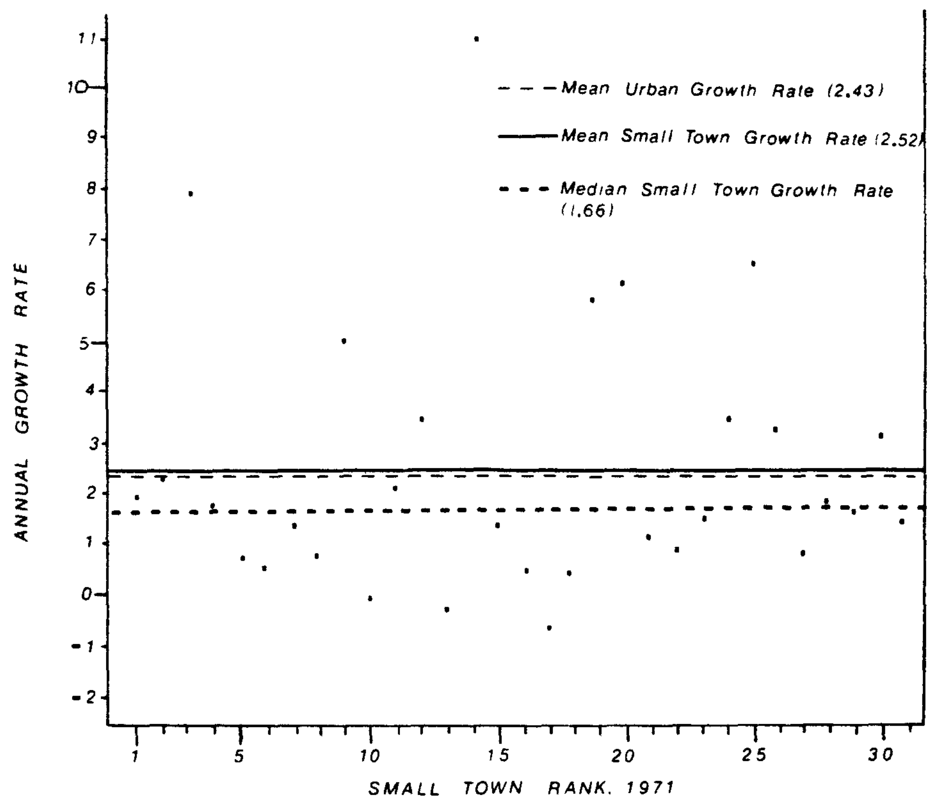


FIGURE 3

GROWTH RATES AND TOWN RANK, 1971-76



If one visualizes lines representing the median and average growth rates across the whole span of small towns during each period, then the lines would be horizontal, suggesting that the whole set of urban places can be characterized as having a common growth rate around which disturbance occurs. Because these lines are horizontal, their vertical shifts upwards or downwards from one period to another represents differences in the overall annual growth rate for each period. For example, in FIGURE 3, the median and average annual growth rate lines are somewhat higher than in FIGURE 2. This suggests that the whole set of small towns must have grown on average by a greater amount during the 1971-1976 period. It is interesting to note that the average annual rate of small town growth became greater than the average annual rate of total urban growth for the study area during the 1971-1976 period.

Before attempting to explain this distribution of individual growth, the most obvious approach for a geographer is to examine its spatial pattern to see to what extent interpretable general features emerge which might account for the variation in small town growth rates.

First, however, one can derive a simple standardized measure from which to compare the growth rates of urban places. One appropriate form of standardization suitable for analyzing variations in urban growth is the use of "z", or standard scores. The calculation follows the standard formula:

$$Z_i = \frac{G_i - G_n}{S_n} ;$$

where (G_i) is the growth rate of the <u>ith</u> town; (G_n) and (S_n) are the means and standard deviations of the study sample(n). Measured in this manner, a small town's rate of growth can not only be expressed as a deviation from the average rate of growth for all small towns in the study area, but can also be expressed as a deviation from the average rate of growth for all urban places in the study area, (TABLE 5).[4]

The spatial patterns of growth during the two periods between 1961 and 1976 are shown in FIGURES 4 and 5. For each period, towns with standard scores of above or below 1.00 standard deviation[5] from the mean are distinguished from towns which grew or declined by less than this. The maps produce a striking sequence which provides a useful commentary on the dynamics of small town growth during the two study periods.

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4 The important assumption for using the standard score (Z) is that the data is normally distributed. It is important to note that the data used here is not indicative of a perfect normal distribution, however, the data is sufficiently distributed so as not to adversely affect the analysis.

5 In discussing the patterns of above and below average growth rates, places whose growth was over 1.00 standard deviation below the mean will be referred to as declining places. The term is used in a relative sense. In many cases the populations of such towns did show an absolute decline in numbers, but in other instances they expanded absolutely even though at a very low rate. The threshold values of -1.00 and -1.00 standard deviations differentiate between the positive and negative extremes of town population change. These values were found to closely approximate natural separations in a frequency distribution of standard scores, (FIGURES 6 and 7).

TABLE 5

Standardized Growth Rates For Urban Areas

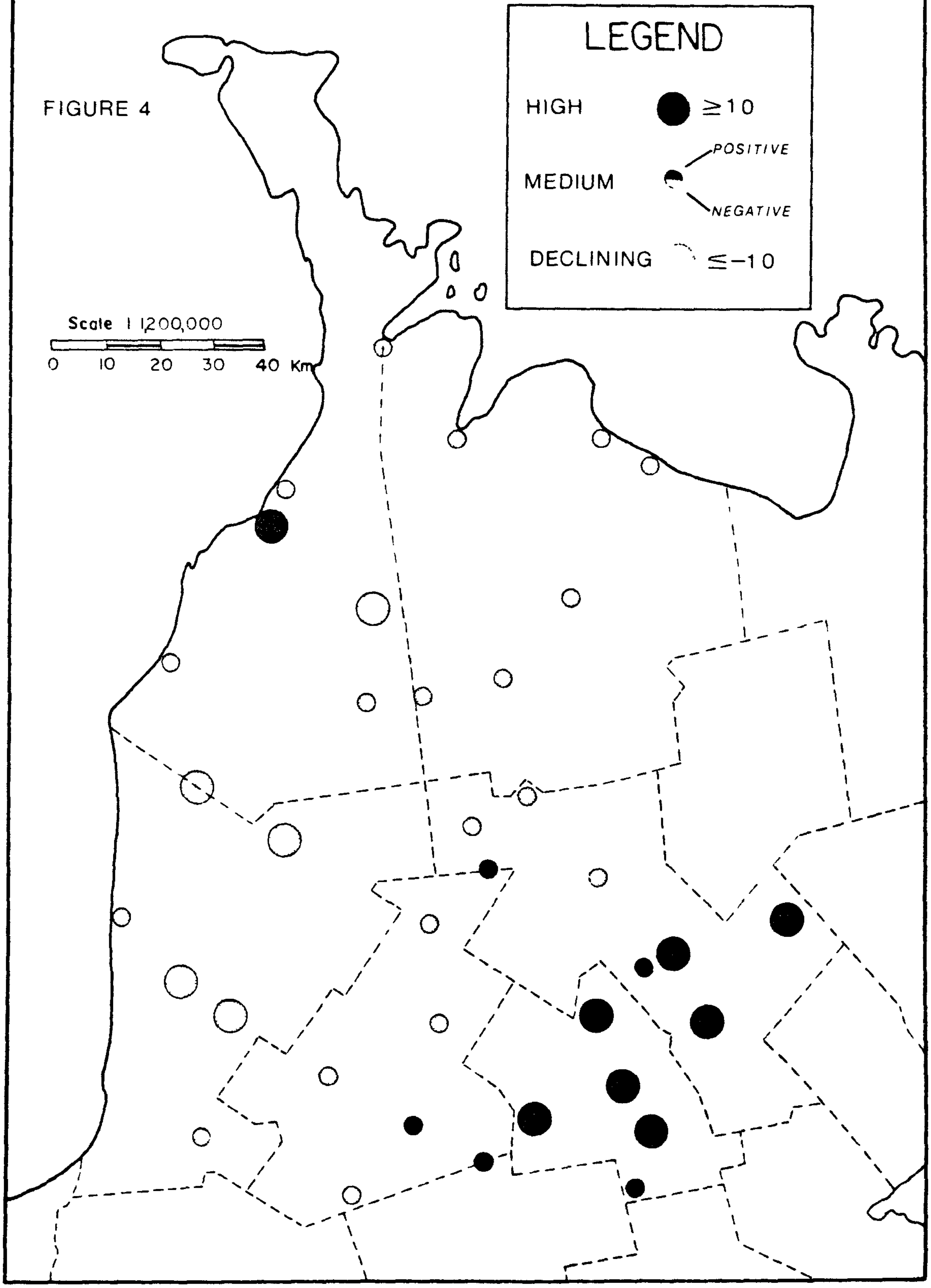
1961-1971, 1971-1976

Town Number*	Standardized Scores Based on the Mean and Standard Deviation for Small Towns		Standardized Scores Based on the Mean and Standard Deviation for all Urban Areas	
	1961-1971	1971-1976	1961-1971	1971-1976
1	.117	.253	- .013	.308
2	.558	- .604	.397	- .636
3	-1.073	- .320	-1.123	- .308
4	-1.794	- .941	-1.794	-1.000
5	- .250	- .783	- .356	- .828
6	1.514	2.040	1.287	2.228
7	.757	1.330	.582	1.468
8	1.880	1.480	1.630	1.628
9	- .352	- .634	- .452	- .668
10	1.440	- .194	1.219	- .196
11	- .029	- .067	- .151	- .060
12	- .397	- .567	- .493	- .596
13	- .103	.955	- .219	1.348
14	.081	- .253	- .048	- .260
15	- .948	- .395	-1.000	- .412
16	- .139	- .223	- .253	- .228
17	- .669	- .455	- .746	- .476
18	- .536	.216	- .623	.268
19	- .147	- .388	- .260	- .404
20	.014	- .149	- .109	.148
21	1.290	.455	1.080	.524
22	.235	- .529	.095	- .556
23	2.950	3.164	2.623	3.428
24	-1.460	-1.112	-1.486	-1.156
25	- .227	1.246	- .335	1.372
26	- .786	- .634	- .856	- .644
27	.338	.403	.192	.468
28	- .250	- .320	- .356	- .308
29	.044	- .701	- .082	- .740
30	- .764	-1.201	- .836	-1.252
31	-1.080	-1.044	-1.130	-1.084
32	------	------	- .700	- .332
33	------	------	- .710	- .524
34	------	------	.120	- .604
35	------	------	2.100	.148
36	------	------	1.210	.268
37	------	------	1.630	- .036

* Town names are identified in Appendix A.

STANDARDIZED GROWTH RATES FOR ALL URBAN AREAS: 1961-1971

FIGURE 4



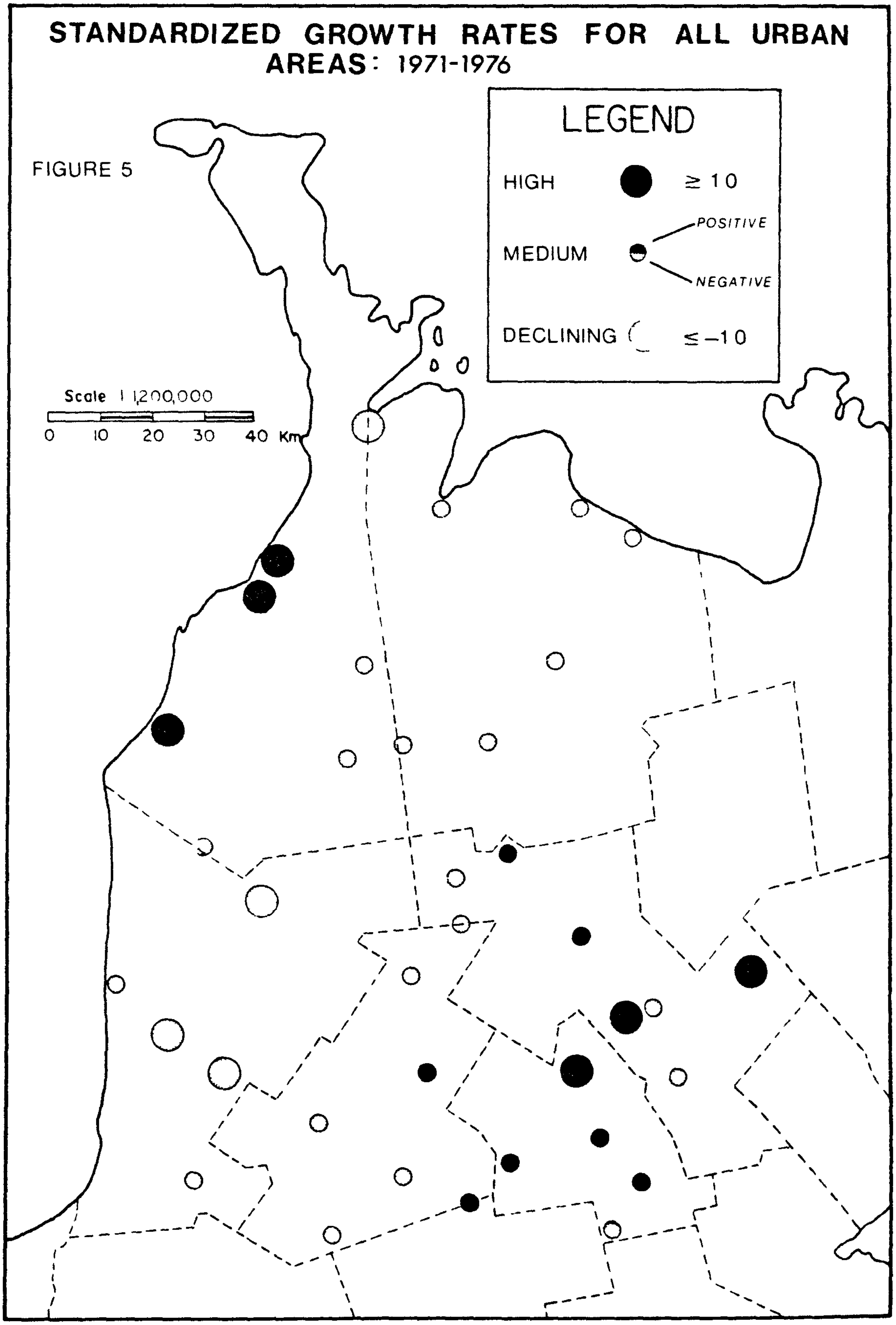

STANDARDIZED GROWTH RATES FOR ALL URBAN AREAS: 1971-1976
FIGURE 5
LEGEND
HIGH ≥ 10
MEDIUM
POSITIVE
NEGATIVE
DECLINING ≤ -10
Scale 1 1,200,000
0 10 20 30 40 Km

FIGURE 6

FREQUENCY DISTRIBUTION OF STANDARD SCORES 1961-1971

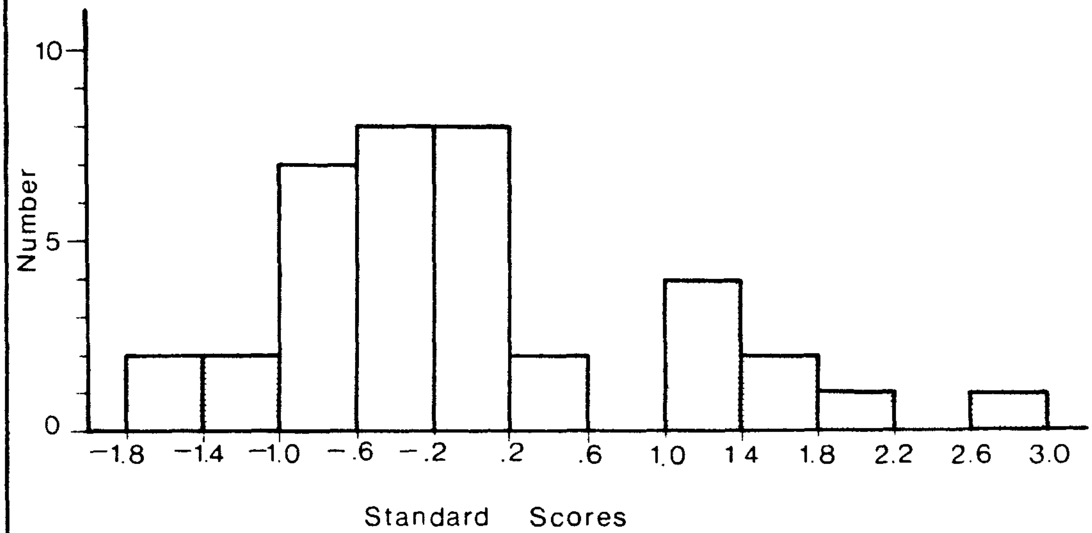
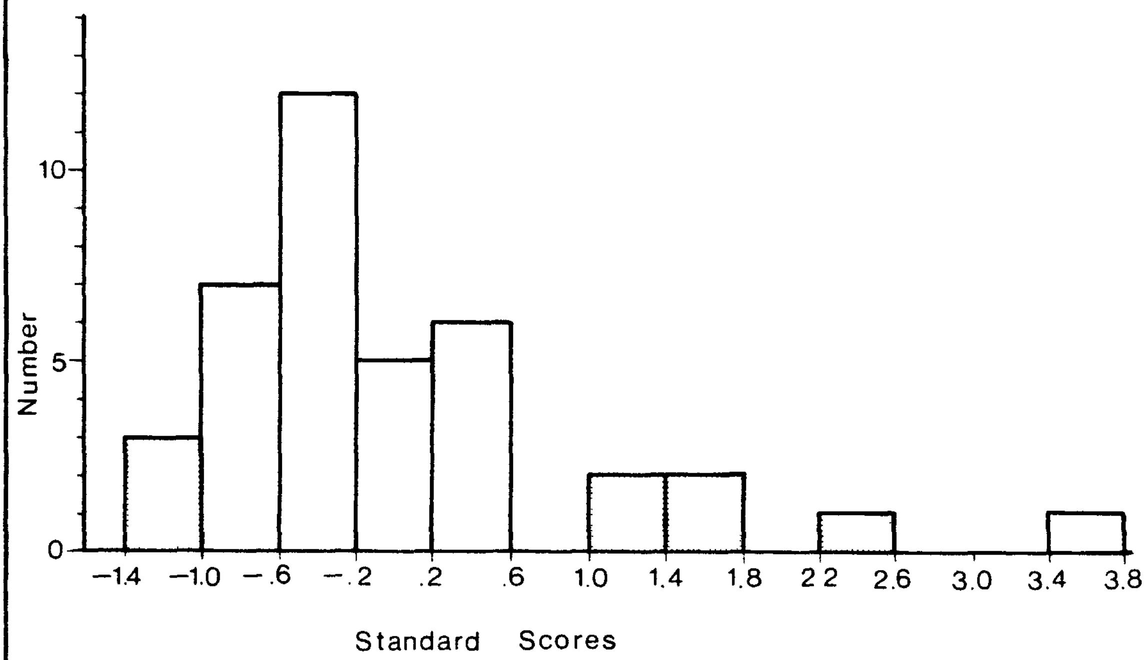


FIGURE 7

FREQUENCY DISTRIBUTION OF STANDARD SCORES 1971-1976



The patterns of relative growth rates, both for individual towns and for regional clusters of small towns tend strongly to confirm the well known pattern of economic development in the Golden Triangle Region.[6]

The 1961-1971 period is dominated by the rapid growth of small towns in close proximity to the manufacturing centers of Kitchener, Waterloo, Guelph, and Cambridge. The rapid growth of Port Elgin is related to the Bruce Nuclear Power Development construction site at Douglas Point. Relative and absolute decline is very marked in the more remote agriculturally based areas of Huron, Bruce, and Grey Counties.

The large urban areas which comprise the Golden Triangle Region are shown to have high standard scores reflecting significant rates of population growth for these centers during the 1961-1971 period.

During the 1971-1976 period small towns in the vicinity of the Golden Triangle Region continued to show high rates of growth in relation to the mean. Rapid growth was also a marked characteristic of the Towns of Southampton, Kincardine, and Chesley. This trend reflects the expansion of construction activities at the Bruce Nuclear Power Development site at Douglas Point during the 1971-1976 period. Although the average rates of growth for small towns were higher during this

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6 The Golden Triangle Region describes that area which includes the Cities of Kitchener, Waterloo, Guelph, and Cambridge.

period, fewer towns in the vicinity of the Golden Triangle Region experienced rates of growth exceeding the average rate of urban growth for the study area. This would seem to suggest that a smaller number of small towns began to assume a greater proportion of the overall increase in small town growth rates during the 1971-1976 period.

Relative and absolute decline continued to be a marked characteristic of small towns in Huron County (Clinton, Seaforth, and Wingham). The remote Town of Wiarton also underwent an absolute decline in population. Throughout both periods the differences between rural and industrial areas remain quite pronounced.

