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An Inter-Regional Analysis of the Growth Rate of Manufacturing Employment in the Province of Ontario, 1960–1972

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AN INTER - REGIONAL ANALYSIS OF THE GROWTH RATE OF MANUFACTURING EMPLOYMENT IN THE PROVINCE OF ONTARIO, 1960 - 1972

By

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THESIS

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Examining Committee

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"ABSTRACT"

Torch, Brian J. "An Inter-regional Analysis of the Growth Rate of Manufacturing Employment in the Province of Ontario, 1960 - 1972."

Despite the existence of different levels of manufacturing activity in the various regions of Ontario, most previous studies of this phenomenon have concentrated on explanation of its locational pattern in southern Ontario only. In contrast, though, this thesis analyzes regional variation in the growth rate of manufacturing employment in a total provincial framework. Also, its approach differs in that it examines variation in the factors which account for manufacturing employment growth and whether or not these variations are consistent over space (between regions) and through time.

The province is divided into three general regions; northern, southern and eastern, and from each region, ten cities are selected to form the basis of the study.

A general linear model is then developed to explain the growth rate of manufacturing employment. The model includes variables which represent three general concepts; market potential, industrial specialization characteristics, and community attitudes towards growth. Using multiple linear regression, estimated linear equations are generated for each of the three regions in each of six two year periods

beginning in 1960.

The analysis of these equations follows two basic paths. First, inter-regional variation of the equations is examined from both total equation structure and individual variable structure. Second, equations of each region are examined separately to determine whether or not the equation structures differ through time. This analysis also involves examination of both total equation structure and individual variable structure.

Results of this analysis produce several general conclusions. Inter-regional variation is found to be the greatest between the northern and southern equations, largely because of the different degree of importance of market potential changes in the two regions. Also, the community attitude variables play an important part in several northern equations whereas they have little significance in the south. Intra-regional variation is found to be the greatest in the southern equations but is also strongly evident in the northern equations. Eastern equations exhibit a high degree of stability.

With respect to the formulation of regional planning policy in Ontario, the thesis contributes two general points. Inter-regional variation emphasizes the need for different policies in different regions. Intra-regional variation through time suggests that policies should be flexible in order to adapt to changing conditions.

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Acknowledgements

The completion of a research effort of this magnitude gives one an immense amount of personal satisfaction. It goes without saying, though, that the final product could not have been produced without the assistance and guidance of several persons. To begin, I would like to express my sincere appreciation and gratitude to Dr. Al Hecht, whose comments and suggestions throughout all stages of the research were most helpful. Especially important, though, were his efforts to steer my initial thoughts and ideas into a tangible research methodology. I would also like to thank the other two members of my thesis committee, Dr. Bruce Young and Dr. Barry Boots, for their constructive criticism and suggestions at both the proposal stage and the transformation of an initial draft to a final one.

Many thanks also go to the staff of the W.L.U. computing centre for their patience and co-operation, and to the staff of Scott's Industrial Directories for the use of their copies of their publications.

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CHAPTER I

INTRODUCTION

(i) Some Comments on Regional Development

Spatial variation of economic growth and prosperity has long been a characteristic of all political units no matter what their size but it is only in the last half century that such variation has come to be recognized as a problem to be dealt with. With the emergence of such recognition, topics such as regional disparities, regional planning and regional development have acquired much credibility in academic as well as political circles.

Perhaps one of the most dominating general characteristics of the regional development era is the involvement of the public sector. For many governments, especially those in capitalistic states, the decision to intervene in the market to bring about a more equitable spatial distribution of wealth has been a difficult one. However, it has been demonstrated that the private sector will not on its own, bring about the distribution that is desired as it is not one of the goals of the profit maximizing firm to seek a socially desirable location (Mathias, 1971). This and two other reasons have been suggested by the literature as justification of public

sector involvement in the treating of regional disparities. For those who oppose government intervention on the grounds that disparities will automatically be erased in the long run by automatic adjustment processes in the market system, Laird and Rhinehart (1967) liken this opinion to the often quoted Keynesian comment "we'll all be dead in the long run". They state that if equalization is inevitable, then why not intervene now with government policies to speed up the equalization process. In effect, such policies would be buying time. Alternatively, Myrdal (1957) and Friedman (1963) have both presented the argument that regional disparities are self perpetuating and will never automatically disappear. Whether one holds either of the two points of view, both appear to justify the existence of government involvement in the removal of regional economic disparities.

As well as these economic rationalizations for government intervention, politicians may also adopt development programs in the face of growing social unrest in the poor regions. Friedman (1963) traces the source of such unrest to the prescence in almost all political units of a centre-periphery colonial relationship in which the less developed outer regions feel that they are being exploited by the core area. If left unresolved, Friedman states that social unrest can turn to conflict.

(ii) The Canadian Case

In Canada, acknowledgement of regional economic disparities has attained its highest level at the national scale partly due to the widely used method of classifying economic regions of the country by provincial boundaries. Such studies as Lloyd and Dicken's factor analysis of Canadian economic health which employed provinces as the level of observation (Lloyd and Dicken, 1972, Ch. 10) help to support the often presented picture of Canadian confederation; the 'have not' Atlantic and Prairie provinces and the rich and dominant Ontario. Also serving to illuminate regional disparities at this scale was the introduction of several federal programs and policies during the 1960's directly aimed at upgrading the economies of the Maritime and western provinces (i.e., ARDA - Agriculture and Rural Development Act, PFRA - Prairie Farm Rehabilitation Act, ADB - Atlantic Development Board, FRED - Fund for Regional Economic Development). Even greater public awareness of such programs was achieved in 1969 with the creation of the federal Department of Regional Economic Expansion (DREE).

Ontario's strong position in the national economic picture has almost totally excluded the province's association with any discussion of regional economic disparities. In fact, though, Ontario's strong position is somewhat misleading. The highly concentrated development of

southern Ontario has had the effect of masking the vast undeveloped areas in the northern portion of the province and the somewhat developed but poor areas of the eastern portion of the province. Perhaps the overriding feature of the provincial variation in development is the overall dominance of the city of Toronto. In 1961, the metropolitan Toronto area accounted for 26% of the provincial population, 33% of the manufacturing empolyment and 37% of the manufacturing establichments. An additional 15% of the province's establishments were located in six other large centres, all of which with the exception of Ottawa were located in south - southwestern portion of the province. In the same year, three-quarters of the centres in eastern Ontario with populations greater than 10,000 experienced a net loss in the number of manufacturing establishments (Collins, 1972).

Despite such large variation in the spatial distribution of manufacturing activity, many studies have limited themselves to explanation of the location pattern of activity in southern or southern and eastern Ontario with the northern area the province being totally ignored. Hay (1965) attempted to identify trends towards the dispersion or concentration of manufacturing counties and cities between 1945 and 1959. However, Hay stated that the northern cities and districts (districts being comparable to southern counties) were left out of the analysis due to the small amount of manufacturing present. One would think that such a study

would be interested in determining if the areas of low activity were benefiting from any trend toward dispersion of manufacturing activity. Similarily, Ray (1965) analyzed the location pattern of manufacturing activity through the use of market potential and economic shadow concepts, but only for southern Ontario.

Until the introduction of a government regional development program in the mid 1960's, regional disparities in the province of Ontario received little recognition. Thoman (1971) cites three trends which initially prompted the government's action. They were the continuing trend of north to south migration of the province's population, the growth of urban sprawl, and the increasing prevalence of unwise use of the physical setting. The province's Design for Development program was officially unveiled in 1966 by the then premier, John Robarts. The policy statement presented listed the aims of the program as the provision of "the best possible environment for the people, the creation of an atmosphere which would encourage economic growth throughout the province, and the smoothing out of conspicuous regional inequalities" (Robarts, 1966, p. 3).