It is interesting to note for the 1971-1976 period that the large urban complexes forming the Golden Triangle Region sustained significant declines in their respective standard scores, reflecting declines in their rates of population growth. The pattern of standard scores suggest that small towns are showing increased rates of population growth relative to the larger urban complexes.

Based on the similar growth patterns displayed by the small towns for the two study periods one might conclude that there is a linear relationship between the growth rates of small urban places during the 1961-1971 period and their corresponding rates of growth for the 1971-1976 period. In this connection it is noteworthy that the growth rates of small towns during the 1961-1971 period are good predictors of their growth rates in the 1971-1976 period, the inter-period coefficient of determination (r^2) being .640. This suggests that 64 percent of the total variation in the 1971-1976 small town rates of growth are associated with the variation in the 1961-1971 small town growth rates.

This finding is significant when one compares it with an average inter-decade coefficient of determination of .172 as reported in the Marshall and Smith study of urban growth in Southern Ontario for the twelve decades between 1851 and 1971 (Marshall and Smith, 1978, 30). However, it would not be appropriate to comment in detail here on these conflicting findings regarding the predictability of town growth rates from one period to another for two important reasons. Firstly, Marshall and Smith considered complete urban systems with populations greater than 1,000 for Southern Ontario, while this study is concerned with only those towns having populations greater than 1,000 but less than 5,000 in 1961 for a relatively small sample. Consequently, the size of the town sample for this study has remained small and consistent while the Marshall and Smith town sample varied from 30 urban areas in 1851 to 192 urban areas in 1971 with no restrictions placed on maximum town size. Secondly, the present thesis is limited to only two periods of time; one of which is not a complete decade; while the Marshall and Smith study considered twelve complete periods. As a result, the modestly predictable small town growth rates for the 1971-1976 period, based on their growth rates for the 1961-1971 period may represent a temporary state of affairs that does not reflect the long term growth trends of small towns.

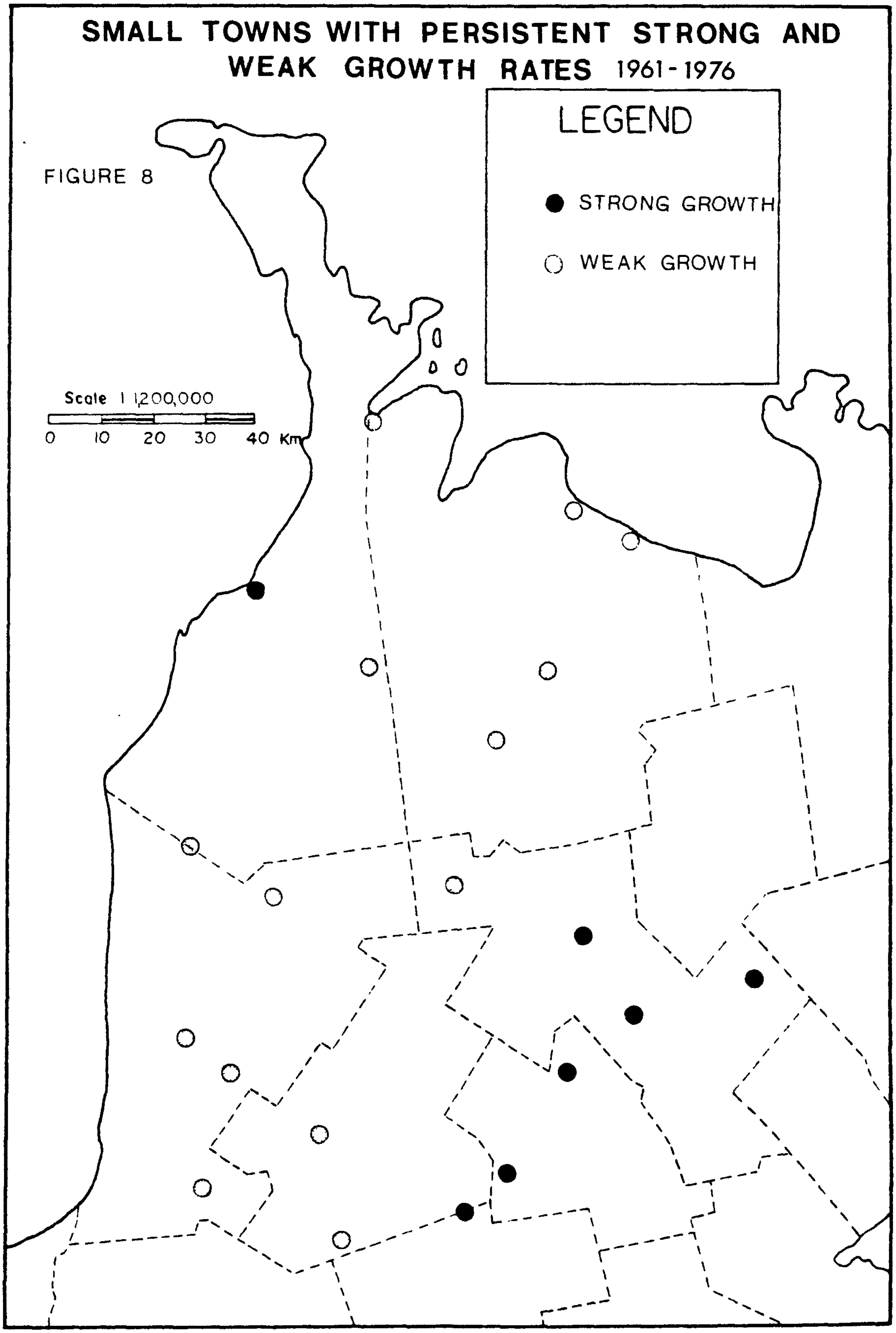
Thus, while it may seem that small town growth rates in one period are good predictors of the growth rates in the following decade, the result should be interpreted with caution. Similar analyses which are beyond the scope of this thesis first need to be conducted for previous periods before the finding presented here can be fully evaluated.

Persistent Strong and Weak Growth

Another manner in which the rates of population change may be examined is to consider cases of persistent strong or weak growth. Strong growth in a given period is defined as a rate of growth exceeding the mean rate for all small towns under consideration for each period. Conversely, persistent weak growth is defined as a rate of growth that showed below average growth during both study periods.

FIGURE 8 shows the spatial distribution of the 7 towns exhibiting persistent strong growth and the 14 towns suffering persistent weak growth. It is not surprising, in light of the previous analysis, that the towns exhibiting persistent strong growth are concentrated within the Golden Triangle Region commuting field. With the exception of Port Elgin; whose growth has been previously identified; there is an absence of towns with persistent strong growth in the agriculturally based Counties of Huron, Bruce, and Grey.

The towns displaying persistent weak growth are much more dispersed than those with persistent strong growth, but they are heavily represented in the western and northern


SMALL TOWNS WITH PERSISTENT STRONG AND WEAK GROWTH RATES 1961-1976
FIGURE 8
LEGEND
STRONG GROWTH
WEAK GROWTH
Scale 1 1,200,000
0 10 20 30 40 Km

sections of the study area, centered on Perth, Huron, Bruce, Grey, and northern Wellington Counties. Marshall and Smith (1978) note that this pattern is difficult to explain because the area is generally fertile and prosperous. Marshall and Smith suggest that this puzzling pattern may be due to a possibility that the area is too generously provided with small central place towns, causing these places to crowd one another out making it difficult for any of them to keep pace with the growth rates of small towns in other parts of the study area. Another plausible explaination is the failure of these towns to develop major growth producing stimuli which would be capable of attracting large numbers of workers to these towns.

(ii) Shift-Share Analysis

The shift-share technique has been selected to present an additional perspective on small town population change because it provides a fairly quick and simple indicator which reflects both the simple percentage and absolute changes in population.

An important aspect of any statistical technique is to supply meaningful comparisons among factors related to a particular problem being explored. It is not necessary that a statistical analysis determine the cause of some phenomena, but rather, it may be used to display and describe significant relationships. The superior advantage of the shift-share technique is its descriptive ability (Lee, 1966). Although there have been few attempts to extend shift-share into new fields such as an analysis of population change, (see Paris, 1970; Davidson, 1972; and TEIGA, 1976) the shift-share technique can be utilized here to measure differential growth changes among small urban areas, providing a basis for making direct comparisons of one town to several other towns. To add further meaning to such measurements, the rates of small town population change are compared with larger urban places in the study area.

The first step in these calculations was to compute the population change which would have occurred in each town if that town had grown at the average rate of growth for all urban areas in the Province of Ontario and in the study area. The expected increases were then compared with the actual increases. The upward or downward shift of a given town (the difference between its actual increase in population and the expected increase) provide quantitative measures for each town's performance relative to all other urban areas, based on the provincial and the study area's average urban growth rates as norms, (TABLE 6).[7]

A shift-share analysis was carried out for each study period for all incorporated centers contained in the study area. The patterns of growth for the two periods are shown in FIGURES 9, 10, 11, and 12. For each period, urban centers

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[7] For a detailed description of the shift-share method of growth measurement see David L. Huff, "Measure for Determining Differential Growth Rates of Markets," Journal of Marketing Research, 4 (November 1967), 391-395.

TABLE 6

Measures of Shift-Share Based on the Average Urban Growth Rates of the Province and Study Area as Norms: 1961-1971, 1971-1976

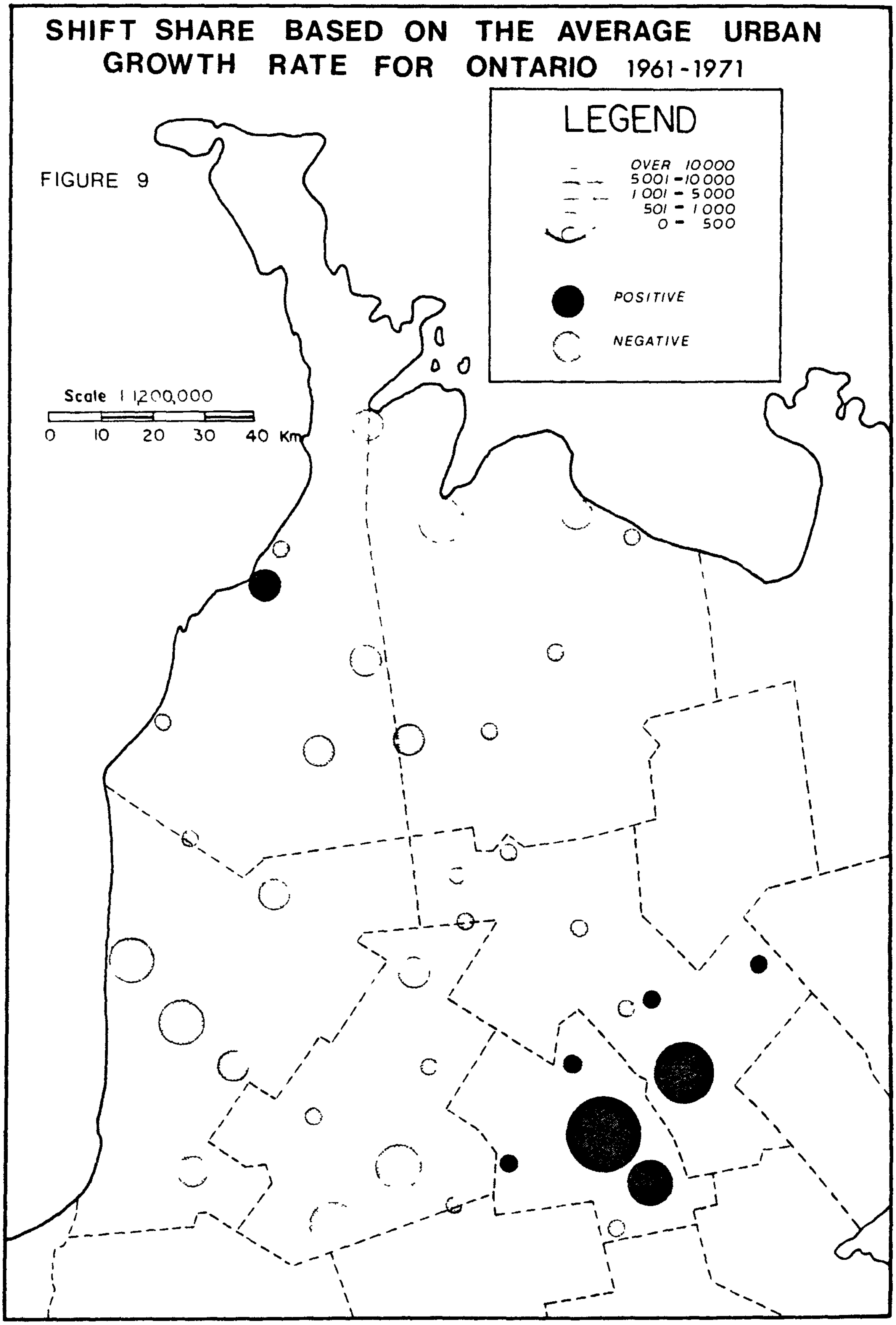
		1961-1971			
		Based on Province		Based on Study Area	
Town Number*	Actual Increase (A)	Expected Increase (E)	A-E	Expected Increase (E)	A-E
1	214	378	- 164	456	- 242
2	256	320	- 64	386	- 130
3	- 4	535	- 539	645	- 649
4	- 337	1100	-1437	1327	-1664
5	268	687	- 419	828	- 560
6	1393	1051	342	1268	125
7	418	468	- 50	565	- 147
8	441	317	124	382	59
9	307	960	- 653	1158	- 851
10	1602	1207	395	1456	146
11	662	1386	- 724	1672	-1010
12	154	514	- 360	620	- 466
13	398	895	- 497	1080	- 682
14	675	1261	- 586	1521	- 846
15	16	325	- 309	392	- 376
16	146	348	- 197	414	- 268
17	211	1208	- 997	1457	-1246
18	82	350	- 268	422	- 340
19	298	708	- 410	854	- 556
20	414	826	- 412	997	- 583
21	827	687	140	829	- 2
22	301	490	- 189	591	- 290
23	1223	514	709	620	603
24	- 121	710	- 831	857	- 978
25	218	573	- 355	691	- 473
26	168	1412	-1244	1703	-1535
27	258	388	- 130	468	- 210
28	123	346	- 223	417	- 294
29	628	1213	- 585	1463	- 835
30	84	678	- 589	809	- 725
31	- 9	920	- 929	1110	-1119
32	402	2019	-1617	2436	-2034
33	1048	5488	-4440	6620	-5572
34	4041	6447	-2406	7777	-3736
35	59393	30193	29200	36423	22970
36	18037	13837	4200	16692	1345
37	20249	12549	7700	15138	5111

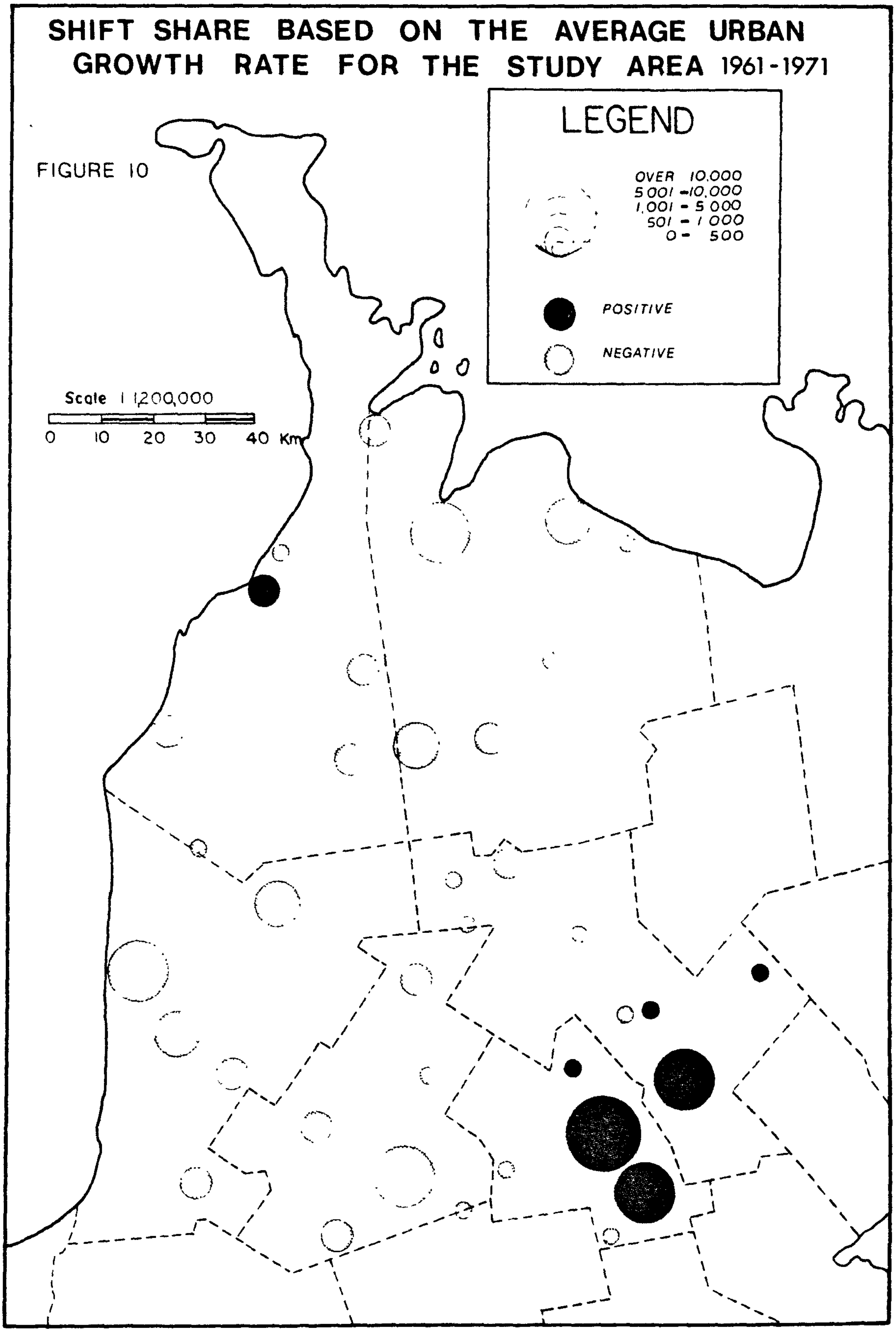
Source: Compiled by author.

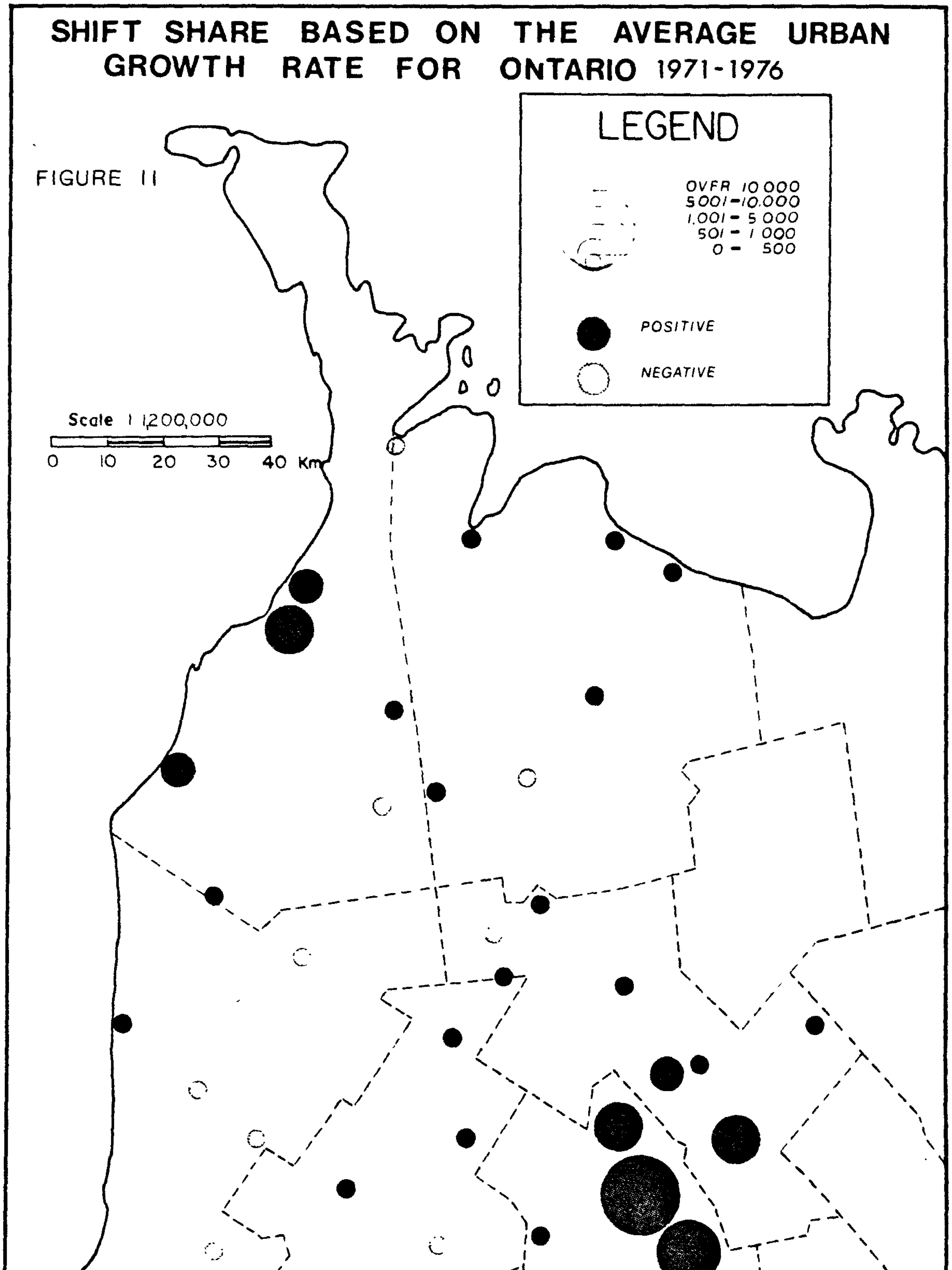
* Town names are identified in Appendix A.