After nearly ten years, the government effort to bring about a more equitable spatial distribution of economic activity has been viewed by some as a dismal failure. The efforts of the provincial Regional Development Branch can be summarized in their preparation of macroscopic plans

for the Toronto Centred Region and several other regions including Niagara, Midwestern Ontario, Northeastern and Northwestern Ontario. But as Britton and Barber (1974) report, there is an absence of any attempt to integrate the goals and objectives of the various regions. They state that it is "frustrating to read recommendations such as 'promote moderate expansion' and 'Diversification in the regional economy (for the Northwestern Ontario region) should be promoted through the attraction of manufacturing industry and tertiary (service) industries.' (Dept. of Treasury and Economics, 1970)" (Britton and Barber, 1974, p. 175). An adequate summation of the problem is also provided by the above authors in their concluding remark; "While regional planning has been attempted, regional policy is lacking."

(iii) Thesis Objectives

The regional development of Ontario's economy can be seen to be a topic of much interest and concern in the province. However, it has been shown that much of the previous work pertaining to the economic activity of the province has largely ignored the regional aspect. This thesis, in contrast, emphasizes the inclusion of the total province in a regional economic analysis. The topic of regional development though, is a very large and encompassing one and could involve a detailed analysis of anyone of a number of economic sectors as well as many social and cultural

aspects. Out of this wide range of characteristics, this thesis has selected a single aspect of the regional economic picture in the province of Ontario, manufacturing activity, as its research base.

A re-examination of the trends and aims of Thoman (1971) and Robarts (1966) respectively serves to further delimit the major research hypotheses. Objectives such as the control of urban sprawl and the promotion of a wiser use of the physical setting suggest that there is a double edge to any proposed program or policy, namely the constraining of growth in the already heavily urbanized areas and the promotion of growth in the declining and undeveloped areas of the province. From this view, the Ontario case presents a rather unique situation in which pressures for changes in the existing conditions originate in both the 'have' and 'have not' areas of the province. From this, it is also possible to visualize the inter-regional planning perspective suggested by Britton and Barber (1974), with the main link between the parts of such a multi-regional framework being the desired growth rate in the respective regions. The rate of growth becomes, then, not only an important concept upon which regional policies and programs can be formulated, but also an important variable to be monitored for the maintenance of an accurate assessment of the relative economic positionings of the regions.

This thesis, therefore, addresses itself to the

analysis of spatial variations in the growth rate of manufacturing activity in the province of Ontario between the years 1960 and 1972. More specifically, the objectives of the thesis are twofold. First is the identification of factors which account for the variation in the growth rate of manufacturing activity. Second is the determination of whether these factors are consistent over space (i.e., between regions) and through time.

Manufacturing activity itself, is measured through manufacturing employment. Evidence in the literature suggests that selection of this variable over a number of other possibilities (i.e., value added, number of establishments, etc.,) is not a critical one in that all the above stated variables have been shown to be highly correlated. Employment, however, was selected because of its use in several previous studies and the fact that this variable can more readily be associated with the problems of regional income disparities than such measures as value added and capital expenditures.[1]

The methodological technique employed by the thesis is multiple linear regression analysis. The fullfilment of the above stated objectives is obtained through the comparison of regression equations generated for three defined regions of the province during six time intervals. Further

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[1] For a further discussion of the selection of manufacturing employment, see p. 26

methodological details are presented in the following chapters. Chapter II outlines the selection procedure used in delimiting the study area and time intervals. Chapter III presents a detailed description of the multiple regression model developed in the thesis with particular emphasis on the method of dependent and independent variable formulation. The remaining portion of the text embodies the results and conclusions reached from the research conducted.

References

Britton, John N. and Gerald M. Barber (1974). "Forecasting the Regional Economy of Ontario." in Bourne, Mackinnon, Simmons and Siegel (eds.) Urban Futures for Central Canada. Toronto: University of Toronto Press, 158 - 177.

Collins, L. (1972). Industrial Migration in Ontario. Ottawa: Statistics Canada.

Friedman, John (1963). "Regional Economic Policies for Developing Areas." Papers and Proceedings of the Regional Science Association. Vol. 11, 41 - 61.

Hay, Keith A. (1965). "Trends in the Location of Industry in Ontario." Canadian Journal of Economics and Political Science. Vol. 31, 368 - 381.

Laird, W.E. and J.R. Rinehart (1967). "Neglected Aspects of Industrial Subsidy." Land Economics. Vol. 43, 25 - 31.

Lloyd, P.E. and P. Dicken (1972). Location in Space: A Theoretical Approach to Economic Geography. New York: Harper and Row.

Mathias, Philip (1971). Forced Growth. Toronto: James Lewis and Samuel.

Myrdal , Gunar (1957). Economic Theory and Undeveloped Regions. London: Methuen & Company Ltd.

Robarts, John (1966). Design for Development: Statement by the Prime Minister of the Province of Ontario on Regional Development Policy. Toronto: April 5, 1966.

Thoman, Richard S. (1971). Design for Development in Ontario. The Initiation of a Regional Planning Program. Toronto: Allister Typesetting and Graphics.

CHAPTER II

DATA BASE FOUNDATIONS

The major research objectives of this study, as outlined in the previous chapter, pertain to the analysis of the growth rate of manufacturing employment in the province of Ontario with a distinct emphasis placed on the regional aspects of such growth. More explicitly, explanation of the growth rate of employment in the various regions through the use of a multiple regression framework is the methodological approach used with the primary goal being the comparison of regression model structure between different regions in different time periods.

The path towards the fulfilment of research objectives is often cluttered with difficult barriers. This chapter outlines both the procedural steps taken to establish a suitable data base and the difficulties encountered in defining this base. These steps were four in number. First was the formulation of study regions. Second was the choice of an observation unit for which manufacturing employment would be recorded. The third and fourth steps involved the selection of the actual observation units (the sample) and the study time periods.

(i) The Study Regions

Keeping in mind the regional context of the thesis, the breakdown of the total study area (Ontario) into regional units was an initial step. As Camu, Weeks, and Sametz state, the problem of establishing area units with economic significance is a complex one. (Camu, Sametz and Weeks, 1964, p. 263) No one system will likely be found to satisfy all the characteristics of regional economic variations. Recognizing the inherent problems in developing a regional classification scheme, it was decided to base the selection of the substudy units on an already existing regional economic classification of the province. The classification selected is one developed by the provincial government in which the province is divided into ten regional economic areas. These areas which are comprised of county, or in the case of northern Ontario, district aggregations, are the basis upon which the province's planning is being carried out. (Thoman, 1971, Chapter 3)

In light of this thesis' objective to present a regional comparison, the use of all ten economic areas as substudy regions would have involved a rather cumbersome and confusing analysis. Since the thesis also desired to retain the total province in the analysis, the selection of only a few of these economic areas was not an acceptable solution to the problem. Therefore, a number of aggregations of these already existing economic areas of the province

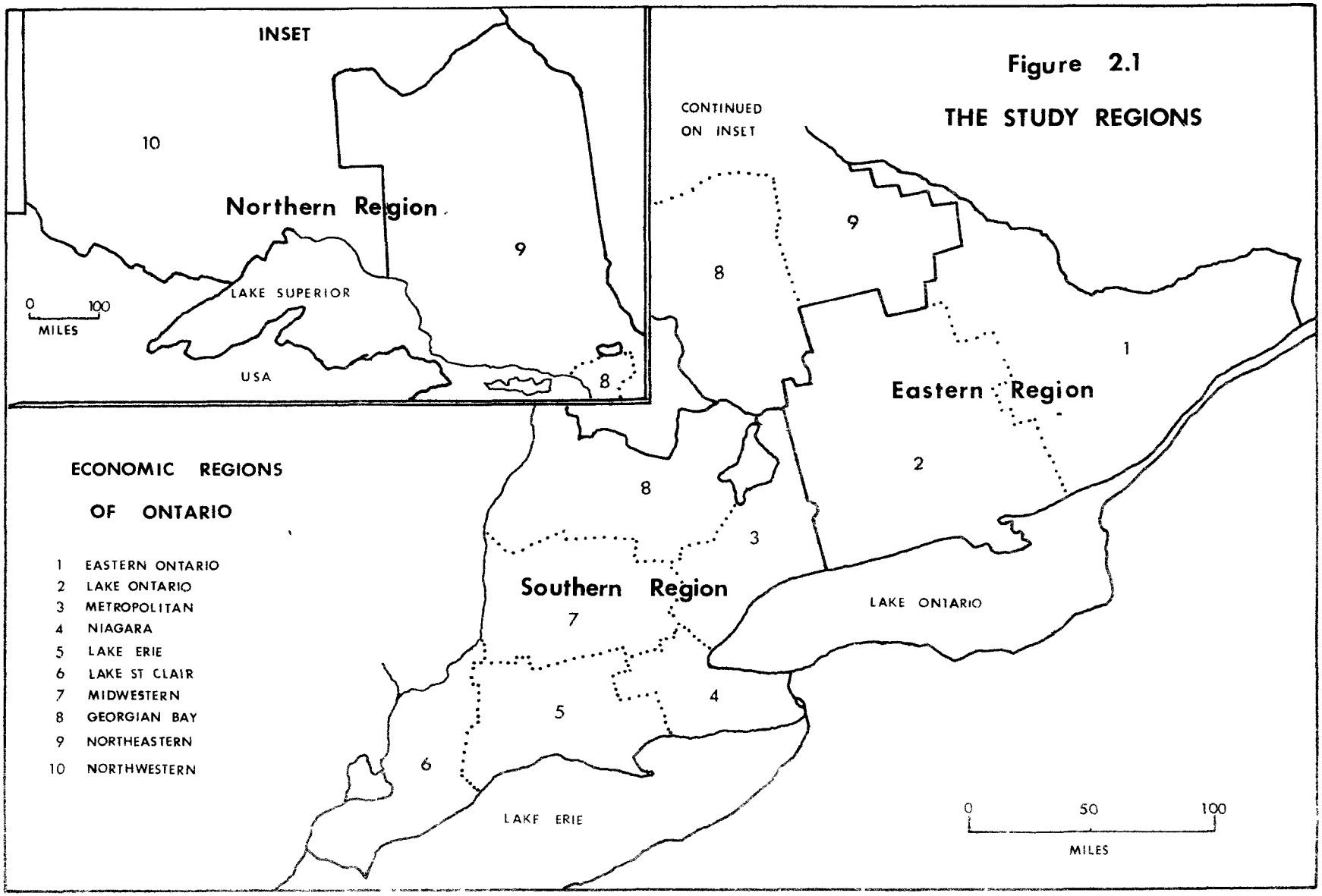
were made in order to define the substudy areas. A NORTHERN region was established by combining the Northwestern and Northeastern economic regions[1], an EASTERN region by joining the Lake Ontario and Eastern Ontario regions, and a SOUTHERN region by amalgamating the remaining six economic regions of south-central and southwestern Ontario.

The boundaries of these three regions, which are also illustrated in Figure 2.1, are almost identical to those used by Berry in his comparitive study of rural poverty in southern, eastern and northern Ontario. (Berry, 1965) In this study, Berry noted that rural poverty is much greater in eastern Ontario than in southern Ontario. These results support the common representation of eastern Ontario being somewhat less prosperous than the highly developed southern portion of the province. These two regions, along with the vastly undeveloped northern portion of the province generalize a basic regional structure of the province of Ontario.

(ii) Observation Units and Data Sources

Selection of three regions was followed by the choice of the statistical area or unit at which observations of the growth rate of manufacturing employment were to be made. In making this choice, the general nature of the variables to be employed in the regression analysis as well as the availability of data to construct them were prime considerations.

[1] also included was a portion of the Georgian Bay region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Northern Region
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Figure 2.1
THE STUDY REGIONS
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1
Eastern Region
2
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3
Southern Region
7
LAKE ONTARIO
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LAKE ERIE
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MILES
ECONOMIC REGIONS
OF ONTARIO
1 EASTERN ONTARIO
2 LAKE ONTARIO
3 METROPOLITAN
4 NIAGARA
5 LAKE ERIE
6 LAKE ST CLAIR
7 MIDWESTERN
8 GEORGIAN BAY
9 NORTHEASTERN
10 NORTHWESTERN

The independent variables of the regression analysis can be classified into three groups; those measuring market potential concepts, those related to aspects of manufacturing diversity or specialization, and a final group composed of variables introduced to capture some measurement of attitudes towards industrial growth. Two statistical units, counties and municipalities, were considered as possible choices. Although the county level offered an excellent data set on manufacturing employment through Statistics Canada's annual Census of Manufacturers, this unit was found to be unsuitable with respect to the third group of independent variables. Data requirements for this group involved the collection of information pertaining to municipal supplies of industrial land and the structure of community tax rates. These variables are naturally more closely associated with individual municipalities than with the entire county unit.

Selecting the individual municipalities within a region as the unit of observation, then, first provided for a satisfactory data base for the industrial attitude variables. The necessary community data was obtained from the Industrial Surveys of Ontario, a type of information or data sheet produced by the Ontario Ministry of Industry and Tourism for prospective industrial firms. The only problem encountered with this source was that information on some municipalities was not available either because of the community's failure to return the data sheet to the Ministry or their returning of only a partially completed

form. This problem was resolved by mailing questionaires to the industrial commissioners of the cities which failed to report data for any of the dates involved in the study time interval.[1]

The selection of municipalities as the observation unit though, produced some problems with respect to the collection of data for the dependent variable employment and the industrial diversification variables. Data on manufacturing employment at the city or town level was also available through the Census of Manufacturers. However, certain data confidentiality rules of Statistics Canada became a major factor in the suitability of this source at the community level. Gilmour (1966) outlines the confidentiality restrictions which can generally be summarized as follows. Considering a single community, if there is one firm within this community which accounts for more than 75% of the centre's factory shipments, then no data pertaining to the manufacturing activity of this community can be released. If there are two firms within a centre which account for more than 90% of the factory shipments, then

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[1] Questionaires were mailed to the following cities in the three study regions: Northern Region - North Bay, Kirkland Lake, Timmins, Kenora, Sturgeon Falls and Sault Ste. Marie, Southern Region - Brampton, Woodstock, Stratford, Kitchener, Chatham, Brantford, St. Thomas, Barrie, Whitby, Eastern Region - Perth, Kingston, Cornwall, Pembroke, Brockville, and Peterborough. All centres except for Peterborough and Kirkland Lake returned the necessary information.

the same publishable data restrictions are invoked. These rules come into effect for many centres throughout Ontario but the majority of communities affected are found in the northern regions of the province. Most municipalities in this region have a limited manufacturing base which is characterized by a high degree of specialization.

Similarily, difficulties in obtaining data at the community level for the industrial diversification variables also had their source in the confidentiality rules of Statistics Canada. Data requirements for these variables involved the collection of employment figures for each of the twenty two digit Standard Industrial Classification (S.I.C.) industry groups at the community level. The above stated confidentiality rules also apply to individual firms within industry groups. Therefore, data on the sectoral breakdown of employment for almost all cities was found to be incomplete. Several examples of such incomplete reporting were: Belleville, 1966 - 3 of twenty groups reported, Brantford, 1960 - 11 of 20 groups reported, Kitchener, 1960 - 10 of 20 groups reported, and Kitchener, 1964 - 9 of 20 groups reported. In addition, those cities for which data on total employment was unreleasable are consequently also void of industry sector employment data.