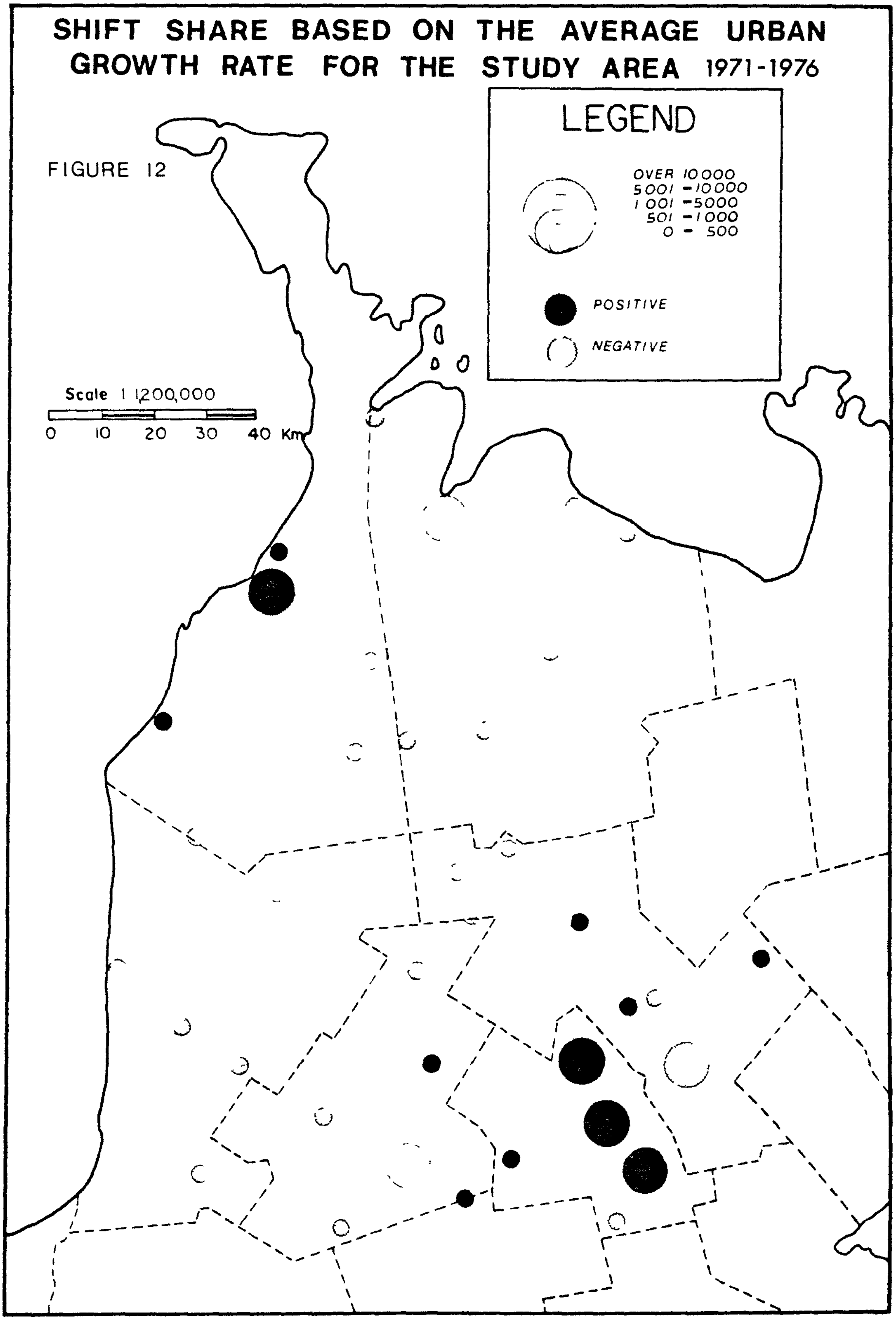
TABLE 6(continued)

Town Number	Actual Increase (A)	1971-1976 Based on Province Expected Increase(E)	A-E	1971-1976 Based on Study Area Expected Increase(E)	A-E
1	246	80	166	201	45
2	59	173	- 14	180	- 121
3	146	97	49	241	- 95
4	- 3	180	- 183	448	- 451
5	53	140	- 87	348	- 295
6	2304	270	2034	671	1633
7	685	109	576	271	414
8	561	82	479	205	356
9	140	191	- 51	476	- 331
10	567	310	- 257	771	- 204
11	628	289	339	719	- 91
12	87	102	- 15	254	- 167
13	943	185	758	460	483
14	449	267	182	664	- 215
15	80	60	20	148	- 68
16	125	70	55	176	- 51
17	274	231	43	574	- 300
18	200	68	132	169	31
19	197	145	52	361	- 164
20	339	173	166	432	- 93
21	620	171	449	427	193
22	106	106	0	263	- 157
23	2164	163	2001	405	1759
24	- 50	122	- 172	303	- 353
25	698	116	582	288	410
26	193	265	- 72	660	- 467
27	293	85	208	212	81
28	106	70	36	173	- 67
29	147	255	- 108	636	- 489
30	- 78	127	- 205	316	- 394
31	- 42	166	- 208	414	- 456
32	572	388	184	968	- 396
33	1056	1053	3	2623	-1567
34	1149	1397	- 248	3480	-2331
35	23249	8849	14400	22045	-1204
36	10420	3532	6888	8799	1621
37	7451	3425	4026	8532	-1081


SHIFT SHARE BASED ON THE AVERAGE URBAN GROWTH RATE FOR ONTARIO 1961-1971
FIGURE 9
LEGEND
OVER 10000
5001 - 10000
1001 - 5000
501 - 1000
0 - 500
POSITIVE
NEGATIVE
Scale 1:1,200,000
0 10 20 30 40 Km


SHIFT SHARE BASED ON THE AVERAGE URBAN GROWTH RATE FOR THE STUDY AREA 1961-1971
FIGURE 10
LEGEND
OVER 10,000
5001 -10,000
1,001 - 5000
501 - 1000
0 - 500
POSITIVE
NEGATIVE
Scale 1 1,200,000
0 10 20 30 40 Km


SHIFT SHARE BASED ON THE AVERAGE URBAN GROWTH RATE FOR ONTARIO 1971-1976
FIGURE 11
LEGEND
OVER 10 000
5001-10.000
1,001-5 000
501-1 000
0-500
POSITIVE
NEGATIVE
Scale 1 1,200,000
0 10 20 30 40 Km


SHIFT SHARE BASED ON THE AVERAGE URBAN GROWTH RATE FOR THE STUDY AREA 1971-1976
FIGURE 12
LEGEND
OVER 10000
5001 -10000
1001 -5000
501 -1000
0 - 500
POSITIVE
NEGATIVE
Scale 1 1,200,000
0 10 20 30 40 Km

with positive shifts are distinguished from those centers which experienced negative shifts in relation to the average rates of growth for all urban areas in both the province and the study area.

It is clearly evident from the maps that the patterns of positive and negative shifts support the patterns of growth identified in the previous exercise, thus reinforcing the spatial patterns of growth already established. During the 1961-1971 period those small towns realizing positive shifts tended to be located in close proximity of the Golden Triangle Region with the exception of Port Elgin whose growth has been previously noted. During the 1971-1976 period, those towns exhibiting a positive shift tended to expand in a westerly direction away from the Golden Triangle Region and also spread into small towns along the coastline of Bruce County. Similarily, for both periods, those small towns suffering negative shifts occupied the remaining areas within the study area, with the greatest concentrations occurring in Huron and Grey Counties.

Another important trend evident in FIGURES 10, and 11 is that small towns began to assume a greater proportion of the study area's upward or positive shift at the expense of the larger urban areas during the 1971-1976 period. TABLE 7 provides additional evidence in this regard. Based on the average urban growth rates for the study area, TABLE 7 indicates that small towns have increased their share of the positive shift from 3 percent during the 1961-1971 period to 66 percent during the 1971-1976 period. In addition, based on the average urban growth rates for the province, TABLE 7 reveals that small urban places have increased their share of the positive shift from 4 percent to 25 percent over the same two periods. These results indicate that regardless of the base urban growth rate employed, the small towns have significantly increased their share of the total upward shift in population growth.

TABLE 7

Profile of Population Shifts Based on the Average Urban Growth Rates of the Study Area and Province as Norms (1961-1971, 1971-1976)

	Based on Study Area				Based on Province			
	1961-71	%	1971-76	%	1961-71	%	1971-76	%
Total Urban Upward Shift	30,359	100	8,230	100	42,810	100	34,085	100
Total Urban Downward Shift	28,419	100	10,404	100	21,624	100	1,363	100
Downward Shift (Small Towns)	17,077	60	5,029	48	13,161	91	1,115	82
Upward Shift (Small Towns)	933	3	5,405	66	1,710	4	8,584	25
Number of towns contributing to the small town upward shift	4	13	10	32	5	16	20	65

Summary

Signs of the massive "counter-urbanization" phenomenon prevalent in the United States, and in many parts of Europe, appear to be present within the urban fabric of the study area by the end of the 1971-1976 period. However, questions do remain about how firmly entrenched this trend may be. Whether this trend has continued to dominate small town growth patterns during the latter part of the 1970's is open to debate. Although a striking feature of the new trend is the increased rate of population growth in locations removed from larger urban centers, it is still true that places surrounding large urban complexes are capturing the largest share of growth. Based on the information considered thus far, some tentative statements seem merited regarding recent patterns of small town population change within the study area. First, the largest population increases taking place beyond the cities are occurring in small communities within the commuting ranges of the Golden Triangle Region and the Bruce Nuclear Power Development site at Douglas Point. Second, a more useful description of what appears to be happening falls under the concept of "urban dispersal" around existing major urban areas (Russwurm et al., 1977). This is perhaps the creation of an ever expanding territory around major cities from which opportunities associated with large urban areas are rendered accessible by improved transportation, increased incomes, and increased amounts of time. It also appears that the human activity patterns associated with Friedmann's urban field concept are manifesting themselves around the Golden Triangle Region, and to a larger extent Toronto.

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CHAPTER III

The Components of Population Change

The recent patterns of population change identified in the previous chapter which may or may not reflect the process of counter-urbanization, underscores the need for a greater understanding of migration and natural growth patterns among small communities occupying the lower levels of the urban hierarchy. If the process of counter-urbanization has indeed operated within the limits of the study area, then the increased rates of small town population growth will be paralleled by increased rates of in-migration.

The present chapter is intended as a simple empirical analysis of the components of population change (natural increase, and migration) between 1961-1971, and 1971-1976 for all small communities in the study area. Through an investigation of the relationships between net migration, natural increase, and population change; an attempt will be made to assess the relative impacts of each component on small town growth rates. In this manner it will be possible to determine if the migration patterns support the concept of counter-urbanization.

(i) Natural Increase

Natural increase is defined as the excess of the number of births over deaths in a population over a given period of time. The rate of natural increase is influenced primarily by fertility and mortality factors whose effects have evolved over a fairly long period of time. For example, the level of fertility is primarily associated with cultural norms, socio-psychological factors, socio-economic status, whereas mortality rates are generally influenced by sanitary and medical technology, the availability of preventive and curative services, and level of income (TEIGA, 1976).

The principal concerns here for small town population change is the decline of national and provincial fertility rates. As in most western countries, fertility rates in Canada have dropped to their lowest levels in over 50 years (Stone and Marceau, 1977). In fact the general fertility rate[8] in Ontario during 1976 was less than 58 per thousand compared to 108.3 per thousand in 1961 (Ontario Statistics, 1978). FIGURE 13 shows the dramatic decline in Ontario's general fertility rate between 1961 and 1968 as well as the more recent, moderate rate of decline.

Fertility rates in the study area clearly reflect the general decline in Ontario's fertility rates during the 15 year period between 1961-1976. In fact, the average birth rate per 1,000 population among the small towns has declined by approximately 8.9 during the 1961-1976 period,(TABLE 8).

TABLE 8

Average Birth Rates Per 1,000 Population in 1961, 1971, 1976 for Small Towns

Year	Small Town Birth Rate
1961	22.8
1971	15.7
1976	13.9

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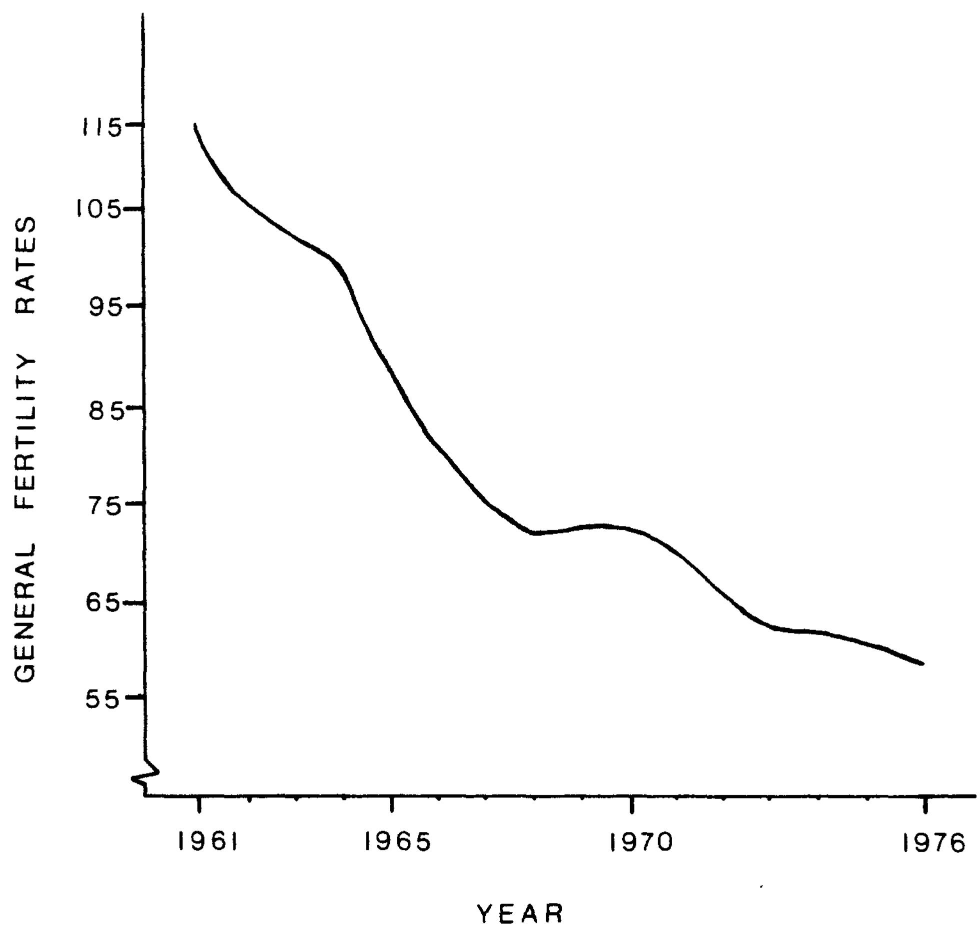
8 The general fertility rate is the birth rate per 1,000 women in the 15-49 age group.

FIGURE 13

GENERAL FERTILITY RATES FOR ONTARIO
1961-1976



Source: Ontario Statistics, 1978, Published by the Ministry of Treasury, Economics and Intergovernmental Affairs, Province of Ontario.

The continued decline of fertility rates in the study area have caused some dramatic changes in the rates of natural increase, thus affecting the growth rates and demographic structures of small communities in the study area.

During the 1961-1971 period, 23 small towns; representing approximately 74 percent of the town sample; sustained positive rates of natural increase, thus contributing positively to their respective rates of growth. On the other hand, 8 communities, representing 26 percent of the town sample, suffered a natural decrease, thus making a negative contribution to their respective population growth rates. During the 1971-1976 period only 17 communities; representing approximately 54 percent of the study sample displayed positive rates of natural growth, while 14 communities or 46 percent of the small town sample demonstrated natural decreces, (TABLE 9).

Based on these figures there can be little doubt that declining fertility rates have in fact impeded small town growth rates in the study area. Also evident is the fact that mortality rates have not declined to a point were they would compensate for declining fertility rates.

Declining fertility and mortality rates combined with the movement of the large baby-boom population through the various age groups in the small towns have contributed to a change in small town demographic profiles. In fact the population structures of many small towns are now aging with the age structure pyramid becoming markedly skewed toward the

TABLE 9

Natural Increase as a Percentage of Total

Population Change: 1961-1971, 1971-1976

Town Number	1961-1971 Percentage Natural Increase	1971-1976 Percentage Natural Increase
1	.6	1.6
2	5.9	3.3*
3	- 6.2	-6.0
4	12.1	2.4
5	2.5	-2.4
6	12.6	8.6*
7	10.8	2.1
8	8.9	8.5
9	9.2	1.5
10	12.7	5.0
11	7.2	1.4
12	2.9	-1.6
13	.5	2.8
14	7.8	1.5
15	-10.9	-6.2
16	- 7.2	-3.4
17	2.0	-1.4
18	.8	-3.4
19	- .4	- .5
20	.8	-1.0
21	13.0	6.6*
22	- 2.1	-1.8
23	2.3	8.5
24	1.9	-2.9
25	6.6	1.5
26	4.0	1.1
27	- 1.2	-5.5
28	- 7.6	- .9
29	6.4	1.2
30	- 1.7	-5.9
31	6.0	1.1

* Since the former County of Waterloo became the Regional Municipality of Waterloo in 1973, statistics have not been published for small communities. Consequently, these figures are based on applicable township averages.

Source: Compiled from Ontario Vital Statistics, 1961-1976.

middle and older cohorts, (TABLE 10).

TABLE 10

Demographic Profile of Small Towns 1961, 1971, 1976

(Percentage of Population)

Age Group	1961	1971	1976
20 years or less	35.4	34.0	30.7
21 to 64 years	48.1	48.2	51.0
Over 65 years	16.5	17.8	18.3

Source: Statistics Canada, 1961, 1971, 1976, Specific Age Groups, Catalogue 92-835, Ottawa.

(ii) Net Migration

The second important factor influencing small town population change is the rate and direction of net migration flows. Compared with natural increase, net migration is a far more changeable component, and its effect on small communities is more immediate and more complex. A basic premise of migration study has been that regions vary in their attractiveness to potential migrants. Three broad groups of causal variables have been identified as underlying areal decisions to migrate: socio-economic variables, demographic variables, and geographic variables (Vincent, 1974).

Given the strength of economic and regional differentiation in the study area, one would not expect changes in the migration component of population change to be uniformly distributed among small urban places.

The net migration estimates which are presented in the TABLES and FIGURES in this thesis cannot be properly assessed without first offering an explanation of the method employed. To estimate net migration, the "vital statistics method" was used, in which actual natural increase is added to the base population; if the actual terminal population exceeds that estimated level the excess is considered net in-migration and vice versa for net out-migration. It is important to note that the estimates generated suffer from the general limitation of the vital statistics method. This method inherently distorts the algebraic number of actual migrants; if there is in-migration it is underestimated and if there is net out-migration the outflow is exaggerated. This arises because the data do not distinguish a birth (death) of the original population from a birth (death) of a migrant after he has moved (Isard, 1961, 55-56). The error is therefore proportionate to the absolute rate of migration. Isard argues that where migration is small (i.e., migration among small towns), the error may justifiably be ignored.

A profile of annual net migration rates is presented in TABLE 11. The dominant feature of TABLE 11 is the significant increase in the annual net migration rates for many small towns during the 1971-1976 period. It is interesting to note that 24 small towns (77 percent of the sample) increased their average rates of in-migration for the 1971-1976 period. In fact the average rate of annual net migration increased from 1.35 percent during the 1961-1971 period, to 2.80 percent during the 1971-1976 period, (TABLE 11).