The resolution of these two problems was partially facilitated through the use of an auxilliary data source, Scott's Industrial Directories. In Ontario, these direct-

ories are published every two years; the first was in 1958. Data in the directory is compiled according to several classifications, one of which is the geographical section in which each municipality of the province is included. Data coverage of communities includes a list of all firms engaged in manufacturing activity, the number of employees of each firm and the products produced by the firm.

City industry employment data by sector was obtained by recording the firm employment with respect to its products. Although a simple process, it is a tedious one since the firms products were coded by Scott's according to a four digit SIC classification different from the one employed by Statistics Canada. In order to maintain data comparability, the Scott's codes were first recoded to the Statistics Canada form and then reduced from a four to a two digit representation. After all firms of a community were classified in the above manner, totals of employment in each of the twenty industry groups were obtained by a simple summation of the firm employment in each goup. A total city employment figure for manufacturing was also obtainable then by summation of the sector totals.

(iii) Study Cities and Time Period Selections

Having selected the municipality as the observation unit, the choosing of cities from the three defined regions to serve as the study area base was conducted in the following manner. An overall sample size of 30 communities

was arbitrarily established, allowing then for the selection of ten cities from each of the three regions. First a list of all centres within the three regions with a population of at least 5,000 in 1960 was compiled.[1] Centres were then assigned sequential numbers in order of their spatial regional location without consideration of any population weighting factor.

For the SOUTHERN region, cities were selected using a random number procedure with the selection subject to certain criteria. The limitation was that at least one centre from each of the six regional economic areas comprising the SOUTHERN region had to be part of the sample. The first six centres were chosen then by randomly drawing cities from the above delimited population until this criteria was met. If a city was selected from an economic region already represented, the city was replaced and another drawn. After the first six centres were selected, the remaing four were chosen at random but with no restriction to their spatial location within the SOUTHERN region.

Selection in the NORTHERN and EASTERN regions was also based on the random number procedure but the limiting criteria were somewhat less complicated since both regions were formed by merging only two economic areas. The only criterion enforced with the selection of cities in these two

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[1]The number of cities satisfying this criteria in the Northern, Eastern and Southern regions were 15, 21, and 49 respectively.

study regions was that there be a relatively even distribution of centres between the comprising parts. In the EASTERN region, the random process produced a sample of ten cities with six from one part and four from the other. In the NORTHERN region, the same ratio between the comprising units was obtained after the selection of the ten centres. One modification though was made to the size of the NORTHERN sample due to the selection of Port William and Port Arthur. These two cities were amalgamated in 1969 to form the city of Thunder Bay. Thus the sample size in this region would have been reduced to nine centres after this merger. In order to keep the sample size at a minimum of ten centres per region for the entire study period, an additional centre was selected from the NORTHERN region.

The complete sample is presented in Table 2.1 along with each centre's population in the sample period, 1961. Also, Figure 2.2 illustrates the spatial location of the study cities.

The time periods for which observations of these communities were made was largely restricted by the necessity of utilizing Scott's Directories as a supplimentary data source. The publication of these directories on a bi-yearly basis enabled a total of nine possible time periods to be examined beginning with the first edition of Scott's in 1958. However, while collecting data from the directories, an accuracy check was performed by cross referencing

Table 2.1

Selected Study Cities by Region

with 1960 Population

Eastern Region		Southern Region		Northern Region	
City	Pop	City	Pop	City	Pop
Belleville	28,700	Stratford	20,189	North Bay	22,684
Peterborough	45,248	Brampton	15,241	Sudbury	78,782
Cornwall	42,267	Brantford	53,201	Kenora	10,407
Lindsay	10,404	Chatham	28,439	Kirkland Lake	15,366
Perth	5,579	St. Thomas	19,617	Timmins	28,325
Kingston	47,611	Guelph	37,123	Sault Ste Marie	41,343
Prescott	5,351	Kitchener	69,622	Fort Frances	8,982
Cobourg	9,388	Woodstock	19,458	Dryden	5,475
Brockville	16,622	Barrie	20,899	Sturgeon Falls	6,281
Pembroke	15,826	Whitby	11,943	Port Arthur	41,761
				Fort William	42,900

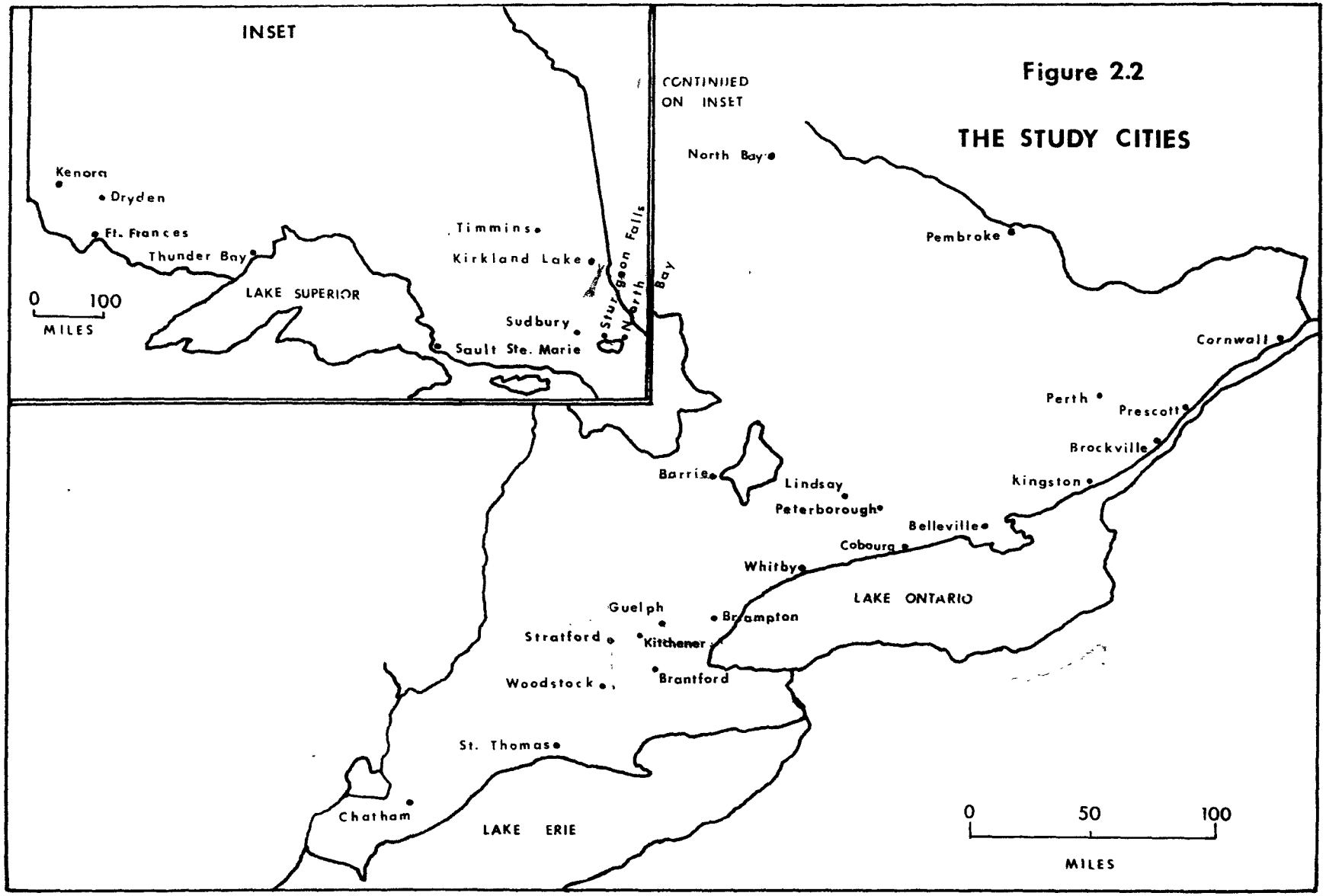

Figure 2.2

THE STUDY CITIES

the information of the time period being collected with the data for the preceding and following period. This process discovered several firms which were present in one edition, missing from the next and present again in the following edition. These firms were assumed to be present in the community for all these periods on the basis that they had simply been omitted from an edition by accident. Therefore, the number of time periods for which data from the Scott's Directories could be derived was reduced to seven two year intervals beginning with the 1960-61 period.

It should also be noted that although the directories are labelled for two year periods, the data contained in them is for the initial year mentioned. Thus, the data in the second edition, entitled 1960-61, is for the year 1960. This information was obtained from conversations with the staff at Scott's.

(iv) Summary

This chapter has described the foundations of the thesis' data base and study area. The province was first divided into three spatial regions. From each of these regions, ten cities were randomly selected to serve as observation units for which the growth rate of manufacturing employment was to be examined during seven specified time periods beginning in 1960.

The description of the variables to be used in the

regression analysis to this point has been general. The following chapter presents a detailed description of both the dependent and independent variables including their theoretical base and method of calculation.

References

Berry, Brian J.L. (1965). "Identification of Declining Regions: An Empirical Study of the Dimensions of Rural Poverty." in Wood, W. Donald and Richard S. Thoman, (eds.) Areas of Economic Stress. Kingston: Industrial Relations Centre, Queens University, pp. 22 - 66.

Camu, Pierre, E.P. Weeks, and Z.W. Sametz (1964) Economic Geography of Canada. Toronto: Macmillan of Canada Ltd.

Gilmour, J.M. (1966). "The Joint Anarchy of 'Confidentiality' and Definitional Change." Canadian Geographer, Vol 10, No. 1, pp. 40 - 48.

Thoman, Rischard S. (1971). Design for Development in Ontario. The Initiation of a Regional Planning Program. Toronto: Allister Typesetting and Graphics.

Annual Census of Manufacturers. Ottawa: Statistics Canada, (1960 - 1971 issues).

Industrial Surveys of Ontario. Toronto: Ministry of Industry and Tourism, (1960 - 1972 city data sheets).

Scott's Industrial Directories. Oakville: Penstock Publications, (1958-59 to 1974-75 editions).

CHAPTER III

THE FRAMEWORK AND FORMULATION OF THE MULTIPLE REGRESSION MODEL METHODOLOGY

The spatial and temporal framework in which analysis of the growth rate of manufacturing employment is to be undertaken has been well defined through the establishment of the employment data base in the previous chapter. At this point, a reconsideration of the thesis objectives provides a perspective in which the methodology employed can be viewed. This thesis strives to answer two basic questions. First, what variables or factors most readily explain the growth rate of manufacturing employment? Secondly, are these factors consistent between spatial regions and different time periods?

The analytical method selected to answer these questions is multiple linear regression. This technique is usually associated with research aimed at predicting the value of a certain variable through the use of several other variables hypothesized to have some type of functional relationship with the variable being explained. This type of methodology is applicable to the first question asked in that it can serve to test the importance of certain variables in explaining the growth rate of manufac-

turing employment in the province. However, this use of multiple regression is secondary in importance to the methodolgy of this thesis. With respect to the second question, multiple regression is employed to examine the spatial and temporal variation in the ability of the independent variables to account for or explain the growth rate of manufacturing employment. Therefore, the basic methodology of this thesis is the comparison of the structure of estimated linear multiple regression equations of a general regression model between the different study regions during the specified time intervals.

(i) Description of the Regression Model

The following sections describe both the dependent and independent variables, how they were selected and the data base used in their calculation.

(a) The Dependendent Variable

The choice of a measure of manufacturing activity can be made from a list of several variables such as the number of establishments, capital expenditures, value added, and employment. The latter variable has been selected for use in this thesis to arrive at a measure of manufacturing growth for several reasons. First, employment has been used in several previous studies to represent manufacturing activity, examples being the work of Harris (1943), Ray (1965) and McClutcheon (1971). Secondly, both Alexander and Lineberg (1961) and Morrison, Scripter, and Smith (1968) have

demonstrated that many of these manufacturing statistics are very similar. The former used correlation analysis to examine the relationship between eight manufacturing variables reported for 2,146 areal units in the 1954 U.S. Census of Manufacturers. Only one of the eight variables, capital expenditures, had low correlation values with the other seven measures. The latter group conducted a similar study using thirteen manufacturing variables from the 1958 U.S. Census and found results consistent with those of the earlier study. These two studies indicate that a choice between the various measures is not a critical one.

The third reason for selecting employment relates to the social unrest and regional friction arguement presented earlier. In the eyes of persons living in a depressed region, the creation of job opportunities is probably the most sensitive issue to be dealt with. Therefore, analysisdealing directly with the growth rate of employment would appear to be a more appropriate tool than analysis of say, manufacturing value added.

Definition of 'manufacturing employment' for the purpose of the dependent variable was established on the basis of the type of data reported in the Scott Industrial Directories. All firms were not consistent in their reporting techniques to Scott's, some giving an accurate breakdown for male and female participation in both the office and factory, while others provided only a total employment

figure for the entire firm Data from the Census of Manufacturers was available at the male/female and manufacturing/non-manufacturing employees level. The figure selected then was the one common to both statistical sources, the total firm employment figure.

The problem of missing data in the Statistics Canada data described in the preceding chapter was first thought to be easily handled by means of relying entirely on the data collected from the Scott Directories for employment figures. However, after these computations were completed, comparisons of Scott's data with that of the census revealed some rather large discrepancies in some cases. In other cases, however, the respective figures were extremely close. It was found that cities with large deviations between the two sources were those with large populations size (i.e., greater than 50,000). This can be accounted for by the fact that Scott's provides less than complete coverage of firms in larger centres. However, for smaller centres, which have fewer firms, the Scott data was very similar to the government collected data. Therefore, from an overall perspective, the best possible data set on manufacturing employment could be derived from a combination of both Statistics Canada and Scott's Directories information. For those cities affected by the confidentiality rule applied to total city reporting, data on employment was supplied from the Scott's directories. Since the centres requiring the use of Scott's data were

small in population size, the mixing of data was not considered a serious restriction.

A minor problem, though, was the absence of a few Statistics Canada city employment figures for the year 1962. This was resolved using an estimation procedure based on the city's share of its county total manufacturing employment in 1960 and 1964. An average of these two shares was calculated and then applied to the 1962 total county manufacturing employment to arrive at a city figure. This method of estimation was necessary for seven centres. [1]

Another problem encountered with the government data was that 1971 was the latest year for which data was available. Rather than projecting these 1971 figures to an estimated 1972 value, they were employed in the data set unadjusted. Also, two centres in this last period had missing data. [2] These figures were estimated using a similar county share technique to the one described above.

One exception to the basis on which a data source for a city was selected was the selection for Sault Ste. Marie. Government data was missing for this centre for the years 1962 and 1964. However, since the substitution of Scott's data for a city over 50,000 in population was deemed undesirable, the figures for these periods were estimated

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[1] These centres were Timmins, Sudbury, Cobourg, Lindsay, Pembroke, Perth, and Brampton.