Net migration rates also showed a significant

TABLE 11

Profile of Net Migration and Population Growth

Rates: 1961-1971, 1971-1976

1961-1971

Town Number	Percent Net Migration	Percent Annual Net Migration	Percentage Population Change
1	17.2	1.72	17.8
2	19.3	1.93	25.2
3	6.0	.60	- .2
4	-21.8	-2.18	- 9.7
5	9.8	.98	12.3
6	29.2	2.92	41.8
7	17.4	1.74	28.2
8	35.0	3.50	43.9
9	.9	.09	10.1
10	29.1	2.91	41.8
11	7.9	.79	15.1
12	6.5	.65	9.4
13	13.5	1.35	14.0
14	9.1	.91	16.9
15	12.4	1.24	1.5
16	20.6	2.06	13.4
17	3.5	.35	5.5
18	6.6	.66	7.4
19	13.6	1.36	13.2
20	15.0	1.50	15.8
21	24.9	2.49	37.9
22	21.5	2.15	19.4
23	72.6	7.26	74.9
24	- 7.2	- .72	- 5.3
25	5.3	.53	11.9
26	- .2	- .02	3.8
27	22.2	2.22	21.0
28	18.8	1.88	11.2
29	9.9	.99	16.3
30	5.6	.56	3.9
31	- 6.3	- .63	- .3
Average	13.5	1.35	16.7

TABLE 11(continued)

1971-1976

Town Number	Percent Net Migration	Percent Annual Net Migration	Percentage Population Change
1	15.8	3.16	17.4
2	1.3*	.26*	4.6
3	14.6	2.92	8.6
4	- 2.5	- .50	- .1
5	4.6	.92	2.2
6	40.1*	8.02*	48.7
7	33.8	6.76	35.9
8	30.3	6.06	38.8
9	2.7	.54	4.2
10	5.4	1.08	10.4
11	11.0	2.20	12.4
12	6.4	1.28	4.8
13	26.3	5.26	29.1
14	8.0	1.60	9.5
15	13.8	2.76	7.6
16	13.6	2.72	10.2
17	8.1	1.62	6.7
18	20.2	4.04	16.8
19	8.3	1.66	7.8
20	12.2	2.44	11.2
21	14.0*	2.80*	20.6
22	7.5	1.50	5.7
23	67.2	13.44	75.7
24	.6	.12	- 2.3
25	32.8	6.56	34.3
26	3.0	.60	4.1
27	25.2	5.04	19.7
28	9.6	1.92	8.7
29	2.1	.42	3.3
30	2.4	.48	- 3.5
31	- 2.5	- .50	- 1.4
Average	14.0	2.80	14.5

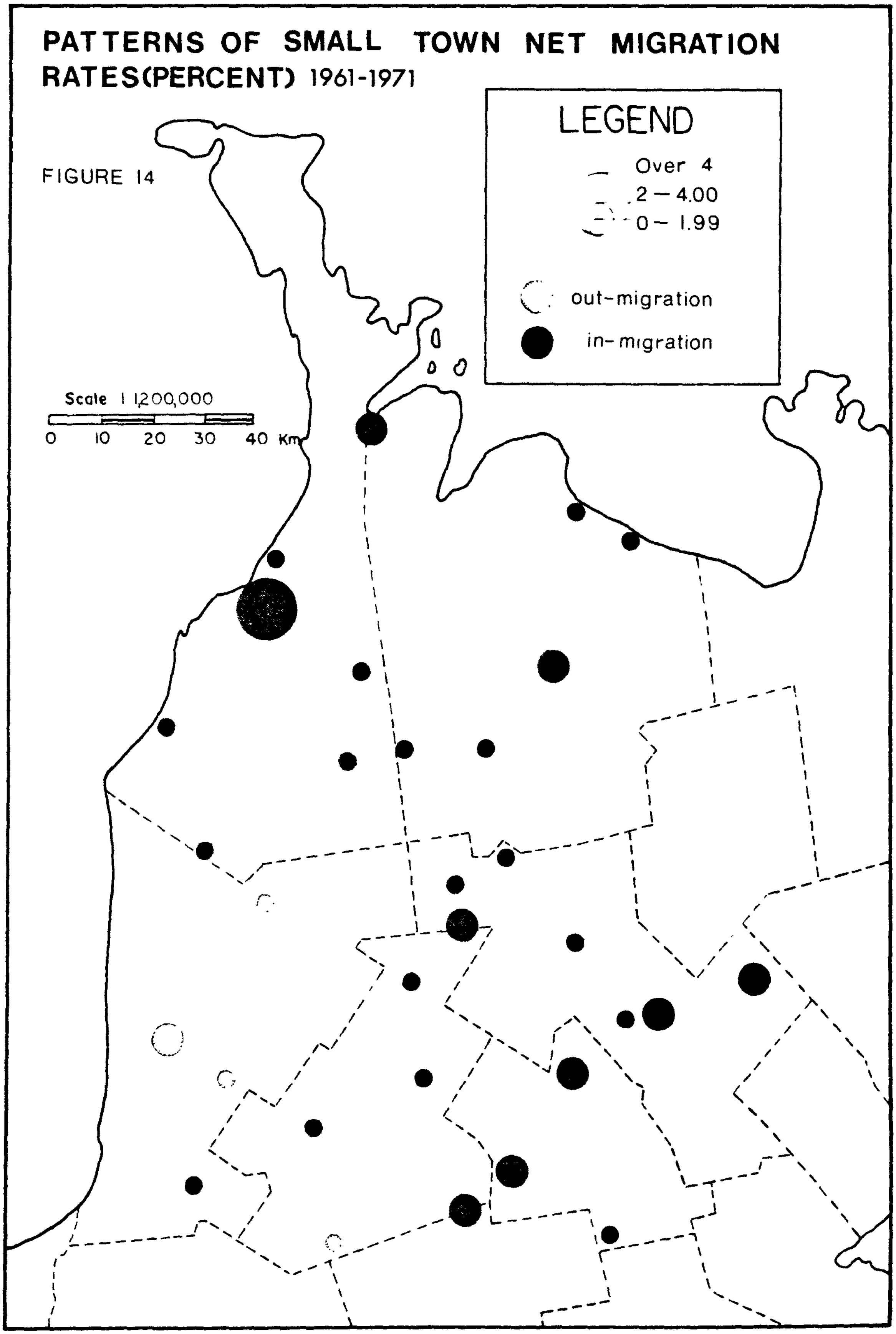
* For reasons previously stated, these figures have been based on applicable township averages.

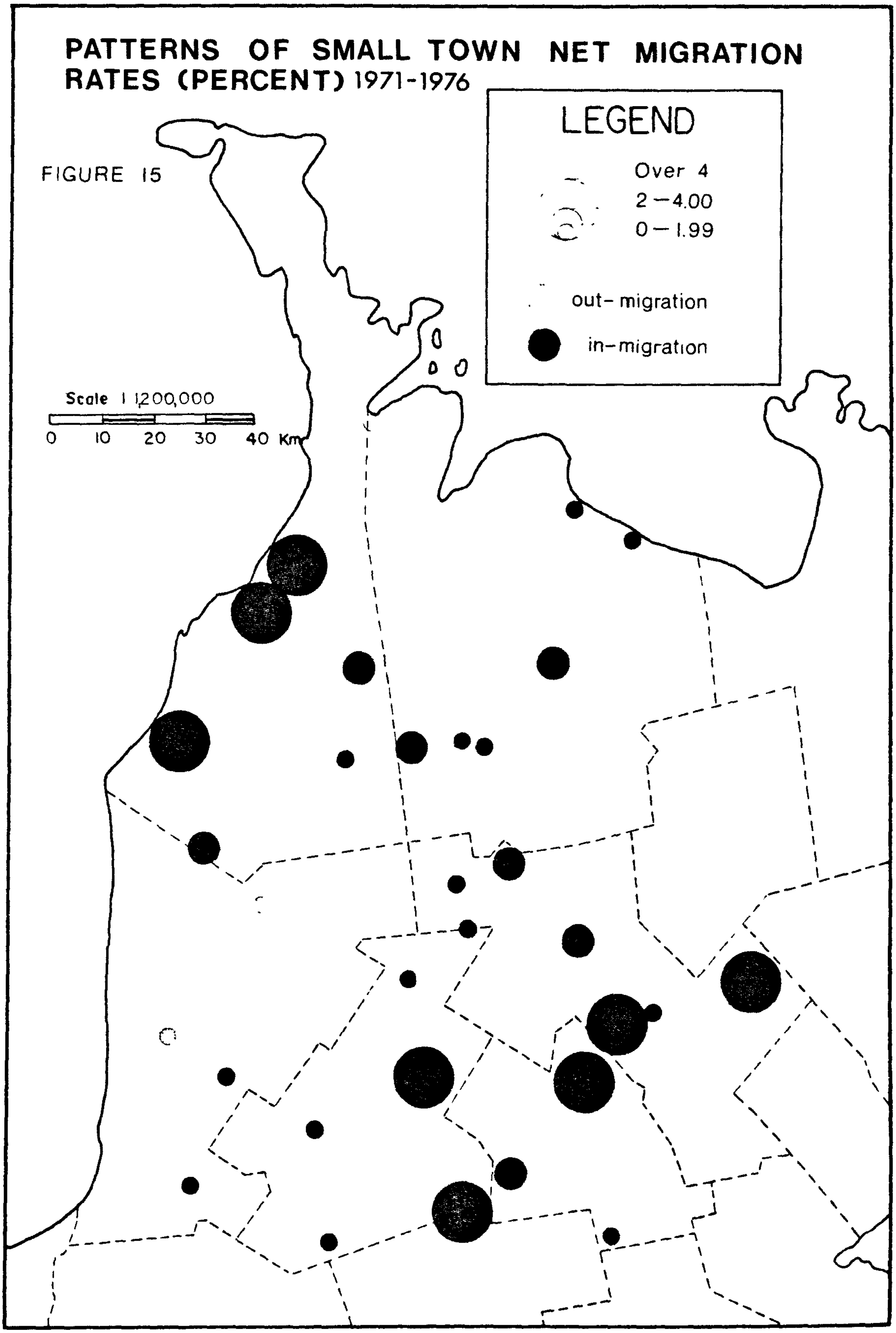
Source: Compiled by author.

correlation with population growth for both study periods. A correlation coefficient (r) of .67 was calculated for the 1961-1971 period, while a correlation coefficient of .98 was obtained for the 1971-1976 period. These simple correlations indicate that the rates of migration change for the 1971-1976 period are more significantly correlated with percentage population change for that period than they are for the 1961-1971 period.

For a number of small towns, migration is becoming a far more important factor than natural increase in determining the growth of the small towns (see TABLES 9 and 11). During the 1961-1971 period, the proportion of growth due to net migration did not exceed that of natural increase in only the small towns of Clinton, Exeter, Wingham, Seaforth, and St. Mary's. Through the 1971-1976 period, the number of these towns decreased to 3 (Ayr, Clinton, and Wingham). During the 1961-1971 period, small town growth due to migration was approximately 4 times that due to natural increase. In the 1971-1976 period, mean small town growth due to migration increased to 28 times that due to natural increase.

The patterns of net migration among the small towns for the two periods are presented in FIGURES 14, and 15. The dominant feature of the 1961-1971 period (FIGURE 14) is the clustering of places with annual rates of in-migration greater than 2 percent, within close proximity to the Golden Triangle Region. Another notable pattern is the clustering of small communities which suffered out-migration


PATTERNS OF SMALL TOWN NET MIGRATION RATES(PERCENT) 1961-1971
FIGURE 14
LEGEND
Over 4
2 — 4.00
0 — 1.99
out-migration
in-migration
Scale 1 1,200,000
0 10 20 30 40 Km


PATTERNS OF SMALL TOWN NET MIGRATION RATES (PERCENT) 1971-1976
FIGURE 15
LEGEND
Over 4
2 — 4.00
0 — 1.99
out- migration
in- migration
Scale 1 1,200,000
0 10 20 30 40 Km

on the western periphery of the study area, centered mainly in Huron County.

The dominant feature of the 1971-1976 period (FIGURE 15) is the vast area occupied by places with annual rates of in-migration greater than 2 percent. FIGURE 15 indicates that within the study area there are two significant zones of high in-migration. One zone occupies the area surrounding the Golden Triangle Region, while the second zone includes those small towns in Bruce County which are located in close proximity to the Bruce Nuclear Power Development site at Douglas Point. An emerging feature of the 1971-1976 period is the development of a corridor of high in-migration which stretches between the two major zones of high in-migration. Although the number of small towns suffering from out-migration declined modestly, they continued to be located mainly in Huron County.

Summary

The results presented in this chapter testify to the fact that the migration component of population change has become the principal factor affecting the direction of small town population change in the study area. Due to declining fertility rates, the natural increase component was found to impede the growth of many small communities.

In general, it was observed that the closer a center was to the Golden Triangle Region or the Bruce Nuclear Power Development site, the more likely it was to show a gain in net migration, and to experience an increase in the proportion of its growth due to net in-migration.

There is no evidence to suggest any direct correlation between the size of centers and the effect of migration. The centers within the smaller size group (1,000 to 2,000) which experienced a high proportion of its growth due to migration did not differ from the migration experience of the larger towns. Indeed, many of the smaller centers had a relatively large influx of in-migrants.

The general increases in the annual mean migration rates over the two periods, appear to support earlier arguments that the process of counter-urbanization has influenced small town growth rates in the study area. On the basis of the trends indicated in this chapter, it appears that the migration component will provide a meaningful index from which to examine the determinants of small towns variations in growth.

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CHAPTER IV

An Examination of Small Town Hierarchical Functional Profiles and Small Town Population Change

In this chapter concern is directed at establishing whether an association exists between the 1971 functional profiles of small towns and their performances on selected population growth indicies during the 1961-1971 and 1971-1976 study periods.

The chapter is divided into four sections. First, the background literature is discussed, with particular reference to applicable classification techniques. Second, the techniques used to determine the functional profiles and a hierarchical grouping of small towns with similar functional profiles are discussed. Third, the functional profiles and hierarchical grouping for the small towns are presented. Fourth, each of the functional groups of small towns is examined with regard to its respective achievement on the selected indicies of population change.

Introduction to the Grouping Analysis

Grouping techniques, as alluded to in Chapter I occupy a central part of this chapter. Before one can investigate whether a relationship exists between groups of small towns with similar functional profiles and their performances on the selected growth indicies, a method of identifying the principal functional characteristics of small towns must first be utilized.

The volume of literature concerned with establishing the functional profiles of urban areas is a reflection of the fact that each technique devised has its own particular advantages and disadvantages. Consequently, no technique presently available can be considered to be the best in all circumstances.

An early classification of American cities by Harris (1943), is regarded as a classic in the literature dealing with urban functional types. In his study, Harris classified metropolitan districts with populations greater than 10,000 on the basis of the activity of greatest importance for each city, as defined by employment and occupational figures. Based on personal insight and a number of arbitrary decisions levels of dominance in employment in different industries were established for each of the urban areas included. Harris identified nine functional classes of cities. These included; manufacturing cities, retail centers, diversified cities, wholesale cities, transportation centers, mining towns, university towns, resort and retirement towns, and other centers, which included political centers.

However, the Harris classification is not without its weaknesses. One basic problem is the essentially intuitive or subjective manner in which he defined specialized cities. Harris placed arbitrary limits on the functions performed by the cities based on the percentage of the labour force employed in the major occupational categories. A second basic problem is that cities were permitted to specialize in only one type of activity. As a result, the labels attached to many urban centers often hid more about the occupational structure than they revealed (Johnson, 1965, 68).

Another functional classification of cities in the United States was developed by Nelson using employment data in 24 industry groups for 897 urban concentrations, each of which included 10,000 or more people (Nelson, 1955). To determine degrees of dominance of a given function, Nelson employed standard deviations to establish degrees of variation from the average employment in a given industry in all cities included regardless of their respective populations. Although this procedure was more objective than was that of Harris, it suffered from shortcomings such as the use of standard deviations for establishment of limits for placement of cities into one of ten designated classes of cities. Nelson's procedure, however, allowed for inclusion of a given city in more than one class of cities, which suggested that a city could be characterized and grouped, based on more than one dominant function.

Despite the potential usefulness of the findings, it is unfortunate that both the Harris and the Nelson classification techniques were apparently undertaken more to illustrate method than to search or structure reality in a problem framework (Yeates and Garner, 1971, 77).

Classification is inevitably subjective and geographers have attempted to solve that problem in part at least by using multivariate techniques, wherein the similarities and dissimilarities between places are sought on the basis of several variables.

When the object of classifying urban places is to group together those that have the greatest similarity in functional structure rather than simply to indicate a dominant function, as is the objective of this study, then different methods must be used than those employed by Harris and Nelson. King's multivariate analysis and classification of Canadian cities provides a useful technique to achieve this purpose (King, 1966). King's methodology will be described in detail in the following section.

The principal advantage of King's classification technique is that the element of choice or subjectivity is reduced to a minimum--the selection of the appropriate variables at the beginning of the analysis.

The choice of technique is also very important as it too is an area of human decision. Davis (1966) states that the principles which should be taken into any grouping scheme, include the need to consider carefully input, technique, and output while maintaining objectivity and comparability. Davis offers no particular best solution to the problem of grouping urban areas but he clearly considers sophisticated statistical techniques similar to that employed by King, the best alternative thus far.

The Principal Methods of Analyses

In this section, the principal methods of analyses designed to identify and group small towns on the basis of their functional profiles for 1971 are introduced.

The three analytic techniques used in this exercise are Principal Components Analysis, Hierarchical Grouping Analysis, and Multiple Discriminant Analysis.

(i) Principal Components Analysis

The first technique applied to the data is the principal component analysis. In selecting the principal component analysis technique used in this study, guidelines similar to those offered by King (1966) were employed. To begin with the data are arranged in the form of an "n x m" data matrix. In this, there are "m" columns, each of which corresponds to a different functionally related characteristic for each small town, and there are "n" rows, each of which corresponds to a different small town. Contained in this matrix is the raw data required for the principal components exercise.

King used a similar data matrix as the starting point of his classification of Canadian cities. His study contained 54 columns--one for each of the economic, social, demographic, and locational characteristics, and 106 rows corresponding to the cities. When combined, the observations for each city formed a 106 x 54 data matrix, each column of which was correlated with every other to result in a 54 x 54 matrix of correlation coefficients. King then proceeded to subject these results to a principal components analysis, the results of which suggested that the variation in the structure of Canadian cities could be expressed in terms of eleven basic dimensions, accounting for 83 percent of the total variance in the data matrix.

Using the basic procedures employed by King, a data matrix for the small towns can be reduced to a matrix of correlation coefficients. Hence, the columns which have been correlated with each other to yield the correlation matrix, contain coefficients which indicate similarities in the way the functional characteristics vary among the small towns.

A high correlation between two characteristics indicates that they vary among the communities in a similar manner; conversely, a low coefficient indicates that they are quite dissimilar. When one analyzes a matrix of correlation coefficients one finds that many of the characteristics are not independent of one another, but rather overlap in the explanation they provide about the subject being analyzed. This suggests that within the characteristics there are a number of common threads which, if identified, might provide a useful basis on which to establish a hierarchical grouping of small towns based on their functional profiles.

Principal components analysis allows one to reduce the rather large number of overlapping coefficients into a small number of succinct dimensions or components as they are technically called, which retain a high proportion of the original data matrix. The number of identified components will determine the dimensions of the classification space in which each community can be located by its factor score.[9]

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[9] To determine the factor score for a case on a component, the case's data on each variable is multiplied by the factor weight for that variable. The sum of these weight x data products for all the variables yields the factor scores (Rummel, 1970).

(ii) Hierarchical Grouping Analysis

The second technique, hierarchical grouping analysis, uses the factor score profiles from the principal components analysis to obtain an optimal grouping of small towns.

The grouping method begins by regarding each town as a separate group. Then at each step the two most similar groups are combined to yield a single group such that the within group variance is minimized. Each successive step reduces the number of groups by one, until finally there is only one group containing all the places and all the variance. It is important to note that no unique solution exists, the two criteria most generally used for selecting a meaningful set of groups are the number of groups desired, and the reduction in the ratio of between group variance to total variance at each step. The latter criterion is used in this analysis such that the grouping chosen is that in which the error term[10] is less than and just precedes that in which the error term increases significantly.

(iii) Multiple Discriminant Analysis

The third technique, multiple discriminant analysis, is used to test the significance of the groupings derived from the hierarchical grouping analysis. Such a test is recommended for two reasons (Berry, 1967, 242). Firstly,

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10 The error term is the sum of the squared differences between corresponding scores in the profiles, divided by the number of towns in the potential group (Veldman, 1967, 310).

it is possible to group totally unrelated data by hierarchical grouping analysis, (i.e., the groups themselves may have no meaning though in this case it is known that relationships do exist between the towns being grouped). Secondly, the number of groups is a subjective decision on the part of the user and as such should be tested.