[2] These centres were St. Thomas and Timmins.

using the same percentage share method. This method seemed appropriate for Sault Ste. Marie since the city accounted for about 90% of its county's (Algoma) manufacturing employment in all periods reported by Statistics Canada.

The final manufacturing employment data matrix then, was comprised of 23 cities for which Statistics Canada served as the data source and seven cities for which Scott' Industrial Directories data was employed. It should be noted that no mixing of the data sources existed in an individual study city. A summary of these data sources for the manufacturing employment data is presented in Table 3.1 The actual data is presented in Appendix I.

From this employment data matrix, the dependent variable was formulated by calculating the percentage growth in manufacturing employment between successive time periods. Specifically, this involved the expression of the actual change in employment between time period 't' and 't + 1' as a percentage of the employment in time period 't'. Thus, for each of the thirty study cities, six observations of the growth rate of manufacturing employment were calculated.

(b) <u>The Independent Variables</u>

The independent variables of a linear multiple regression model are those variables which are hypothesized to exhibit a directional relationship with the dependent variable. In more general terms, they are the variables which attempt to explain or account for variation in the

Table 3.1

Data Source for

Manufacturing Employment in the Study Cities

Eastern Region		Southern Region		Northern Region	
Belleville	+	Stratford	+	North Bay	+
Peterborough	+	Brampton	++	Sudbury	++
Cornwall	+	Brantford	+	Kenora	*
Lindsay	++	Chatham	+	Kirkland Lake	*
Perth	++	St. Thomas	++	Timmins	++
Kingston	+	Guelph	+	Sault Ste. Marie	++
Prescott	*	Kitchener	+	Fort Frances	*
Cobourg	++	Woodstock	+	Dryden	*
Brockville	+	Barrie	+	Sturgeon Falls	*
Pembroke	++	Whitby	*	Port Arthur	+
				Fort William	+

\+ Statistics Canada
++ Statistics Canada with supplementary estimations
* Scott's Industrial Directories

dependent variable via a least squares estimation technique. The previous chapter provided an initial introduction of the independent variables of the regression model formulated in this thesis. Basically, these variables can be classified into three groups, those which measure market potential concepts, those which pertain to manufacturing diversity or specialization and those which measure community attitudes towards industrial growth. Each of these three groups has as its source, methodologies and concepts present in the existing literature of manufacturing location studies. The following sections present a detailed description of the actual independent variables contained in these three general groupings, some aspects of the literature on which they were based, and the method by which they were calculated.

1. Market Potential Variables

The market potential concept, introduced by Harris (1943), refers to the total possible market available to producers at all possible locations. Calculations of market potential are based on the formula

$$P_i = \sum_{j=1}^{n} \frac{X_j}{d_{ij}^{b}}$$

where P_i is the total potential at centre i, n is the total number of centres to which potential is measured, X_j is some measure of the total market available at centre j,

d is the distance between centres i and j, and b is the power to which distance is raised to account for a distance decay relationship.

Several studies of Ontario manufacturing have employed the market potential concept. Ray (1965) calculated market potential values for all counties of southern and eastern Ontario for the year 1961. Using retail sales as the basis on which total market was established, potential values were calculated for the respective counties to sixty-three statistical units within Canada. These units comprised all Ontario counties and districts, ten regions of Quebec and the remaining eight provinces as single units. The distance measure was defined as the shortest road distance between the geographical centres of each unit with the distance between a unit and itself being set at five miles. The distance decay exponent was set at 1.42, a value obtained by Ray after some extensive research with truck and railway movements of freight in the province of Ontario. Ray's main analytical tool was multiple regression in which the number of manufacturing firms and manufacturing employment served as dependent variables and market potential and economic shadow, a concept introduced by Ray to account for American branch plants locating in the province, as the independent variables. Results of Ray's work were highly significant with both concepts providing high levels of explanation of the distribution of manufacturing activity

in southern Ontario.

An investigation of the manner in which market potential effects the changes in manufacturing activity was the basis of McClutcheon's analysis of manufacturing in thirty-three Ontario cities between the years 1951 and 1961 (McClutcheon,1971). The market potential measurements used in McClutcheon's study were based on calculations from three different variables: retail sales, population, and income, with each of these three tabulated for three different distance decay exponent values. Each of these nine measurements was used as the independent variable in a simple regression with both the absolute change in manufacturing employment and a change of employment based on a shift and share technique as the dependent variable. Then employing a multiple regression framework, all nine market potential variables served as independent variables while the same dependent variables were used. Analysis in both the simple and multiple cases included examination of the total manufacturing activity and a breakdown by the twenty two digit industry groups. Results for the total activity analysis were significant in both the simple and multiple regressions with some levels of explanation reaching the ninety percent level.

Both these studies provided high levels of explanation of the locational pattern of manufacturing activity. However, the importance of the market potential concept in

accounting for changes in the manufacturing distribution may be overestimated by studies such as the above two. Although both studies propose to measure manufacturing market potential, the use of such potential indicators as population and retail sales suggest more a measure of urban agglomeration. The flow of goods between manufacturing firms before their arrival on the retail market represents a large amount of manufacturing activity. To take account of such inter-firm flows, market potential measurements for manufacturing might better be estimated by using value added or total employees in manufacturing as surrogate for the total possible market available in a community. Secondly, McClutcheon's study can be criticized in that it examined changes in manufacturing activity between two time periods but only calculated market potential for a single time period. Therefore, he failed to capture the correlation of changes in both variables. This latter point seems to suggest a more meaningful research hypothesis.

These two criticisms served as the basis for the development of market potential measures employed in this thesis. For each of the even numbered years from 1960 to 1972, market potential values were calculated for each of the study cities using manufacturing employment as the surrogate for possible contacts. Reference points for the calculations were established as the largest centre in each of Ontario's counties and districts with the total manufac-

turing employment for that county or district being assigned to that centre. Possible potential outside the province was limited to the adjacent provinces of Manitoba and Quebec. For these inter-provincial potentials, distance reference points were established as central points of each province with the total manufacturing employment of the province being assigned to this point. Like Ray's study, distance measures were taken as the shortest road distance between the two points in question. Also, distance between a centre and itself was set at five miles. Over the twelve year study period, some significant changes occurred in the provincial road network. These changes were taken into consideration by calculating two inter-city distance matrices, the first based on a 1960 Department of Highways road map, the second on a 1966 edition of the same map. Potential calculations for the first first three time periods were based on the 1960 matrix, the remaining four periods on the 1966 matrix. After all values of potential were established, the <u>percentage change in manufacturing market potential</u> was calculated between each of the seven observation years. Therefore, for each city in the study, six observations of this percentage change were produced. This variable served as the first independent variable of the regression model.

To distinguish between local, regional, and total market potential, further market potential calculations produced percentage changes in potential within 250 and 500

mile limits. These variables formed two additional independent variables in the regression model.

2. Structural Diversity Variables

Variables developed in this group were designed to test hypotheses concerning the relationship of employment growth and characteristics of stuctural diversity or specialization in the manufacturing sector. A study by Wong (1969) provides an excellent introductory description of some provincial structural characteristics. Wong examined the degree of specialization of the province's ten economic regions and the degree of localization of sixteen two digit industry groups. His findings indicated that the two regions comprising the entire northern portion of the province were the most specialized or the least diversified in their manufacturing mix. The industry groups found to be the most localized or spatially concentrated were the primary metals and wood products groups, both of which play a major role in the resource oriented northern economy.