Discriminant analysis has been used extensively in geographical research and has been applied successfully to a number of classification studies (i.e., King, 1967; Williams, 1971; and Barber, 1972). The discriminant technique tests classifications to see whether the between class differences are significantly larger than the within class variations, thus testing the null hypothesis that the classes are equal (i.e., that there is no significant difference between the groups). The null hypothesis is tested by comparing the computed "F ratio" with the tabulated values of "F".[11]

In addition, measures of the separation of the classifications are taken. The separation of the groups is

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11 "F" ratio distribution is defined as the ratio of two independent chi-square distributions, each divided by their respective numbers of df (degrees of freedom) (Young and Veldman, 1977, 267). The "F" ratio is commonly used when making inferences concerning two variances from two different statistical populations or groups.

measured by two criteria, Wilks' Lambda[12] and Canonical Correlations[13]. The smaller the value of Wilks' Lambda and the larger the value of the canonical correlations, the better the groupings.

Analyses and Results

This section will begin with discussions of the three analyses based on the 1971 data matrix, (APPENDIX B).

(i) Principal Components Analysis

Many indicies of functional structure could have been included in this analysis, however, some had to be rejected for lack of data. The sixteen variables selected for the analysis are listed in TABLE 12. No argument is presented here that these sixteen indicators of small town functions are the best measures or the only ones that could be devised, however, they were selected as being appropriate because they all represent several functional characteristics of small urban places. The values of the variables are presented in APPENDIX B.

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12 Wilks' Lambda is a measure of group discrimination. The values for Wilks' Lambda can range from 0 to 1 with the degree of compactness or group homogeneity increasing towards zero.

13 Canonical correlations are measures of association between the single discriminant function and the set of (g-1) dummy variables which define the "g" group memberships. It tells us how closely the function and the group variable are related, which is just another measure of the function's ability to discriminate among the groups. The values for canonical correlations can range from 0 to 1 with the degree of separation increasing towards 1.

TABLE 12

Selected Variables (1971)

Variable Number	Description	Code Name
1	Total value added from manufacturing	TVALAD
2	Value added from manufacturing per capita	VALADC
3	Value added from manufacturing per employee	VALADE
4	Total number of employees in the local manufacturing labour force	TOTEMP
5	Total number of manufacturing plants	TOTPLA
6	Local manufacturing employment as a percentage of the total labour force	MEMPER
7	Number employed in the retail-service sector	NUMRSS
8	Number of retail-service establishments	NUMEST
9	Retail-service sales per capita	RSSALC
10	Total retail-service sales	TOTSALE
11	Percentage of workers commuting	PERCOMM
12	Number of workers commuting	NUMCOMM
13	Percentage of local labour force incommuting	PERINCO
14	Percentage population over 65 years of age	PER65
15	Number of persons over 65 years	NUM65
16	Number of incommuters	NUMINCO

The present analysis was executed by using the SPSS (Statistical Package for the Social Sciences) packaged programme "Factor" with the principal components analysis and varimax rotation options.

The principal components analysis reduced the sixteen selected variables to four dimensions which together accounted for 87.2 percent of the total variance exhibited by the correlation matrix, (TABLE 13). The four dimensions generated have eigenvalues greater than 1.0; eigenvalues of 1.0 or greater are usually considered to be statistically significant. TABLE 13 summarizes the proportion of the total inter-community variance and the respective eigenvalues accounted for by each of the components.

TABLE 13

Percentage of the Total Variance and the Respective Eigenvalues Accounted For by the First Four Principal Components

Component	Variance	Cumulative Variance	Eigenvalue
I	34.0	34.0	5.43
II	32.0	66.0	5.10
III	13.0	79.0	2.08
IV	8.2	87.2	1.30

TABLE 14 indicates the percentage of the variance for each variable accounted for by the four components. These values represent the squares of the factor loadings (i.e., the correlation of a particular variable with each component) expressed as a percent. The variables least well accounted for by the four components are Value Added per Employee (63.5) and the Total Number of Manufacturing Plants (68.1). However, the number of variables which are summarized quite well by the four components is very large. This implies that the variation of most of the sixteen functional characteristics are effectively captured by the first four components; a desirable feature for the present analysis.

TABLE 14

Percentage of the Variance of the Sixteen Variables Accounted for by Each Component

Components	I	II	III	IV	
Code Name					Total
TVALAD	15.4	76.3	0.8	0.3	92.8
VALADC	2.6	91.5	0.6	0.2	94.9
VALADE	0.2	54.1	6.9	2.3	63.5
TOTEMP	29.4	65.4	0.0	0.0	94.8
TOTPLA	20.3	44.3	3.5	0.0	68.1
MEMPER	0.0	75.5	1.8	0.1	77.4
NUMRSS	85.1	3.2	6.3	2.2	96.8
NUMEST	83.7	2.8	0.6	7.4	94.5
RSSALC	35.1	20.9	16.5	7.1	79.6
TOTSALE	87.3	3.7	6.6	0.1	97.7
PERCOMM	39.2	0.1	47.7	4.6	91.6
NUMCOMM	5.0	22.7	50.8	2.9	81.4
PERINCO	4.4	0.0	0.0	89.0	93.4
PER65	61.4	11.8	5.3	10.9	89.4
NUM65	9.8	10.6	60.4	0.1	80.9
NUMINCO	64.2	27.1	0.0	3.6	94.9

TABLE 15 provides a 31 x 4 matrix of factor loadings. The factor loadings are important because they demonstrate the strength of the relationship between a variable and a component. In order to facilitate interpretation of the components, variables showing the highest correlations for each component have been rank ordered.

A brief description and interpretation of each of the four components follows. The emphasis is on the structure of the components; the strength and direction of the relationship between variables and their interpretation in relation to the factor scores (TABLE 16) of the derived group of towns.

Component I

The first component which accounts for 34.0 percent of the total variability can be identified primarily as a retail-service function. Variables loading highly (greater than .55) are presented in TABLE 17. When a town acquires a high positive factor score (greater than 1.0) on Component I, it is associated with a significant retail-service function. When a town receives a high negative factor score (less than -1.0) it is associated with a rather weak retail-service function relative to the other small towns. Places scoring highly on Component I are presented in TABLE 17.

Component II

The second component is related to manufacturing activity, and accounts for 32.0 percent of the total variability. Variables loading highly on this component are

TABLE 15

Ranked Factor Loadings

Components Code Name	I	II	III	IV
TOTSALE	.9346	.1925	.2574	-.0393
NUMRSS	.9227	.1786	.2506	-.1479
NUMEST	.9151	.1664	.0803	-.2729
NUMINCO	.8012	.5207	-.0080	.1912
NUM65	.7838	.3442	-.2310	-.3305
RSSALC	.5931	-.4572	.4065	.2673
VALADC	.1619	.9564	.0801	.0489
TVALAD	.3929	.8734	.0901	-.0558
MEMPER	-.0312	.8690	.1357	.0331
TOTEMP	.5418	.8088	.0262	-.0090
VALADE	.0495	.7359	.2636	-.1518
TOTPLA	.4510	.6655	.1863	-.0170
PER65	-.3131	-.3263	-.7777	-.0351
NUMCOMM	.2239	.4763	.7128	-.1694
PERCOMM	-.6262	-.0430	.6903	.2145
PERINCO	-.2120	.0097	.0099	.9434

TABLE 16

Factor Scores

Components Town Name	I	II	III	IV
Arthur	-1.196	-0.056	0.530	-0.535
Ayr	-0.846	-0.021	1.263	2.538
Chesley	-0.686	-0.111	-1.736	-0.330
Clinton	1.990	-1.685	1.252	1.484
Durham	0.119	-0.322	-1.214	0.222
Elmira	0.139	2.095	1.047	0.029
Elora	-1.373	0.440	0.485	0.452
Erin	-0.874	-0.729	1.793	0.271
Exeter	0.596	-0.647	0.928	-0.560
Fergus	0.306	3.110	0.535	-0.057
Hanover	2.175	0.832	-0.443	0.731
Harriston	-0.801	-0.253	-0.431	-1.797
Kincardine	0.888	-1.479	1.648	-1.057
Listowel	2.119	0.697	-0.324	0.987
Lucknow	-0.834	-0.452	-1.026	0.490
Markdale	-0.192	-1.141	-1.428	1.294
Meaford	0.950	0.494	-0.649	-0.869
Milverton	-1.525	0.190	0.419	0.204
Mitchell	-0.439	-0.026	0.195	-0.094
Mount Forest	0.516	-0.787	-0.937	-1.482
New Hamburg	-0.236	-0.098	2.123	-0.271
Palmerston	-0.571	-0.633	-0.498	0.345
Port Elgin	-0.175	-0.509	0.566	-1.246
Seaforth	0.074	-0.201	-0.496	0.192
Southampton	-0.417	-0.401	0.201	-1.623
St. Marys	0.450	1.277	-0.013	-1.493
Tavistock	-0.801	-0.005	-1.209	0.110
Thornbury	-1.456	1.062	-0.599	1.578
Walkerton	0.995	0.643	-0.490	-0.194
Wiarton	0.426	-1.387	-0.699	0.572
Wingham	0.680	0.107	-0.790	0.108

TABLE 17

Component I

Factor Loadings for Component I

Code Name	Variable Name	Highly Positive	Highly Negative
NUMRSS	Number employed in the retail-service sector	.93	
TOTSALE	Total retail-service sales	.93	
NUMEST	Number of retail-service establishments	.92	
NUMINCO	Number of incommuters	.80	
NUM65	Number of persons over 65 years	.78	
PERCOMM	Percentage of workers Commuting		-.62
RSSALC	Retail-service sales per capita	.59	

High Factor Scores on Component I

Town Number	Town Name	Highly Positive	Highly Negative
11	Hanover	2.17	
14	Listowel	2.11	
4	Clinton	1.99	
18	Milverton		-1.52
28	Thornbury		-1.45
7	Elora		-1.37
1	Arthur		-1.19

presented in TABLE 18. When a town gets a high positive score on Component II, it is associated primarily with a relatively strong manufacturing function. Towns earning a high negative score on the second component are associated with a relatively weak manufacturing base. Small towns scoring highly on this component are listed in TABLE 18.

Component III

The third component which accounts for 13.0 percent of the total variability can be identified predominantly as a residential component. Variables loading highly on this component are listed in TABLE 19. When a town receives a high positive score, it is associated with a notable commuting or dormitory function. On the other hand, towns acquiring a high negative score are associated with a significant retirement function. Towns with high factor scores on Component III are listed in TABLE 19.

Component IV

Component IV accounts for 8.2 percent of the total variability among the data. This component tends to identify communities which attract a large proportion of their employed labour force from outside the community, (TABLE 20). When a town gets a high positive score on this dimension, it is associated with a significant incommuting labour force. When a town receives a high negative score on this component it is linked to a small incommuting labour force. Towns acquiring high factor scores on Component IV are presented in TABLE 20.

TABLE 18

Component II

Factor Loadings for Component II

Code Name	Variable Name	Highly Positive	Highly Negative
VALADC	Value added from manufacturing per capita	.95	
TVALAD	Total value added from manufacturing	.87	
MEMPER	Local manufacturing employment as a percentage of the total labour force	.86	
TOTEMP	Total number of employees in the local manufacturing labour force	.80	
VALADE	Value added from manufacturing per employee	.73	
TOTPLA	Total number of manufacturing plants	.66	

High Factor Scores on Component II

Town Number	Town Name	Highly Positive	Highly Negative
10	Fergus	3.11	
6	Elmira	2.09	
26	St. Marys	1.27	
28	Thornbury	1.06	
16	Markdale		-1.14
30	Wiarton		-1.38
13	Kincardine		-1.47
4	Clinton		-1.68

TABLE 19

Component III

Factor Loadings for Component III

Code Name	Variable Name	Highly Positive	Highly Negative
NUMCOMM	Number of workers commuting	.71	
PERCOMM	Percentage of workers commuting	.69	
PER 65	Percentage population over 65 years of age		-.77

High Factor Scores on Component III

Town Number	Town Name	Highly Positive	Highly Negative
21	New Hamburg	2.12	
8	Erin	1.79	
13	Kincardine	1.64	
2	Ayr	1.26	
4	Clinton	1.25	
6	Elmira	1.04	
15	Lucknow		-1.02
27	Tavistock		-1.20
5	Durham		-1.21
16	Markdale		-1.42
3	Chesley		-1.73

TABLE 20

Component IV

Factor Loadings for Component IV

Code Name	Variable Name	Highly Positive	Highly Negative
PERINCO	Percentage of the local labour force incommuting	.94	

High Factor Scores for Component IV

Town Number	Town Name	Highly Positive	Highly Negative
2	Ayr	2.53	
28	Thornbury	1.57	
4	Clinton	1.48	
16	Markdale	1.29	
13	Kincardine		-1.05
23	Port Elgin		-1.24
20	Mount Forest		-1.48
26	St. Marys		-1.49
25	Southampton		-1.62
12	Harriston		-1.79

The results of the principal components analysis indicate that it has been successful in identifying three distinct functional dimensions. The first three dimensions are found to all represent important functions carried out by small communities (i.e., retail-service, manufacturing, and residential). The fourth component (incommuting) does not identify a specific functional activity performed by small towns. For this reason, it will not be included in the grouping exercise.

The next step in the grouping procedure will be to determine whether the three functional dimensions are capable of grouping small towns on the basis of their factor scores.

Grouping Analysis

(i) Grouping Test

Before executing the hierarchical grouping procedure the following analysis is undertaken to test for the existence of groups from among the small centers under consideration. If the functional dimensions derived from the principal components analysis order small towns into distinct clusters, one can feel justified in subjecting the factor scores to a hierarchical grouping analysis to bring out the groups. On the other hand, if groups are nonexistant among the dimensions, such justification would be more difficult.

For the purpose of this exercise, it is convenient to define a *group* as a collection of points in which every individual is closer to some member of the collection than to any individual outside of it. Groups occur in random, as well as in nonrandom distributions. Nonrandom distributions differ from random ones in the extent to which the groups are isolated, increased isolation of groups being characteristic of aggregated distributions and decreased isolation being distributions that tend toward uniformity (Clark, 1955, 373). A group may be said to be completely isolated if each of its members is closer to every other member than to any individual outside of the group.

The tendency for isolation of groups of size "n" in a population may be called grouping of order "n", positive, neutral, and negative grouping implying tendencies for isolation respectively greater than, equal to, and less than that expected in a random distribution.

A number of procedures have been developed in recent years for measuring departures from randomness in the distribution of points. It has been shown by (Clark, 1955) that in a random distribution in one-dimensional space that the proportion of points for which the relation of nearest neighbour is reflexive--that is, points which are the nearest neighbour of their nearest neighbour--is .666. In one dimensional space the probability formula for a random distribution is,

$$P_{n_k} = ({}^{2}/_{3})^{n_k} \text{ where:}$$

P = the probability of a random distribution, and

n = (1,2,3,...k) nearest neighbours.

As a test of the functional dimensions ability to group small towns into distinct groups, the proportion of individuals for which the relation of nth nearest neighbour is reflexive, for n=1-4, was ascertained for each of the factor score distributions (i.e., retail-service, manufacturing, and residential dimensions). TABLE 21 indicates that negative grouping tends to be a marked characteristic of the factor scores which is a desirable feature for justification of the grouping analysis. Although the significance of the differences between these proportions have not been determined, one can argue that due to the large proportion (83 percent) of negative grouping evident, that it should be possible to identify groups of small towns on the basis of the factor scores for the three functional components.

TABLE 21

Proportions of Individuals for which the Relation of nth Nearest Neighbour is Reflexive for Components in One-Dimensional Space

	Size of Sample			
	—	31	31	31
n	Random Distribution	Retail Dimension	Manufacturing Dimension	Residential Dimension
1	.666	.645*	.709	.645*
2	.444	.387*	.258*	.322*
3	.296	.322	.129*	.129*
4	.197	.097*	.129*	.193*

* denotes proportions which demonstrate negative grouping

(ii) Hierarchical Grouping Analysis

Attention already has been focussed upon the relative positions of certain small towns on the various functional dimensions. Now the question is raised as to how the 31 communities are located relative to one another in the total small town dimensions space. For the purpose of this discussion, the first three components are considered to form the basis of the small town dimensions space. Component IV was omitted from the grouping procedure as it would, as indicated earlier, contribute little to the purpose of establishing groups of small towns based on their functional profiles.

Since these three components are orthogonal or uncorrelated, the distances between small town points in the dimensions space can be regarded as measures of their similarities. At each successive stage of the grouping procedure, individual small towns or existing groups of towns are linked on the basis of minimizing the increment in the within group variance. As previously suggested, this grouping procedure has no single analytic solution and if pursued to the end, results in only one group containing all of the study towns.

At the beginning of the process there are 31 groups of one town each, and associated with these groups is an error term which in this case is zero. As the number of objects within a group increases, its error will also increase. Examination of the errors associated with successive stages in the grouping process will usually reveal a particular level (number of groups) that is especially worthy of study, since reduction to the next stage would involve a substantially larger increase in the error term than has been associated with previous reductions (Veldman, 1967, 311).

The hierarchical grouping analysis was executed with the programme "HGROUP" (Veldman, 1967, 314-315). The result is a set of five groups which are presented in TABLE 22. A brief description and interpretation of each of the five groups follows.

TABLE 22

Small Town Groupings 1971

Group Number	Towns
1	Elmira, Fergus
2	Hanover, Listowel, Meaford, St. Marys, Walkerton, Wingham
3	Clinton, Exeter, Kincardine
4	Arthur, Ayr, Elora, Erin, Milverton, Mitchell New Hamburg, Port Elgin, Southampton, Thornbury
5	Chesley, Durham, Harriston, Lucknow, Markdale, Mount Forest, Palmerston, Seaforth, Tavistock, Wiarton

For map see Appendix C.

Group 1

The first group consists of two towns (Elmira, and Fergus), both of which are located within close proximity to the Golden Triangle Region. The dominant feature of this group, distinguishing it from all other groups, is the exceptionally high positive scores that these towns achieve on the manufacturing dimension, (TABLE 23).

TABLE 23

Factor Scores on the Selected Functional Dimensions for Group 1

Town Name	Dimensions		
	Retail-Service	Manufacturing	Residential
Elmira	.139	2.095	1.047
Fergus	.306	3.110	.535

The high levels of manufacturing associated with these towns can be largely attributed to market accessibility factors. These towns have benefited from spread effects[14], generated with the decentralization of industrial activities outwards from Toronto and the Golden Triangle Region.

Elmira and Fergus demonstate that they also have an above average dormitory function associated with them. Further improvements in private transportation, combined with factors associated with an evolving society (i.e., higher incomes, higher levels of education, new preferences for places to live) have accorded these towns a notable residential (dormitory) function.

14 There are many aspects of the spread effect. Initially, economic growth in a particular urban center in a region is based on the concentration of innovations, decision-making, and efficient transportation and communication systems. Later these effects are diffused to adjacent centers in the region through technical spillover. Classical equilibrium theory sees such spread effects of economic development as the mechanism by which the growth process is transmitted widely throughout the economic system, evening out distributional imbalances (Lloyd and Dicken, 1972, 178).

Although Elmira and Fergus rank as the two largest towns in the study area by 1976, it is interesting to note that they do not rank as high on the retail-service dimension as their population sizes might seem to suggest, (TABLE 23). This may in part be attributed to their close proximity to the larger urban complexes contained in the Golden Triangle Region, which may have deprived these towns of much of their local serving importance.

The diverse functional structure of these towns suggest that Elmira and Fergus have achieved a more complex functional profile than any of the other groups of small towns. To reflect the more complex and diversfied functional structure characterizing these towns, they will be referred to as mature towns.

Group 2

Small towns making up the second group are characterized by positive scores on the retail-service and the manufacturing dimensions, and negative scores on the residential dimension, (TABLE 24).

TABLE 24

Factor Scores on the Selected Functional Dimensions for Group 2

Town Name	Dimensions		
	Retail-Service	Manufacturing	Residential
Hanover	2.175	.832	-.443
Listowel	2.119	.698	-.324
Meaford	.950	.494	-.649
St. Marys	.450	1.277	-.013
Walkerton	.996	.643	-.490
Wingham	.680	.107	-.790

TABLE 24 reveals that the second group of towns score better on the retail-service dimension than those in the first group. This may in part be attributed to the fact that these centers are located in regions removed from major urban areas. As a result, the strong friction of distance between these towns and major urban areas has enabled them to achieve above average levels of retail-service activity by permitting them to serve relatively large trade areas. Another factor which may contribute to the above average levels of retail-service activity is their presence on major highways. Certainly the quality and condition of the surrounding road network will affect a small town's potential for drawing outsiders or losing sales to nearby communities.

A second notable characteristic of this group of communities is their above average scores on the manufacturing dimension. Although these centers do not score as highly on this component as the first group of towns, they do, nevertheless possess above average levels of manufacturing activity. Site and situation factors[15] (i.e.,accessible natural resources, break-of-bulk) appear to have played

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15 Site is the precise features of the terrain on which the settlement began and over which it has spread. Situation is usually taken to mean the physical conditions (as for the site) over a much wider area around the settlement. But of equal importance are the human characteristics of the surrounding area, since these affect the character and fortunes of the urban settlement (Yeates and Garner, 1971, 47).

significant roles in this regard. For example, the Towns of Walkerton and Hanover have benefited from the presence of substantial forest resources which have attracted several wood working industries to these towns. In addition, improvements in rail and road facilities have provided these centers with access to local and national markets.

A third important trait of this group is their high rank on the retirement function of the residential dimension. These centers have evolved significant concentrations of persons aged 65 years or older.

Group 3

The third group of towns consists of those centers which score positively on both the retail-servive dimension and the residential dimension, and negatively on the manufacturing dimension, (TABLE 25).

TABLE 25

Factor Scores on the Selected Functional Dimensions for Group 3

Town Name	Dimensions		
	Retail-Service	Manufacturing	Residential
Clinton	1.991	-1.685	1.252
Exeter	.596	-0.647	.928
Kincardine	.888	-1.479	1.648

The significant positive scores that these towns achieve on the retail-service dimension suggest that these towns; which are located in regions peripheral to major urban areas; have been able to develop above average levels of retail-service activity and central place importance. To this effect, they demonstrate local and regional serving importance.

Because these centers are located in peripheral regions dominated by the agricultural sector, they have failed to attract and develop significant levels of manufacturing activity.

Another important function served by these towns is the dormitory function. The availability of a wider selection of goods and services in these towns combined with locational factors may be responsible for attracting commuters who work in neighbouring employment poles.

Groups 4 and 5

These two groups of towns primarily identify those places occupying the lowest levels of the urban place continuum which function as dormitory centers and retirement centers, (TABLE 26).

With the exception of Thornbury, the fourth group consists of towns scoring positively on the residential component. This suggests that these towns exhibit an important dormitory role. Although these towns score negatively on the retail-service dimension, this does not imply that these towns do not possess important retail-service activities. The scores do suggest that relative to the other small communities being considered, these towns have below average levels of retail-service activity. Because

TABLE 26

Factor Scores on the Selected Functional Dimensions for Group 4 and Group 5

Group 4 (dormitory)

Town Name	Dimensions		
	Retail-Service	Manufacturing	Residential
Arthur	-1.197	-.056	.530
Ayr	-0.846	-.021	1.263
Elora	-1.373	.440	.485
Erin	-0.874	-.729	1.793
Milverton	-1.525	.190	.419
Mitchell	-0.439	-.026	.195
New Hamburg	-0.236	-.098	2.123
Port Elgin	-0.175	-.509	.566
Southampton	-0.417	-.401	.201
Thornbury	-1.456	1.022	-.599

Group 5 (retirement)

Chesley	-.686	-0.111	-1.736
Durham	.119	-0.322	-1.214
Harriston	-.801	-0.253	-0.432
Lucknow	-.834	-0.452	-1.026
Markdale	-.192	-1.141	-1.428
Mount Forest	.516	-0.787	-0.937
Palmerston	-.571	-0.633	-0.498
Seaforth	.074	-0.201	-0.496
Tavistock	-.801	-0.005	-1.210
Wiarton	.426	-1.388	-0.699

these centers occupy the lowest levels of the urban continuum they tend to provide rather limited retail-service activities to small restricted trade areas.

The fourth group of towns are also shown to achieve rather diverse scores on the manufacturing dimension. Elora, Milverton, and Thornbury are characterized by positive scores on the manufacturing dimension while the remaining towns score negatively on the manufacturing dimension. Site factors have been important in allowing Elora, Milverton, and Thornbury to develop above average levels of manufacturing activity.

The fifth group of towns are clustered on the basis of their negative scores on the residential and the manufacturing dimension. The negative scores on the residential dimension indicate that the retirement function is an important characteristic of these towns. Only the Towns of Wiarton and Mount Forest were able to generate notable levels of retail-service activity. This may in part be attributed to specific locational attributes which provide these centers with relatively large trade areas.

(iii) <u>Multiple Discriminant Analysis</u>

Multiple discriminant analysis is used here to test the significance of the five groups derived from the hierarchical grouping analysis. The discriminant analysis was executed with the SPSS subprogram "Discriminant" (Nie et al., 1975, 434-467). The program used the classification results developed by the hierarchical grouping analysis.

The results of the discriminant analysis are summarized in TABLES 27, 28, and 29 and FIGURE 16. TABLE 27 indicates that all of the discriminant variables selected were significant. The three functional variables produced a very high degree of separation as demonstrated by a final Wilks' Lambda of (.011) and canonical correlations of (.9388), (.8836), and (.7539) for the first, second, and third discriminant functions respectively. The small value for Wilks' Lambda reveals that considerable discriminating power exists in the variables being used. The relatively large canonical correlations suggest that a large proportion of the variance in the discriminant functions is explained by the five groups.

TABLE 27

Selected Statistics from the Discriminant Analysis

Step Number	Variable Number	Variable Name	Wilks' Lambda
1	2	Manufacturing component	.20217
2	1	Retail-service component	.04685
3	3	Residential component	.01125

Discriminant Function	Canonical Correlations
1	.9388
2	.8834
3	.7539

Further evidence about the group differences can be derived from the group centroids and a plot of the cases. Group centroids are the mean discriminant scores for each group on the respective functions. The centroids summarize the group locations in the reduced space defined by the discriminant functions. These are best visualized by plotting them on a graph defined by the three discriminant functions. This has been done in FIGURE 16, where the dots represent the group centroids and the numbers represent cases from the groups with the corresponding number. The graph shows that there is very little overlap among the groups. Only the third and fourth groups are not clearly separated. However, the overlap has not adversely affected the grouping routine because TABLE 28 indicates that the grouping routine was able to correctly identify 100 percent of the cases as members of the groups to which they actually belong.

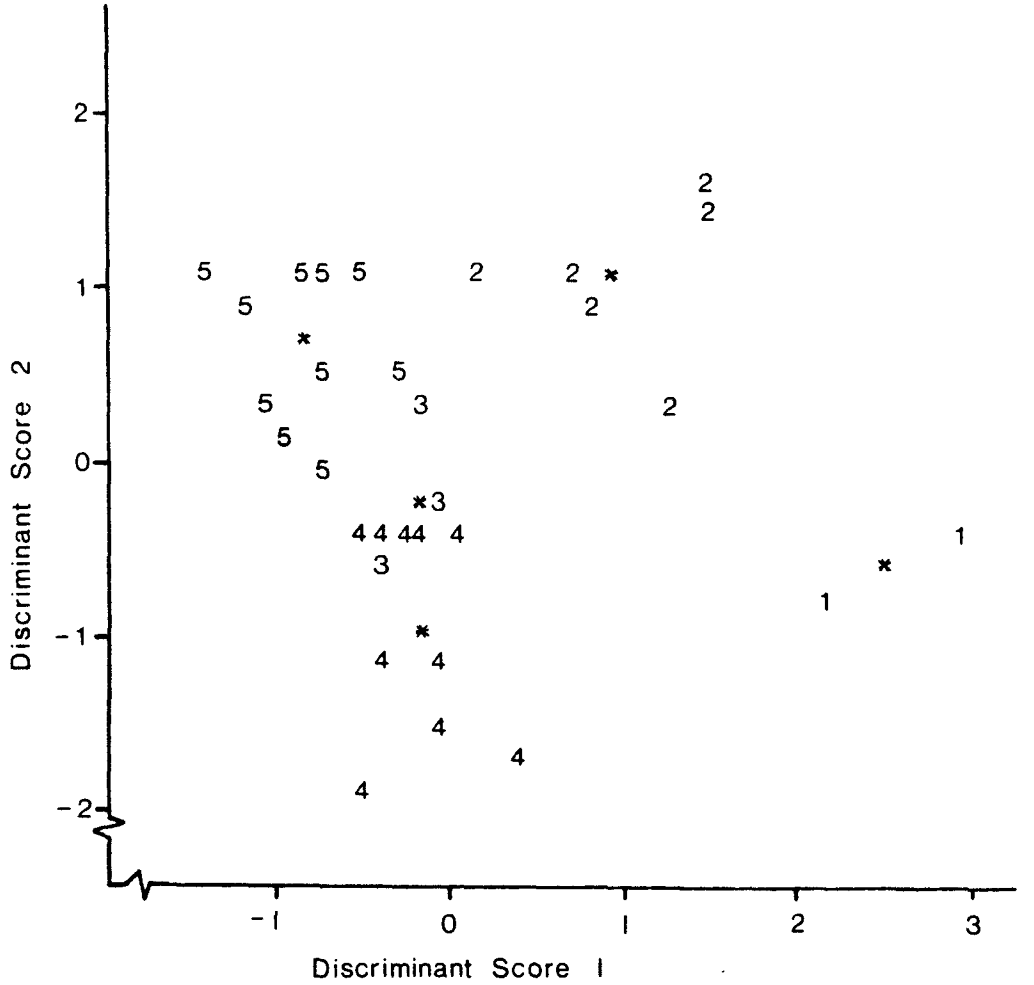
TABLE 28

Predicted Group Membership

Actual Group	Number of Cases	Predicted Group Membership Group1	Group 2	Group 3	Group 4	Group 5
1	2	2 100%	0 0%	0 0%	0 0%	0 0%
2	6	0 0%	6 100%	0 0%	0 0%	0 0%
3	3	0 0%	0 0%	3 100%	0 0%	0 0%
4	10	0 0%	0 0%	0 0%	10 100%	0 0%
5	10	0 0%	0 0%	0 0%	0 0%	10 100%

FIGURE 16

PLOT OF DISCRIMINANT SCORES



KEY

Symbol	Group
1	1
2	2
3	3
4	4
5	5
* Centroids	

The computed "F" values allowed the null hypothesis that all groups were equal to be rejected at the .01 confidence level, (TABLE 29). The original groupings were therefore highly significant. The disriminant analysis made no changes to each group. In view of the fact that all of the groupings used were significant in the "F" test and were compact according to the two criteria, Wilks' Lambda, and canonical correlations, the original grouping was retained unchanged.

TABLE 29

Group "F" Ratio Matrix

	Group 1	Group 2	Group 3	Group 4
Group 2	14.3*			
Group 3	27.0*	15.3*		
Group 4	28.9*	33.3*	9.4*	
Group 5	46.2*	30.1*	13.2*	22.3*

* significant at the .01 confidence level

Group Performances on Selected Growth Indicies

This section examines the nature of the relationship between the five groups of small towns and their population growth rates. The growth indicies selected for this analysis are, percentage population change, and percentage population change attributable to migration.

Although some of the groups contain an insufficient number of cases to permit accurate interpretations, several tendencies can be noted. FIGURE 17 reveals that during both study periods, there are significant variations among individual small town growth performances on the selected growth indicies within each of the five groups.

The prominant feature of FIGURE 17 is that no complete group of small communities demonstrates consistent above average rates of growth and in-migration during the two periods of study. There are extreme variations present which would appear to reflect locational attributes not considered by the functional dimensions. It is interesting to note that as a group, dormitory towns (Group 4) and mature towns (Group 1) demonstrate the highest rates of growth during the two study periods, (TABLE 30). This would seem to suggest that the dormitory function is an important factor accounting for variations in small town rates of growth.

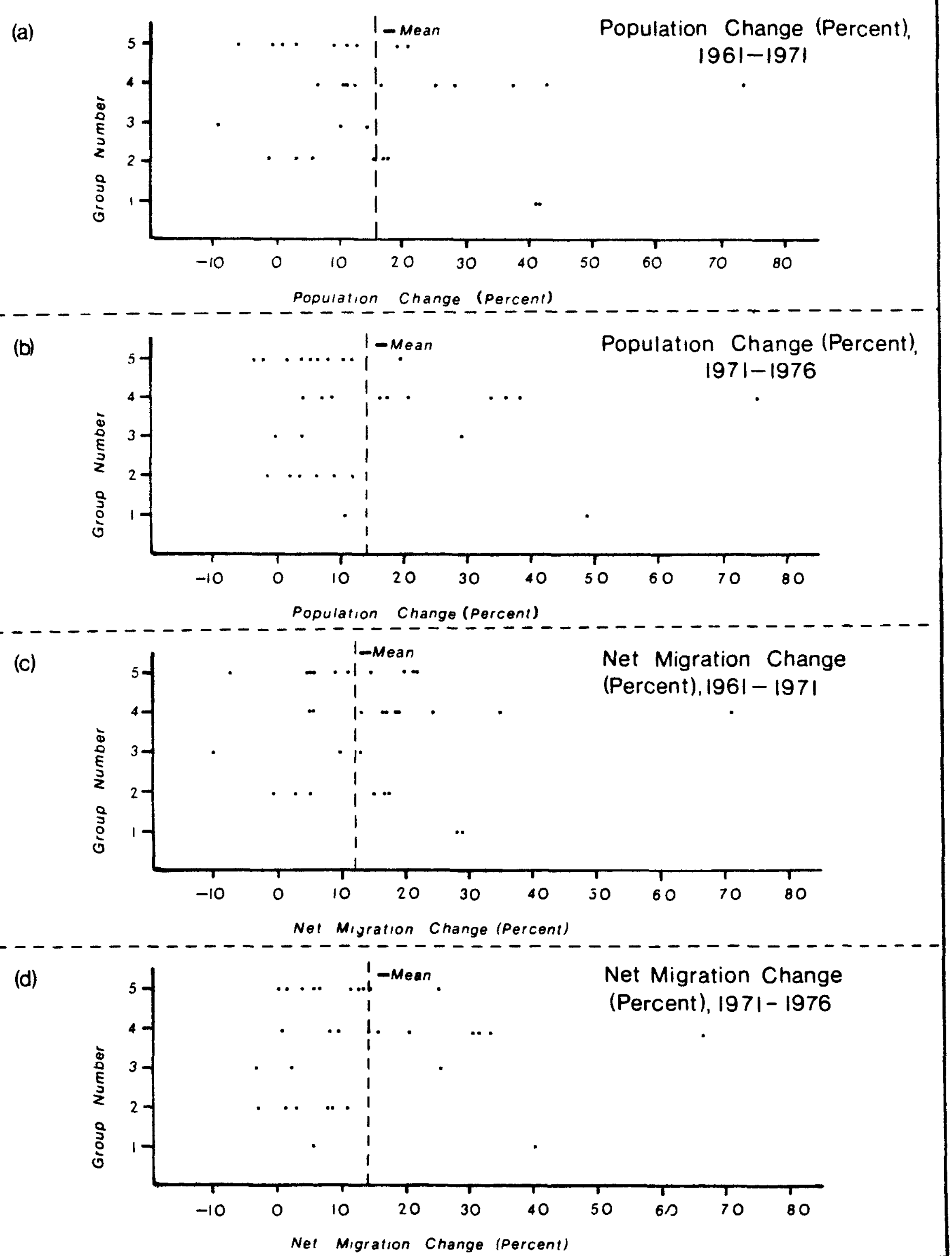
TABLE 30

Annual Net Migration and Population Change by Group: 1961-1971, 1971-1976

	1961-1971		1971-1976	
Group	Change (%)	Migration (%)	Change (%)	Migration (%)
1	4.18	2.91	5.64	4.55
2	.99	.40	1.28	.99
3	.40	-0.24	2.22	1.76
4	2.77	2.30	5.86	4.66
5	.87	1.12	1.16	2.01
Mean	1.84	1.30	3.23	2.80

FIGURE 17

PLOTS OF SMALL TOWN SCORES ON SELECTED GROWTH INDICIES: 1961-1971, 1971-1976



Another notable feature of FIGURE 17 and TABLE 30 are the below average rates of population growth and in-migration for diversified towns (Group 2). During the 1971-1976 period this group of towns exhibited rates of growth and in-migration below the mean. It seems that rates of population growth and net in-migration are not a function of small town diversity or complexity. Another interesting aspect of FIGURE 17 are the weak rates of growth and in-migration for the service centers with an important retirement function (Group 5). The implication is that the retirement function does not appear to be an important factor in accounting for increased rates of growth among the small towns.

The results presented here suggest that hierarchical groups of small towns based on similar functional profiles do not provide a useful basis from which to examine variations in small town rates of growth. The extreme variations in population growth performances demonstrated by the small towns within each of the functional levels, do not reflect the average group growth rates. The results imply that it would be more useful to examine the functional dimensions on an individual basis. In this manner it may be possible to determine the relative association that each functional dimension has with the population growth indicies.

Synthesis and Summary

On the whole, the grouping of small towns is consistent with the accepted broad regional variations in the principal roles assumed by small towns which have evolved during the urbanization process. It is generally accepted that certain economic activities grow faster than others during the urbanization process. In a study of sequential relationships among urban functions, functional regions, and urban growth, Ray (1968) identified four main stages in the urbanization process. In the initial stage, the economic foundations of urban growth were "low order central place" functions, the result was relatively high rates of growth in low order centers. In a second stage, urban growth accelerated in those urban places where special functions, such as administration, and resource development were acquired. In the third phase, improvements primarily the establishment of higher order central place functions and the creation of an hierarchy of market regions. This hierarchy of market regions is reflected in the grouping procedure. Eventually, higher order manufacturers with low distance decay enabled some centers to capture national and subnational markets, thereby creating areal concentrations of punctiform agglomerations.

Although Ray's stage model does not go beyond the fourth stage, it is important to note that the process of urbanization has continued to influence the character and growth of small urban places in the study area.

When population growth rates and net migration were calculated for the five levels comprising the functional hierarchy, it became evident that the degree of functional complexity or diversity was not an important determinant of variations in the rates of small town population change. In fact, the results presented in the chapter suggest that continued improvements in transportation, changes in social preferences and resource development have accelerated the growth of those small towns where the specialized dormitory function was acquired. These trends in small town growth suggest that small urban places in the study area demonstrate growth rates which reflect the second stage in Ray's model of the urbanization process.

The tendencies reported here imply that it would be useful to examine the functional dimensions individually in order to determine their relative association with variations in small town growth performance. In this way, the key factors influencing small town growth rates can be identified and the significance of the dormitory function can be better assessed.

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CHAPTER V

Identifying the Determinants of Small Town Growth Variations

In this chapter the small towns are treated as a sub-system described by a range of interacting demographic, functional, economic, and locational variables over a fifteen year period from 1961 to 1976. In particular, this analysis focuses on the obvious but complex relationships between small town growth and various growth determinant variables. In this context, the chapter attempts to reveal some of the more important determinants of variations in small town growth in Southwestern Ontario.

The first part of the chapter reviews factors previously found to correlate significantly with variations in urban growth. The second part discusses and presents the data and regression procedures designed to identify the most relevant explanatory variables from among the growth determinants. The results of the regression procedures are presented in the third section. Finally, the implications and effectiveness of the regression analyses are discussed.

Selected Urban Growth Determinants

This section is presented as an introduction to and a brief survey of recognized growth determinant hypotheses which are appropriate to the study of variations in small town growth rates.

(i) Initial Size Hypothesis

One of the earliest hypothesis of urban growth suggested that the size of a community at the beginning of a growth period is a crucial variable in explaining population increase during that period. That is, the larger the urban area, the faster the absolute growth of that town. This hypothesis has been examined thoroughly by researchers. It has been successfully demonstrated with various multivariate statistical techniques that initial size at the beginning of a period is related positively to the growth of urban areas during that period (Hart and Salisbury, 1965; Fuguitt and Deeley, 1966; Tarver and Beale, 1968; and Davidson, 1972).

The initial size hypothesis has also been applied to the study of migration. A basic premise of migration study has been that urban places vary in their attractiveness to potential migrants. In many cases the attractiveness of an urban place as a potential place of residence is directly related to the number of job opportunities in that place. Since the number of job opportunities in a place are highly correlated with its size, the population size of a place serves as an operational substitute for alternative migration destinations (Shaw, 1975, 47).

(ii) Differential Accessibility Hypothesis

Each urban place within any urban system has a distinct position in a broader system of urban areas, and as a result has a different level of accessibility to other urban places in the system and to regions outside the system. Several measures have been developed, each of which is hypothesized to account for one dimension of a centers accessibility.

One such measure is "metropolitan accessibility" as defined by a simple distance decay relationship. A number of studies have examined the hypothesis that urban growth is directly related to distance from large urban areas and metropolitan centers. Certainly, the spread of populations out from the metropolitan centers suggests that nonmetropolitan growth might be partially explained by nearness to metropolitan centers.

Walzer and Schmidt (1977) examined the importance of proximity to a major urban center by grouping towns with populations less than 10,000 into 10 mile intervals surrounding a center of 25,000 persons or greater. Their findings supported the hypothesis that proximity to larger urban centers has a positive effect on urban population growth. Similar findings were reported by (Davidson, 1972; Hodgson, 1972; and Fuguitt and Beale, 1976).

Researchers studying net migration patterns have also noted that distance from a major urban center appears to positively influence the rate of urban growth. Rodd (1971) briefly examined the distance decay hypothesis between migration rates and proximity to major urban areas for Southern Ontario. Rodd grouped all urban areas with populations over 1,000 for 1951 by distance to the nearest of the five major urban areas with populations over 100,000 (Windsor, London, Hamilton, Toronto, and Ottawa). In each case the simple average migration rates were calculated. Although Rodd did not test for significance, he did note a striking inverse relation between migration rates and proximity to major urban areas. Rodd concluded that there seemed to be some form of growth effect for urban areas which is created by the size of larger cities, and which diminishes by distance. This finding gains additional support in a "residential location preference" survey conducted by (Fuguitt and Zuiches, 1975).