These strong regional differences in manufacturing diversity suggest a possible relationship between the growth rate of manufacturing and the level of diversification. The theoretical basis for this hypothesis is outlined by Keeble and Hauser (1971) in their study of manufacturing growth in the outer south-east region of England. They state that highly specialized areas are highly vulnerable in terms of industrial stability and growth whereas more diversified

areas have a greater probability of healthy expansion. Contrary to this reasoning, Britton (1967) discovered a positive relationship between percentage growth in manufacturing employment and area specialization in his study of the Bristol region of England.

Another consideration with respect to the diversity or specialization of a city or region is labour pool characteristics. If a region's industrial structure is highly specialized, it follows that its labour pool will also be highly specialized. Estall and Buchanan (1961) cite examples of how a highly specialized labour pool is very immobile with respect to changing jobs between industries. Thus, if a region has a large but highly specialized labour pool, this fact may hinder the entrance of different industry groups into the area because of their inability to attract labour from the already existing industry. On the other hand, the specialized labour pool may serve to attract more industry in the same industry group because of the plentiful supply of a skilled labour force in that group. Rusling (1974), in his study of why firms located in Cambridge, Ontario, discovered that metal fabricating firms considered the already existing pool of skilled metal workers in the area a very important factor in their choice to locate in Cambridge.

The measure of specialization employed in this thesis is one developed by Isard (1960). The index is based

on the comparison of two percentage distributions, in this case the distribution of employment between the twenty two digit S.I.C. industry groups and the total province. The latter is assumed to be the norm and if a city's distribution is identical to that of the province, it is said to have a completely diversified structure. Consider the above mentioned percentage distributions as two 20 x 1 matrices. Let matrix A be the percentage distribution of manufacturing employment amongst the industry groups of an individual city. Let matrix B be the same percentage distribution of manufacturing employment for the total province. The index is calculated then by (1) subtacting each element of A from the corresponding element of B, (2) summing either all the positive or negative differences between the two matrices (the choice between the two is not important since each produces the same total), (3) dividing the absolute value of this sum by 100.00

Therefore, if a city has a distribution identical to that of the province, the summation of either the positive or negative differences will be zero. Consequently, a city which has its entire manufacturing labour force in one industry group will have an index value which approaches unity. Thus, the greater the value of the index, the greater the degree of specialization in the community under consideration.

Indices of manufacturing specialization were cal-

culated for each of thirty study cities in each of the seven observation years on the basis of the sector employment data obtained from Scott's Industrial Directories. Since Scott's does not report a total provincial employment figure, the standard to which the city distributions were compared was the sector employment at the provincial level reported in the Census of Manufacturers. From these indicies, two independent variables were formed. The first variable was established by calculating the average of the indices between the two years in which growth was being considered. For example, for the growth period, 1960 to 1962, the average of the 1960 and 1962 indices served as the input. This variable provides some measure of the existing state of specialization during the time interval being considered. The second independent variable was formulated by calculating the absolute change in the specialization index over the two year intervals. This variable is introduced to capture possible correlations between growth of manufacturing employment and shifts in the degree of specialization.

3. Community Variables

Variables in this section have been entered into the regression framework in response to a study conducted by Spelt and Kerr (1960) on some aspects of the location of manufacturing in southern Ontario. In this study, the authors examined the distribution of manufacturing activity

with respect to market accessibility and labour wage rates. Their results indicated that even though the eastern region of the province had greater accessibility to the two major markets of Canada (Toronto and Montreal) and generally lower wage rates than centres in southwestern Ontario, the latter area was experiencing much more growth in its manufacturing sector. To better account for the existing pattern of manufacturing distribution, Spelt and Kerr suggested that other variables such as attitudes of labour forces, community attitudes towards industrial growth and community attributes with respect to educational, consumer and recreational facilities might be considered. This thesis attempts to incorporate some of these hypothesized variables as independent variables of the regression model.

The attitudes of the work force in the selected study cities and the relationship of these attitudes to the growth of the manufacturing sector is introduced into the regression model through the development of a "labour climate index" independent variable. This index was calculated in the following manner.

For each of the years between 1960 and 1972 inclusive, data was collected for each community on the total number of man-days lost due to either strikes or lockouts. The source of this information was publication of the federal Department of Labour entitled Strikes and Lockouts in Canada. Beginning in 1969, this publication reported only

those strikes and lockouts involving more than one hundred employees. Therefore, to maintain consistency in the strike data, only strikes involving more than 100 employees were recorded from the pre 1969 issues. Also, data was collected with no distinction made between various employment sectors. All strikes then, not just manufacturing strikes, were recorded.

Naturally, a municipality with a large labour labour force or a greater number of firms would have a higher probability of experiencing labour problems than a community with a small labour force or a few firms. It is necessary then to apply some weighting factor to an index of strike climate. Ideally, this weighting factor would be the total labour force of the community. However, this data was not available and population was selected as the weight to be applied.

From the strike and population data, the labour climate index was calculated in the following manner. For the growth period being considered (e.g., 1960-62), the average number of man-days lost per year in the initial two years of the period (1960 and 1961) was divided by the population in the final year (1962). This procedure was followed for each of the cities in each of the six growth intervals. These index values then served as an independent variable in the regression model. The indices, which range from a value of zero for a community free of labour unrest

and upwards, are hypothesized to have an indirect relationship with the dependent variable, growth rate of manufacturing employment. That is, as the labour climate increases (indicating an increasing amount of strike activity), the growth rate of manufacturing employment declines.

The importance of the availability of serviced industrial land in a community for the promotion of industrial expansion and the attraction of new industry has been indicated by several authors. Gilles (1974), in commenting on the growth of Kitchener, Ontario, states that at present the city has no supply of publically owned serviced industrial land. The question which faces the city is one of the desirability of continued growth. This applies not only to the attraction of new industry but the retention of the already existing base. Particularly with respect to the existing firms, Gilles points out that if they desire to expand and cannot find suitable conditions in the community they are presently located in, they may well decide to relocate entirely in another centre rather than constructing a branch outlet there.

The importance of the availability of land to industrial growth is also illustrated by McDowell (1973) in his study of relocating and locating firms in the Kansas City metropolitan area. His results indicated that after considerations of local, regional and national market accessibility, the availability of suitable land was the next

most important factor considered by firms in their decision to locate or relocate in the area.

Following the logic of Gilles, the attitude of a community towards continued growth of their industrial base can be monitored by examining the amount of industrial land they offer to potential manufacturers. The measurement of this community attitude has been introduced in the thesis through the construction of an "industrial land index." The index is based on the conditions which existed in the initial year of any of the six two year growth periods examined. From the Industrial Surveys of Ontario, data was collected on the amount of service and unserviced industrial land and the breakdown between private and public ownership in each of the thirty study cities. However, in several cases, data was not available at these specified levels, as only a total figure was supplied. Therefore, the total amount of existing land available for industrial use was selected as the measurement to be used. To capture the concept of replenishment of land supply, the total amount of land available in a specified time period was divided by the existing number of firms in the community.

The interpretation of the attitude towards growth from this surrogate measure can be seen in the following example. A city with an already large number of firms can be assumed to have had a previous period of healthy expansion of its industrial base. At some point in the past, we

could also assume that the city had a large supply of industrial land. If during a period of growth, a city decides that more growth is not wanted, the supply of land will not be replenished. However, if during a growth period, the supply of land remains high, the city can be said to still maintain a positive attitude towards more growth. Therefore, it is hypothesized that there is a direct relationship between the industrial land index developed above and the growth rate of manufacturing employment. The industrial land index then, was inserted in the regression model as another independent variable.

The importance of industrial taxes in the decision making process of firm location has been considered by many. However, studies such as the one conducted by Due (1961) have indicated that there is no significant correlation between tax burden and the growth of manufacturing. The use of taxes in a comparative cost technique has also been hindered by the fact that it is difficult to put a value on the amount of services received for taxes paid. It is possible that high taxes could represent excellent services and therefore serve as an important factor in attracting industry to an area.