The Fuguitt and Zuiches survey carried out in Wisconsin, went beyond previous location preference surveys by adding a question concerning the desirability of proximity to a large urban area, defined to be over 50,000 population. The results of the survey showed that a high proportion (61 percent) of the respondents expressed a desire to live in rural areas or small towns. However, only 24 percent wanted such a place to be more than 30 miles from a central city. The authors concluded that very few metropolitan residents prefer to live beyond commuting distance, whereas somewhat over half of respondents in nonmetropolitan areas would like to live within metropolitan commuting range.

The extent to which one may generalize based on the Wisconsin study is debatable. Firstly, Wisconsin is not one of the more densely populated States and its population composition is less metropolitan than that of Southern

Ontario as a whole. Secondly, the location preference study merely reflects the idealized residential preferences of the respondents and not real movements. As a result, the value placed on proximity to major urban areas may be different from that in more densely populated areas, and in reality, though, as indicated earlier, the evidence from other studies is consistent with the findings of the Wisconsin study.

Another more complex measure of urban accessibility applied by researchers to describe variations in urban growth is a measure known as "population potential". Population potential is a demographic-geographic measure that is commonly used by researchers in analyzing the attractive force of any particular location on the movements of goods and people. These models are termed gravity models since the basic formula is derived from Newtonian physics. Commencing with the well known Zipf (1946), P_1*P_2 / D hypothesis (a principle of least effort), much emphasis has been placed on the gravity and potential concepts of human interection.

One major problem with the potential models is that the parts of the expression are open to varying definitions. In practice, mass has conventionally been equated with population size, and distance with mileage or travel time. Another limiting factor is the assumption that interaction intensity decreases over distance systematically in all directions. Nontheless, it seems that the distance decay concept is an important factor in net migration patterns.

Migration studies using such gravity model concepts reflect two major internal net migration trends during the century (Stone, 1969). One trend is the unprecedented swarming of the population into urban areas. The second one is superimposed on the first, particularily in economically advanced societies, namely a movement from lower to higher order centers. The net result of these two migratory trends has been increasing concentration of populations into fewer, but larger agglomerations.

A major asset of the gravity formulations is that an implicit attempt has been made to relate the concept to central place theory. As Olsson (1965) points out, a crucial idea in this theory, when related to migration, is that just as goods are purchased in the nearest place offering them, the potential migrant first decides which type of place can best satisfy his intentions, then by minimizing costs and efforts he moves to the nearest satisfactory alternative.

(iii) Employment Mix Hypothesis

Certain economic activities grow faster than others during different periods of time. In general, urban places with a relatively high proportion of rapidly growing activities are most likely to experience high levels of growth. Berry and Horton (1970) argue that differential urban growth has largely resulted from changes in the national patterns of employment. Berry and Horton suggest that recent differences in relative growth of urban areas can be attributed to an industry mix effect, whereby urban places growing most rapidly are those fortunate enough to have a large share of their workers in the rapid growth industries.

Russwurm et al. (1977) suggest that the importance of the service sector as a source of employment underlies the more recent changes in urban growth patterns. The same author also notes that employment in the field of resource development in many outlying areas accounts for variations in urban growth.

(iv) <u>Income Hypothesis</u>

Income differentials in the form of attainable wages and salaries are considered to play a major role in the decision to migrate from one place to another. Accordingly, the competitive model of factor mobility predicts that the volume of migration to place (j) will increase as wages at (j) exceed those of place (i). Strong support has been generated for the role of differential income in a study by Laber et al. (1971), of interragional migration in Canada, by Sweetland (1971) of American inter-SMSA[16] migration, and in a study of Canadian interprovincial migration between 1956 and 1961 by McInnis (1969).

One significant limitation to this hypothesis as a determinant of small town population change and more specifically net migration is that it is limited to earners of income which tends to exclude the young and the retired.

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16 The SMSA is an areal unit which is known as the Standard Metropolitan Statistical Area and is used in the United States to identify another type of urban area.

(v) Unemployment Hypothesis

Another hypothesis put forward concerning net migration patterns and which is a fundamental component of the economic push-pull hypothesis, is that increasing levels of unemployment at a place of origin stimulates out-migration and increasing levels of unemployment at possible places of destination deters in-migration (Shaw, 1975, 72).

Although surveys attest to the importance of job-seeking as a motive for migration, statistical studies appear to be divided on the role of unemployment as an impetus to migrate. For example, studies by (Vanderkamp, 1968; Blanco, 1963; and Oliver, 1965) support the hypothesis that the levels of unemployment in places of origin do account for a significant proportion of the variation in migration rates, while (Lowry, 1966; Greenwood, 1968; and McInnis, 1969) have presented evidence against the unemployment-migration relationship. These conflicting findings appear to be a function of the various scales, regions, and methodologies considered in the studies.

The Data and Regression Procedures

(i) Variable Criteria

The choice of input data is a critical step in any type of regression analysis since the quality and relative importance of the variations are directly dependent on the initial data set. The intent here is to provide an accurate description based on reliable measures of urban attributes for the selected small towns.

From the literature reviewed, it became apparent that initial size, distance from nearest metropolitan area, employment structure, income, employment status, and demographic profiles have played significant roles in the growth of urban places. It was hypothesized that they would have similar effects on small towns in the study area.

Variable input for each of the two time periods comprises four general types of data -- i) demographic, ii) economic, iii) locational (spatial), and iv) employment structure. Through a progressive sequence of testing and deletion, a final set of growth determinant variables were derived, (TABLE 31).

TABLE 31

Variables used to Describe Small Towns

In Analysis of Small Town Growth: 1961-1971 and 1971-1976

Variable Number	Code Name	Variable Name	Description
1	RETCOM	Retail Component	Factor scores derived from principal components analysis
2	MANCOM	Manufacturing Component	Factor scores
3	RESCOM	Residential Component	Factor scores
4	METACC	Metropolitan Accessibility	Road distance between each town and the nearest metropolitan center (i.e., London and Kitchener-Waterloo)
5	EMPSTA	Employment Status	Percentage of the labour force unemployed in 1971

The inevitable limitations imposed by inconsistent time series data have necessitated the elimination of the data for the 1961 census year from consideration. The most complete data inventory has been prepared for 1971, (Appendix D).

The first three variables were derived from the principal components procedure outlined in Chapter IV. There are four notable advantages for including them in the regression models. Firstly, they can be used to test the significance of the association between each component and the selected growth indicies. Secondly, these variables meet an important assumption of the regression model (i.e., the independent variables are not interrelated with one another). Thirdly, these variables are highly correlated with other growth related variables, (TABLE 32) and thus, can be used to represent the common underlying dimensions associated with these variables. TABLE 32 indicates that the retail component is highly correlated with the initial size variables (POP61 and POP71). In addition, the residential component is shown to be highly correlated with the income variable (PIN6000). Fourthly, the retail and manufacturing components can provide useful surrogate measures of "employment mix" because they were partially derived from measures of employment within the retail-service and the manufacturing sectors.

TABLE 32

Correlation Matrix for Selected Growth Related Variables and the Functional Components

	RETCOM	MANCOM	RESCOM	POP61	POP71	PIN6000
RETCOM	1.00					
MANCOM	-0.001	1.00				
RESCOM	.001	-0.001	1.00			
POP61	.772	.54	.15	1.00		
POP71	.834	.34	.04	.87	1.00	
PIN6000	.063	.32	.70	.36	.13	1.00

POP61 = Town population in 1961

POP71 = Town population in 1971

PIN6000 = Percentage of the labour force with an annual income greater than $6,000

In the absence of a well developed theory of small town growth, it is possible that several important growth determining factors have been excluded from this inquiry. In addition, it is difficult to isolate variables which can be unambiguously proposed as growth determinants and are not merely the outcome of the growth process. With the exception of the functional components, it can be argued that the types of variables presented here have been tested successfully in other studies of urban growth (i.e., Davidson, 1971; and Hodgson, 1972).

Growth in the system of small towns is measured in two ways--i) population change (percentage change in population); and ii) migration change (percentage change in population attributable to migration). The basic data used in this particular analysis apply to the 1971 census year. Two time intervals are considered by the regresssion procedures: 1961-1971; and 1971-1976.

This type of approach implicitly involves two basic assumptions. First, that the aggregation of small towns in the study area possess the properties of, or operates as, a system; and second, that the interval of time over which the system is being studied will provide a clear representation of the spatial and temporal relationships. In dealing with the first assumption, the small towns are analyzed as a distinctive urban aggregate or subsystem. In reference to the second assumption, two time intervals are considered, and the structure of the small towns are examined at one point in time. In this regard, two approaches are employed by the regression procedures. First, an attempt to predict small town growth differentials by utilizing differences in growth variables prior to the period of growth (1971-1976); and second, an attempt to explain small town growth differentials by examining differences in the growth variables at the end of the growth period (1961-1971).

(ii) <u>The Regression Model</u>

The general linear multiple regression model may be expressed as;

$$G = b_0 + b_1x_1 + b_2x_2 \dots + b_nx_n + e$$

where "G" is the dependent growth variable, $x_1, x_2, \dots x_n$ represent the values taken by the independent growth determinants, "b_0" is a fixed constant (Y intercept), $b_1, b_2, \dots, b_n$ are regression coefficients (Beta Coefficients), and "e" is an error term.

The stepwise solution option has been utilized in the regression procedures. In stepwise multiple linear regression each independent variable is examined to determine whether it accounts for enough of the variation in growth to be significant statistically. The principal advantage of the stepwise technique is that it orders the independent variables in terms of the amount of variation in the dependent variable explained by each. Another advantage of the stepwise technique is that it will isolate a subset of available predictor variables that will yield an optimal prediction equation with as few terms as possible.

The basic assumptions of the multiple regression model may be summarized as follows:

i) that true linear relationships exist between the dependent and the independent variables

ii) the errors of estimate "e" are distributed independently of the "x's" and are normally distributed with zero mean and unit variance

iii) the independent variables are not interrelated with one another.

In this analysis it is admitted that not all the independent variables used satisfy the first assumption. However, the often stated alternative of transformation of one or more but not all of the independent variables, creates statistical and interpretative problems of even greater magnitude (Golant, 1972). With respect to the second assumption, as this thesis makes no assumption about the underlying distribution, it cannot evaluate the "goodness" of the equation. In addition, as the thesis is in fact dealing with a population rather than with a sampling distribution, the theoretical necessity of such tests is not apparent. The third assumption is considered the most important as the effects of the independent variables are additive, the inclusion of substantially intercorrelated variables produce unrealistically large coefficients of determination (r^2), and creates ambiguity in separating the influences of each independent variable. In this study, unreasonably high correlations between independent variables were avoided, (TABLE 33).

TABLE 33

Correlation Matrix

For the Independent Variables

	RETCOM	MANCOM	RESCOM	METACC	EMPSTA
RETCOM	1.000				
MANCOM	-0.001	1.000			
RESCOM	0.001	-0.001	1.000		
METACC	0.180	-0.325	-0.390	1.000	
EMPSTA	0.438	-0.023	0.092	0.263	1.000

Analysis and Results

Stepwise multiple regression procedures are used to identify the most relevant explanatory variables from among the data. The SPSS subprogram "Regression" has been used to generate the regression equations (Nie et al., 1975,320-367).

(i) Regression Results for the 1961-1971 Period

a) Migration Change

The first regression equation generated from the stepwise regression procedure was based on the migration variable (dependent variable) and the five independent variables described in TABLE 31. Analysis of this equation served to identify a major problem. This pertained to the insignificant regression equation achieved after adding the five independent variables to the regression procedure, (TABLE 34). The regression equation is shown to be significant only after the retail-service variable (RETCOM) was added during the first step of the regression procedure. This simple regression equation, based on only one independent variable (RETCOM) accounts for only 12 percent of the total variation in net migration during the 1961-1971 period.

b) Population Change

The second regression equation developed from the stepwise regression procedure was based on the percentage population change variable (dependent variable) and the five independent variables. Analysis of these regression results revealed that the final regression equation was significant

TABLE 34

Results from Migration Regression 1961-1971

Step Number	Coefficient of Determination (r^2)	Degrees of Freedom (df)	F ratio	Variable Entered: Code Name	Variable Entered: Variable Number
1	.126	1,29	4.18*	RETCOM	1
2	.176	2,28	2.99	RESCOM	3
3	.204	3,27	2.31	MANCOM	2
4	.248	4,26	2.14	METACC	4
5	.273	5,25	1.87	EMPSTA	5

* significant at the (.05) level of confidence

TABLE 35

Results from Population Regression 1961-1971

Step Number	Coefficient of Determination (r^2)	Degrees of Freedom (df)	F ratio	Variable Entered: Code Name	Variable Entered: Variable Number
1	.194	1,29	7.02*	RESCOM	3
2	.271	2,28	5.21*	MANCOM	2
3	.325	3,27	4.34*	EMPSTA	5
4	.342	4,26	3.37*	METACC	4
5	.356	5,25	2.76*	RETCOM	1

* significant at the (.05) level of confidence

at the (.05) level of confidence, (TABLE 35). The five independent variables are shown to account for 35 percent of the total variation in percentage population change among the small towns for the 1961-1971 period.

The ratio of the explained and unexplained variances is used to test the significance of each independent variable in the regression equation. The ratio is commonly referred to as the "F" ratio. The result of the "F" ratio is then compared to a minimum "F" value which determines whether the independent variable is significant or not. This method of testing revealed that the residential variable (RESCOM) was significant at the (.01) level of confidence and the manufacturing variable (MANCOM) was significant at the (.05) level of confidence, (TABLE 36). The remaining variables were not significant at either level. Together, the two significant independent variables accounted for approximately 27 percent of the variation in small town population change during the 1961-1971 period.

TABLE 36

Regression Coefficients and F Values for the Final Regression Equation

	RETCOM	MANCOM	RESCOM	METACC	EMPSTA
Regression Coefficients	-2.238	5.614	9.107	5.192	-2.185
F Values	.52	3.59*	8.58**	.76	1.47

* F value significant at (.05) confidence level

** F value significant at (.01) confidence level

TABLE 37

Results from Migration Regression 1971-1976

Step Number	Coefficient of Determination (r^2)	Degrees of Freedom (df)	F ratio	Variable Entered: Code Name	Variable Entered: Variable Number
1	.095	1,29	3.05	RETCOM	1
2	.167	2,28	2.82	RESCOM	3
3	.268	3,27	3.29*	METACC	4
4	.350	4,26	3.51*	EMPSTA	5
5	.372	5,25	2.96*	MANCOM	2

* significant at the (.05) level of confidence

(ii) Regression Results for the 1971-1976 Period

a) Migration Change

The third regression equation was based on the migration variable and the five independent variables. Analysis of the regression results revealed that the final regression equation was significant at the (.05) confidence level, (TABLE 37). The five independent variables were found to account for 37 percent of the total variation in migration rates for the 1971-1976 period.

The results of the "F" test revealed that the residential variable (RESCOM) and the metropolitan accessibility variable (METACC) were significant at the (.01) confidence level, while the employment status variable (EMPSTA) was significant at the (.05) level of confidence, (TABLE 38). The significant variables are shown to account for 25 percent of the total variation in migration rates.

TABLE 38

Regression Coefficients and F Values for the Final Regression Equation

	RETCOM	MANCOM	RESCOM	METACC	EMPSTA
Regression Coefficients	-3.71	2.34	7.45	.13	-2.91
F Values	1.97	.85	7.78**	6.69**	3.55*

* F value significant at (.05) confidence level

** F value significant at (.01) confidence level

TABLE 39

Results from Population Regression 1971-1976

Step Number	Coefficient of Determination (r^2)	Degrees of Freedom (df)	F ratio	Variable Entered: Code Name	Variable Entered: Variable Number
1	.176	1,29	6.20*	RESCOM	3
2	.247	2,28	4.60*	EMPSTA	5
3	.355	3,27	4.96*	METACC	4
4	.388	4,26	4.12*	MANCOM	2
5	.413	5,25	3.53*	RETCOM	1

* significant at the (.05) level of confidence

b) Population Change

The final regression equation is based on the percentage population change variable and the five independent variables. The regression results indicate that the final regression equation is significant at the (.05) confidence level, (TABLE 39).

The "F" test results show that the RESCOM and METACC variables are significant at the (.01) level of confidence, and the EMPSTA variable is significant at the (.05) level of confidence, (TABLE 40). The three significant variables account for 35 percent of the total variation in population change for the 1971-1976 period.

TABLE 40

Regression Coefficients and F Values for the Final Regression Equation

	RETCOM	MANCOM	RESCOM	METACC	EMPSTA
Regression Coefficients	-3.06	3.44	10.89	.14	-3.14
F Values	1.08	1.48	13.50**	6.24**	3.36*

* F values significant at (.05) level of confidence

** F values significant at (.01) level of confidence

Effectiveness of the Regression Models

(i) Proportion of Variance Explained

The effectiveness of the regression equations reflected in the proportion of the variance explained by the significant independent variables was found to vary according to the length of the growth period being considered, the measure of growth employed, and whether one is explaining growth in the preceding period or predicting growth in the succeeding period, (TABLE 41).

TABLE 41

Percent Variance Accounted for by the Significant Independent Variables: 1961-1971, 1971-1976

Dependent Variable	1961-1971	1971-1976
Percentage change in migration rates	12	25
Percentage change in population	27	35

The highest proportions of variance accounted for by the independent variables occurred during the five year period (1971-1976); which was also the predicted growth period; and equations based on the percentage population change variable (dependent variable). Of the four regression equations analyzed, the 1961-1971 regression model for migration change was the least receptive to explanation of the variance. However, in spite of these notable regularities, all of the regression models performed poorly. In fact, in all of the regression equations the level of explanation accounted for by the significant independent variables was found not to have exceeded 35 percent, (TABLE 41). It is important to note that the levels of explanation displayed by the regression models do not imply causality, but describe a relationship between the dependent and the independent variables within this limited study area. In addition, comparative analysis based on the five year period can be considered inconclusive because of the tendency for short-run growth rates to be highly unstable.

(ii) Relative Importance of Variables

On the basis of the significance of each independent variable in the growth equations, the functional components are found to dominate the 1961-1971 analyses, while functional, locational, and employment variables are found to dominate the 1971-1976 analyses.

It is interesting to note that the significance and composition of the two regression equations generated for the 1961-1971 period changed as a function of the dependent variable, while the two regression equations produced for the 1971-1976 period both remained statistically significant while retaining identical sets of significant independent variables when the dependent variable was changed. This observation can be attributed to the fact that migration rates were more highly correlated with population growth rates for the 1971-1976 period than for the 1961-1971 period (r=.67, 1961-1971; and r=.98, 1971-1976).

The 1961-1971 regression model of migration change indicates that the retail-service variable is significant in accounting for variations in the change of migration rates for the small towns. Considering the high correlations between this functional component and the initial size variables identified on page 124 , the results would seem to suggest that changes in migration rates vary positively as a function of initial size, and level of retail-service activity.

The 1961-1971 analysis of percentage population change reveals that the residential (dormitory) component and the manufacturing component are significant in accounting for variations in the rates of small town population change. Considering the high correlations between the residential component and the income variable identified in TABLE 32, the results suggest that changes in the rates of population growth are a function of the size of the commuting labour force, level of income, and the strength of the manufacturing sector.

The two regression equations produced for the 1971-1976 period reveal that the residential component, metropolitan accessibility, and employment status account for a significant proportion of the variation in migration and population rates of change for this period. These results imply that the predicted variations in the growth indicies are a function of the strength of the dormitory function, level of income, distance to nearest metropolitan area, and level of unemployment.

The low levels of variance accounted for by the independent variables serves to delimit a major limitation. This pertains to the static nature of the independent variables used in the regression procedures. The dependent variables (population growth indicies) used in the regression procedures represent dynamic measures which reflect a change in the growth indicies over selected periods of time. On the other hand, the independent variables (growth determinants) represent a cross sectional profile for each small town taken at one point in time (1971). An attempt has been made here to account for or explain a dynamic process with simple static phenomena. The results indicate that the structural characteristics of small towns taken at one point in time, are poor indicators of their growth variations over a period of time which is characterized by rapid random rates of population and migration change.

Synthesis and Summary

The urban growth determinants used in the regression analyses are shown to poorly reflect small town growth performance. In all instances it was not possible to explain or predict over 50 percent of the variability among the selected growth indicies. The highest proportion of variance explained (41 percent) is achieved for the shortest time period (1971-1976). However, as was previously noted, analyses based in this period should be considered inconclusive because of the tendency for short run growth rates to be highly unstable. The appearance of the 1981 census data will certainly aid similar analyses in the future.

The regression models do imply, however, that accessibility and locational differentials appear as factors related to growth, as theory suggests. That these factors appear prominently in almost all equations is evidence of the importance of employment accessibility and the availability of an existing urban infrastructure in influencing small town growth patterns. Economic variables, particularilly level of income, also appear as an obvious component of small town growth.

Although the traditional growth determinant variables are found to reflect a small proportion of the total variation in the small town growth indicies, there is considerable evidence that many important variables may have been left out of the regression equations. Other factors which have not received attention in this paper include: dynamic measures of the growth determinants; the character, quality and stability of the housing inventory; external influences (i.e., private and public decision making); sewage treatment capacity; and local council attitudes towards growth.

It is evident from this list that many growth implications associated with these factors are unique and thus cannot be measured efficiently by regression procedures. The relatively simple economic structure of small urban places suggests that they appear to be very sensitive to external and internal influences.

The fact that the regression procedures have been less than successful in accounting for variations in the small town growth indicies during the two study periods suggests that many diverse processes of growth are taking place within the system of small towns considered in this thesis. This extreme complexity of growth has been augmented by such random events as decisions to delay or stop expected public investment, decisions to offer industrial incentives, locational decisions in the field of energy planning, and individual decisions to alter residential preferences. As a result, it becomes difficult to describe in simple cartographic displays and mathematical equations such a complex phenonomeon as recent demographic change.

Many authors whose analyses of urban areas are directed towards recent urban systems growth phenomena (e.g., Borchert, 1967, 1972; Dunn, 1971; Bourne, 1978; and Curry, 1976) view urban systems growth primarily as a reflection of a complex and evolving society in which each urban place plays many roles simultaneously and operates under a wide variety of interdependent forces (Simmons, 1978). In their view one must add to the evolving economic forces of migration the characteristics of an evolving society with increasingly higher incomes and levels of education, new preferences for places to live, and new life styles. Consequently, these authors conclude that social change has become an important determinant of urban growth rather than simply a consequence of other changes.

The advocates of this social change approach treat the urban system as open in the fullest sense. It is open to forces of change and evolution whose affects are largely unpredictable at any one point in time. When both the spatial implications and the interaction effects among growth forces are considered, the growth or decline of urban places becomes almost a random event (Curry, 1976).

This latter view of the North American urban system has been clearly reinforced by events which have occurred in the study area during the past two decades. For example, the impact of the Area Development Agency[17] on the economic structure and population growth of small towns, the stimulation of small town growth through a large influx of capital investment into the nuclear energy industry, and increased preferences for living in small towns while commuting to jobs in large cities. The growth performances of small towns in the study area for the two study periods appear to reflect growth patterns inherent in the social change approach to urban systems growth. Consequently, no simple deterministic model will be particularily useful in accounting for the spatial pattern of small town growth under such probabilistic conditions.

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17 The Area Development Agency was established by the Federal Government in 1963 to assist in regional economic development. The program was designed to improve opportunities in certain areas of Canada, and to alleviate areas of high unemployment. The agency provided financial incentives to manufacturers that established new manufacturing processing facilities, or that expanded existing facilities if an increase in employment resulted (Irvine, 1977).

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CHAPTER VI

Summary and Conclusions

Summary

This thesis represents a cross sectional snapshot of short term growth processes and provides evidence that very different relationships exist among and between the components of population growth for small towns, depending on the particular urban place, the data, and the time period under study.

It is demonstrated that distinct regional and temporal variations in small town growth rates exist within the study area. Small towns are shown to be experiencing increased rates of growth relative to larger urban areas in the study area and in the province. In fact most towns continued to experience absolute population increases at much higher rates than at the beginning of the study period (1961-1971). Thus, in terms of relative population change, the trend has been upward, indicating that small towns as places of residence havebecome more popular. Chapter III provides evidence that the spatial redistribution of population through net migration was the predominate process directing the growth of small towns during the 1961-1976 period.

There is not sufficient evidence to warrant a firm conclusion that small town growth in the study area will continue at current high rates. Migration flows into small towns may prove to be short term, cyclical responses to particular changes in the provincial and national economy as has often been the case in the past. There are now signs that rates of population growth among small communities are declining somewhat, perhaps reflecting rising property costs and energy costs. The recent revival of interest in small urban areas as places of residence may be attributed to social change of the seventies that may disintegrate as the costs involved rise. Thus, the future growth performances of small towns seem to be uncertain.

A hierarchical grouping of small towns based on their functional profiles was established in the fourth chapter for the purpose of determining the degree of association between small town functional profiles and their rates of growth. The analysis revealed that hierarchical groups of small towns; based on their functional profiles for 1971; did not account for variations in the selected growth indicies. As a result, functional complexity and diversity is not considered to be a major factor associated with population growth variations. However, the results did suggest that a useful exercise would be to examine the functional dimensions individually in order to determine their respective levels of association with the growth indicies.

The functional dimensions, along with measures of accessibility, and employment status were introduced as independent variables into stepwise multiple regression procedures to determine the significance of their relationship with the selected growth indicies for the 1961-1971 and the 1971-1976 periods. Although the regression equations were shown to poorly reflect variations in the growth indicies, they did reveal that locational, accessibility, and functional factors account for a significant proportion of the variations in the selected growth indicies. It is suggested that dynamic growth determinant variables might increase the levels of explained variance. The results of the regression procedures also appear to reflect random growth patterns inherent in the social change approach to urban systems growth.

Some Possible Implications for Future Research and Planning

The major conclusion reached in this paper is that small towns are showing strong growth relative to larger urban areas in the study region for the 1961-1976 period. Significant changes have been documented in small town population dynamics, demographic structure, and migration patterns. These trends in part raise a number of basic questions regarding the implications of the emerging urban fabric for public policy, planning, and research.

Shifts in the patterns of small town population growth and metropolitan dominance, as well as the direction of migration flows and in the spatial diffusion of economic growth are apparent. Add to these trends the serious but as yet largely unanalyzed, spatial impacts of continued monetary inflation, increased interest rates, heightened regionalism, increasing energy costs, and separatist feelings in Quebec and Western Canada and the climate for future small town population growth beyond the study period does indeed become dubious.

Nevertheless, it does not seem unreasonable to conclude that many of our perceptions and expectations of small town growth performance, as well as the policies and research strategies based on those perceptions, are becoming outdated. The parameters directing small town population growth and migration flows habe indeed become complex and unpredictable.

Policy priorities for the eighties may now need to be revised. Increasingly planners and politicians will be faced with difficult choices, based on an awareness that the small towns are set within a context of continued uncertainty. Declining fertility rates have contributed to either low or negative rates of natural population change for many small towns in the study area. As a result, decisions to stimulate the growth of specified towns, may have to be assessed against the consequences of pre-empting growth from other areas. The issues are obviously more complex than this example implies, but they do suggest the importance of viewing small town growth in terms of an integrated space economy and system of urban areas, set within an atmosphere of uncertainty.

The declining fertility rates combined with low mortality rates are causing the demographic profiles of many small towns to become noticeably skewed toward the middle and older age groups. The aging of the population profiles for many small towns will alter mobility and consumption patterns, since each age group behaves somewhat differently. Obviously, housing and recreational priorities will have to shift toward the needs of the middle aged and elderly populations.

Policies will have to be designed to deal with, or at least allow for unpredictable growth patterns among small towns in view of recent trends toward economic uncertainty. Planners, politicians, and academics require a new set of analytical methods, and a revised set of benchmarks from which to build an understanding of the processes which are now the geography of small towns in Ontario and in Canada. Bourne (1978) argues that future approaches must include a strong geo-political interpretation and an explicit recognition of uncertainty and instability in urban systems.

Suggestions for Future Research

Almost inevitably research projects are terminated with many questions still unanswered and many more raised. Consequently, further research can take many directions.

The underlying factors associated with variations in the selected growth indicies are very complex. Thus, the results of the analyses presented in the thesis must be viewed with discretion, especially since they are based on a relatively small sample size. The results, however, should not be ignored. Despite the small sample, some of the factors associated with variations in the rates of small town growth were observed.

One possible area for further research would be to extend the general findings of the thesis and investigate them in a case study approach (micro-scale). This could involve the analysis of both static and dynamic growth determinant variables within individual small towns to ascertain precisely their associations with selected indicies of population change.

Although the research presented here demonstrates the influence of locational, functional, and economic characteristics upon small town growth, the results suggest that there are many other variables that impinge on the matter of small town growth which should be considered. To explore the notion that more complex relations are involved requires an inductive approach to ascertain what, if any, are the associations between the variables. The analytic problem becomes one of determining the strategic and relevant ways in which small towns differ from one another given many possible variables.

Another neglected aspect of research on small urban places are the effects generated from influences deriving from outside their political boundaries. It is clearly evident from the thesis results that many forces of change emanating from beyond the political boundaries exert important influences on the rates of small town population change.

At a very broad level, Bourne (1978, 40,41) concludes that,

> " future urban research has an even more significant part to play in the emergent urban reality...Researchers must clearly focus more on the changing interdependencies among urban phenomena, and on the relationship between urban development and the turbulent environment provided by economic and political uncertainty, and social change...Careful monitoring and sensitive anticipations of future trends are essential prerequisites of an improved base of urban policy research. "

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APPENDIX A

Urban Populations: 1961, 1971, 1976

Town Number	Town Name	1961	1971	1976
1	Arthur	1,200	1,414	1,660
2	Ayr	1,016	1,272	1,331*
3	Chesley	1,697	1,693	1,839
4	Clinton	3,491	3,154	3,151
5	Durham	2,180	2,448	2,501
6	Elmira	3,337	4,730	7,034*
7	Elora	1,486	1,904	2,589
8	Erin	1,005	1,446	2,007
9	Exeter	3,047	3,354	3,494
10	Fergus	3,831	5,433	6,000
11	Hanover	4,401	5,063	5,691
12	Harriston	1,631	1,785	1,872
13	Kincardine	2,841	3,239	4,182
14	Listowel	4,002	4,677	5,126
15	Lucknow	1,031	1,047	1,127
16	Markdale	1,090	1,236	1,361
17	Meaford	3,834	4,045	4,319
18	Milverton	1,111	1,193	1,393
19	Mitchell	2,247	2,545	2,742
20	Mount Forest	2,623	3,037	3,376
21	New Hamburg	2,181	3,008	3,628*
22	Palmerston	1,554	1,855	1,961
23	Port Elgin	1,632	2,855	5,019
24	Seaforth	2,255	2,134	2,084
25	Southampton	1,818	2,036	2,734
26	St. Marys	4,482	4,650	4,843
27	Tavistock	1,232	1,490	1,783
28	Thornbury	1,097	1,220	1,326
29	Walkerton	3,851	4,479	4,626
30	Wiarton	2,138	2,222	2,144
31	Wingham	2,922	2,913	2,871
32	Goderich	6,411	6,813	7,385
33	Owen Sound	17,421	18,469	19,525
34	Stratford	20,467	24,508	25,657
35	Kitchener-Waterloo	95,851	155,244	178,493
36	Cambridge	43,926	61,963	72,383
37	Guelph	39,838	60,087	67,538

* Due to regionalism, these figures do not appear in the Census of Canada publications. As a result, these figures were obtained directly from the municipalities involved.

Source: Census of Canada, 1961, 1971, 1976, Population: Geographic Distributions, Ottawa.

APPENDIX B

Status of Small Towns for Sixteen Functional Variables*

Town Number	TVALAD $000's	VALADC $000's	VALADE $000's	TOTEMP	TOTPLA	MEMPER	NUMRSS
1	1,618	114	935	173	5	30.6	118
2	1,799	141	904	199	9	33.2	82
3	1,331	78	633	210	5	32.6	118
4	721	23	974	74	8	4.7	484
5	1,613	65	831	194	6	14.6	180
6	12,785	270	1,229	40	21	50.0	318
7	2,128	112	771	276	5	34.7	96
8	843	58	991	85	7	22.1	127
9	2,346	70	953	246	8	17.6	298
10	23,199	427	1,979	172	16	50.3	359
11	9,712	192	932	42	21	39.4	461
12	1,513	84	756	200	7	28.0	144
13	754	23	618	122	7	12.0	414
14	10,477	224	910	151	9	43.3	468
15	689	65	1,148	60	5	13.3	94
16	80	6	200	40	3	5.1	104
17	6,307	156	964	654	16	35.2	338
18	1,181	99	742	159	8	42.4	83
19	1,923	76	1,124	171	10	18.7	206
20	1,418	46	719	197	8	15.3	250
21	3,251	108	1,102	295	12	27.7	271
22	283	15	690	41	7	4.4	116
23	1,514	53	912	166	6	16.8	266
24	2,035	95	807	252	13	22.5	199
25	1,819	89	1,151	158	7	20.8	213
26	11,602	249	1,669	695	11	32.8	330
27	1,362	91	1,001	136	8	18.1	110
28	2,783	228	1,231	226	8	39.6	90
29	7,614	170	1,030	739	13	31.3	357
30	117	5	195	60	5	6.9	193
31	4,893	168	1,140	429	8	26.7	292

* Variable descriptions are provided in TABLE 12.

APPENDIX B (continued)

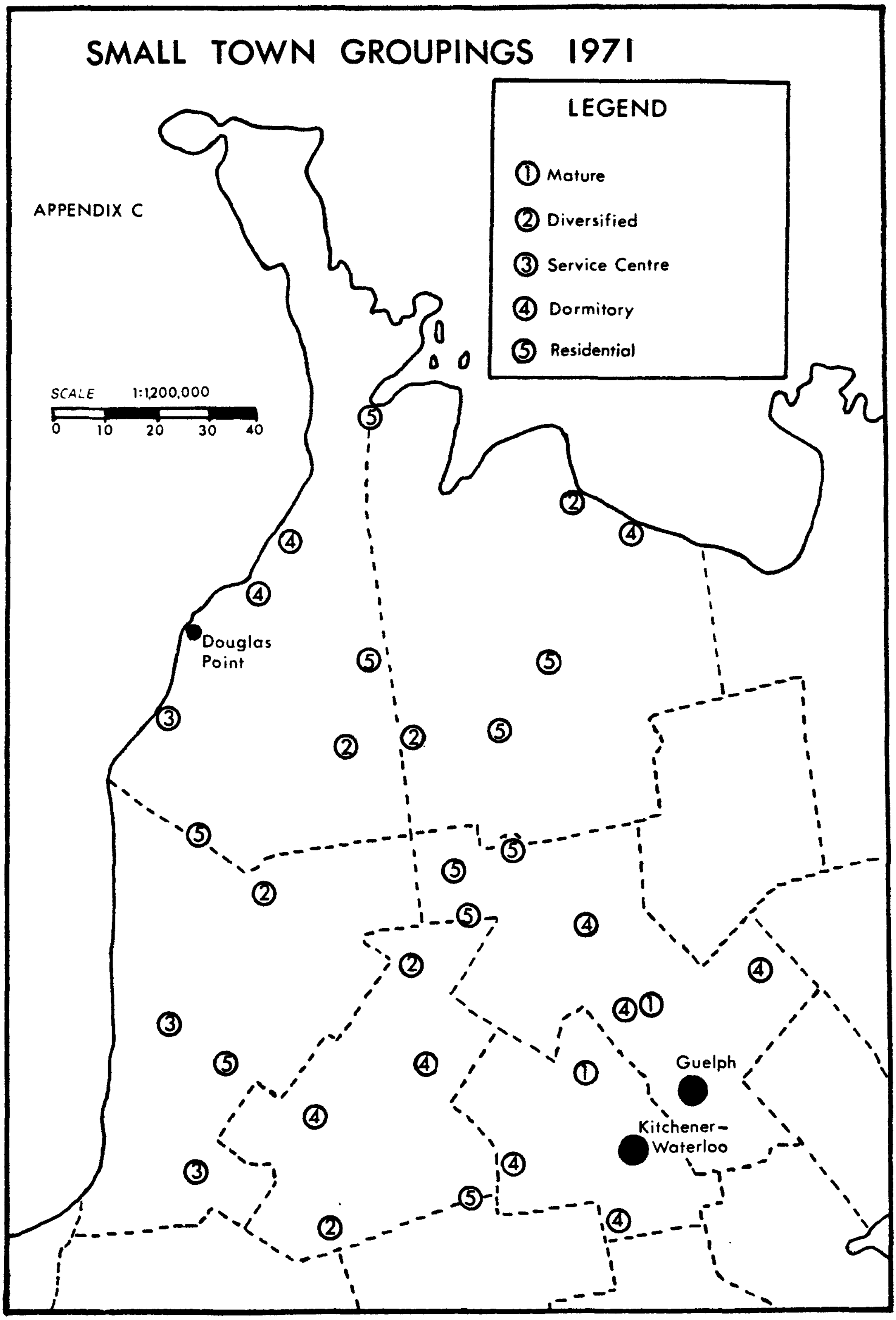
NUMEST	RSSALC $000's	TOTSALE $000's	PERCOMM	NUMCOMM	PERINCO	PER65	NUM65	NUMINCO
44	240	3,388	40	235	38	24.0	287	215
27	367	4,665	52	250	60	36.7	568	360
42	232	3,936	26	140	40	23.2	333	255
109	480	15,137	28	305	51	48.0	312	795
79	214	5,235	18	160	46	21.4	290	605
85	207	9,793	35	655	43	20.7	307	885
42	152	2,895	48	380	50	15.2	301	395
43	367	5,303	56	285	43	36.7	417	165
94	325	10,901	34	435	39	32.5	365	550
92	215	11,688	31	615	43	21.5	325	1,010
122	339	17,189	15	275	42	33.9	372	1,100
55	228	4,069	26	185	27	22.8	282	190
99	382	12,361	43	500	35	38.2	298	360
120	369	17,253	19	350	44	36.9	368	1,160
35	285	2,988	30	100	47	28.5	317	210
46	257	3,183	20	95	52	25.7	306	405
97	282	11,415	18	265	34	28.2	337	625
32	230	2,747	52	225	44	23.0	330	165
63	223	5,689	41	335	46	22.3	276	425
81	280	8,515	15	160	30	28.0	340	390
54	324	9,762	45	525	40	32.4	360	425
43	205	3,808	35	260	48	20.5	328	450
90	220	6,284	34	380	37	22.0	236	360
65	289	6,177	22	180	42	28.9	310	465
78	269	5,488	28	210	30	26.9	257	225
104	228	10,604	22	415	33	22.8	321	695
42	208	3,100	27	150	45	20.8	281	340
33	186	2,270	43	185	58	18.6	252	330
97	248	11,119	15	250	38	24.8	311	900
68	311	6,926	25	160	46	31.1	358	400
91	304	8,871	13	140	41	30.4	303	645

Sources: Census of Canada, 1971, Manufacturers: Geographic Distributions, Ottawa.

Census of Canada, 1971, Retail and Service Activity, Ottawa.

Census of Canada, 1971, Journey to Work Data, Ottawa.

Ministry of Industry and Tourism, Industrial Surveys of Ontario Municipalities, 1971, Toronto.


SMALL TOWN GROUPINGS 1971
LEGEND
1 Mature
2 Diversified
3 Service Centre
4 Dormitory
5 Residential
APPENDIX C
SCALE 1:1,200,000
0 10 20 30 40
Douglas Point
Guelph
Kitchener-Waterloo

APPENDIX D

Status of Small Towns for Selected Growth Determinant Variables*

Town Number	RETCOM	MANCOM	RESCOM	METACC	EMPSTA	PIN6000
1	-0.19	-0.05	.53	50	5.4	20.5
2	-0.84	-0.02	1.26	18	6.4	27.0
3	-0.68	-0.11	-1.73	139	7.0	13.5
4	1.99	-1.68	1.25	10	9.6	24.0
5	.12	-0.32	-1.21	115	5.5	15.5
6	.14	2.09	1.04	21	3.1	30.4
7	-1.37	.44	.48	29	3.5	26.5
8	-0.87	-0.73	1.79	45	4.0	27.3
9	.59	-0.64	.93	50	5.0	22.6
10	.30	3.11	.53	28	6.0	25.5
11	2.17	.83	-0.44	123	8.7	20.0
12	-0.80	-0.25	-0.43	51	3.8	16.4
13	.89	-1.48	1.65	147	7.8	23.7
14	2.12	.69	-0.32	62	6.6	23.4
15	-0.83	-0.45	-1.02	109	2.5	18.0
16	-0.19	-1.14	-1.43	140	3.8	15.5
17	.95	.49	-0.65	196	3.6	20.0
18	-1.52	.19	.42	61	5.1	21.7
19	-0.44	-0.02	.19	64	4.7	22.0
20	.51	-0.78	-0.93	70	7.4	19.3
21	-0.23	-0.09	2.12	18	5.0	24.8
22	-0.57	-0.63	-0.49	72	3.1	24.3
23	-0.17	-0.51	.56	184	3.9	26.1
24	.07	-0.20	-0.49	82	2.7	18.0
25	-0.41	-0.40	.20	192	5.2	19.6
26	.45	1.27	-0.01	45	5.7	30.2
27	-0.80	-0.01	-1.21	35	0.8	15.3
28	-1.45	1.06	-0.60	180	6.7	18.6
29	.99	.64	-0.49	114	5.7	24.7
30	.42	-1.38	-0.70	197	7.6	14.4
31	.68	.10	-0.79	96	4.8	21.1

* Variables are described in TABLES 31, and 32.

Sources: Census of Canada, 1971, Income Status, Ottawa.

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