However, like the industrial land index developed above, the tax structure of the community is considered in this thesis from the municipality's side rather than that of the decison making firm. From the community tax struc-

ture, an additional measure of community attitudes towards manufacturing growth has been developed. To skirt the problem of the quality or quantity of services offered for the tax dollar, this measurement is based on the ratio between the residential and industrial mill rates in the thirty study cities. It is hypothesized that if a community holds a favourable attitude towards industrial growth, the mill rates it sets for the residential and industrial categories will reflect this attitude. If a city assesses the same mill rate for both residential and industrial groups, the ratio between the rates will be one. The community is said, then, to be imposing no additional burden on either group. (It should be noted that in all cases, the industrial rate exceeded the residential rate, thus making 1.00 the maximum value of all ratios.) However, the wider the gap between the two rates, the greater the indication towards an extra burden on the industrial group.

Data on the industrial and residential tax mill rates was also obtained from the Industrial Surveys of Ontario with the exception of a number of communities where direct contact with the city or town clerk was necessary to obtain the desired information.[1] In the case where the city had different rates for separate and public school supporters, the public school rate was adopted. The ratio of the residential to the industrial mill rate was then calculated for each of the thirty study cities in each of the seven

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[1] see p. 16 for a list of communities contacted.

observation time periods. From these ratios, two independent variables were formulated for the regression model. The first variable is similar in nature to that of the land index in that it represents the existing condition in the initial year of any growth period. Thus, for the period 1960 to 1962, the mill rate ratio of 1960 became an independent variable. It is hypothesized that a direct relationship exists between this variable and the growth rate of manufacturing employment. The second variable is similar to the structure of the market potential variables in that it incorporates the concept of correlating the percentage change in the mill rate ratio with the growth of employment. The relationship expected between these two variables is a positive one, with the increase in the percentage change of the mill rate ratio indicating a movement towards a more positive attitude towards industrial growth.

The final independent variable is introduced to account for, in a general manner, the level of community attributes with respect to consumer and recreational facilities. Several authors such as Mueller and Morgan (1962) and Greenhut and Colberg (1962) have mentioned that these factors are important in some cases in influencing the growth of industry in a community. In formulating a variable to represent such facilities, a number of possible variables were considered. Such things as the number of golf courses

public swimming pools, modern shopping centres, etc., could all be considered part of a communities attributes. To incorporate all of these in a single variable, it is assumed that the population size of a community will serve as an adequate surrogate for the level of attributes available.

This assumption is based on the concept of urbanization economies of scale. As a centre increases in size, it is able to provide more public services as the population reaches the necessary threshold for the provision of such services. An example of such a service is public transit. This service would not likely be provided until a suitable base of potential users exists. These threshold levels can also be related to the availability of consumer goods and services in urban areas. A centre with a larger population is likely to offer a greater variety of goods and services than a centre of smaller population because the former centre's size includes the minimum market size of a greater number of functions.

Therefore, the final independent variable of the regression model is the population of the respective study cities in the initial year of the growth intervals. Again, this variable measures the state of the population at a certain point in the growth interval. This state, then, is hypothesized to have a direct relationship with the growth of employment during the rest of the growth period.

(ii) Generation of Estimated Regression Equations

The total regression model, then, consists of the dependent variable; growth rate of manufacturing employment, and ten independent variables. The independent variables are divided into three groups, market potential concepts (3 variables), a city's industrial structural characteristics (2 variables), and community variables (4 variables). Table 3.2 presents the complete model in mathematical equation form along with a list of the variables and the computer code names employed.

Best fit estimates of the linear regression equations were generated for the individual regions in each of the six two year time intervals. Each region was thus represented by six different estimated multiple regression equations of the general regression model. The Statistical Package for the Social Sciences (Nie, Bent and Hull, 1970) program for stepwise multiple regression was the computer program used to generate these equations. This package was selected on the basis of its ability to accomodate missing data. Of the total number of variables calculated for the regression analysis (11 variables by 30 cities by 6 time periods) less than ten variable observations were left unrecorded. However, initial regression runs showed that the default option (in the program) of listwise deletion of cases with missing values was very detrimental with respect to the number of observations entering the equations. This option

Table 3.2

The Multiple Regression Model

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 - \beta_4 X_4 - \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 - \beta_9 X_9 + \beta_{10} X_{10}$$

Variable	Description	Code Name
Y	Percent growth of manufacturing employment	
X_1	Percent change market potential with no mileage limit	MCZERO
X_2	Percent change market potential with 500 mile limit	MC500
X_3	Percent change market potential with 250 mile limit	MC250
X_4	Absolute change in specialization index	SIDIFF
X_5	Average index of specialization in time period considered	SIAV
X_6	Industrial Land Index	LI
X_7	Mill Rate Ratio in initial year of growth period	TRATE
X_8	Percentage change in mill rate ratio	PMC
X_9	Labour Climate Index	CLIMATE
X_{10}	Population in initial year of growth period	POP

caused any city with a missing observation to be excluded from the analysis. Therefore, all other observations for this city were wasted. SPSS did specify an alternative option for the handling of missing values though. This was the pairwise deletion of cases in which only those calculations involving missing values were removed from the analysis. When using this option, though, the manual suggests that comparison of regression equations may not be valid since not all the same variables were used in their calculation. Since the objective of this thesis outlines the comparison of regression equations as the major methodological approach, it was questionable whether a pairwise deletion would be appropriate. However, since the amount of missing data was minimal, it was decided to take the risk of comparing slightly different equations for the sake retaining all observations in the calculations of the equations.

The data, itself, used in compiling the variables of the regression model can be found in Appendix I. Included in this appendix are the industrial land, tax mill rates, manufacturing employment, strike and population data. Also, in Appendix II are examples of how the variables were calculated from the raw data.

References

Alexander, J.W. and James B. Lindberg (1961). "Measurements of Manufacturing: Coefficients of Correlation." Journal of Regional Science. Vol. 3, 71 - 81.

Britton, John N. (1967). Regional Analysis and Economic Geography. London: Bell Ltd.

Due, John F. (1961). "Studies of State and Local Taxes Influences on Location of Industry." National Tax Journal, Vol. 14, 163 - 173.

Estall, R.C. and R.O. Buchanan (1961). Industrial Activity and Economic Geography. London: Hutchinson and Company Ltd.

Gilles, A.J. (1974). "Municipal Industrial Development with Special Reference to Kitchener." in Walker and Bater, (eds.), Industrial Development in Southern Ontario. Waterloo: University of Waterloo Department of Geography Publication No. 3, 199 - 230.

Greenhut, M.L. and Marshall Colberg (1962). "Factors in the Location of Florida Industry: Summary of General Findings." in Greenhut, M.L., Factors in the Location of Florida Industry. Tallahasse: Florida State University, 58-81.

Harris, Chauncey D. (1943). "The Market as a Factor in the Location of Industry in the United States." Annals of the Association of American Geographers. Vol. 44, 315 - 348.

Isard, Walter (1960). Methods of Regional Analysis: An Introduction to Regional Science. Cambridge, Mass: M.I.T. Press.

Keeble, D.B. and D.P. Hauser (1971). "Spatial Analysis of Manufacturing Growth in Outer-Southeast England, 1960 - 1967. I Hypotheses and Variables." Regional Studies. Vol. 5, 229 - 261.

McClutcheon, R.P. (1971). "Market Potential as a Factor in Changes in Manufacturing in Ontario, 1951 - 1961." Unpublished M.A. Thesis. University of Western Ontario, London, Ontario.

McDowell, J.H. (1973). "Factors Influencing the Locational Decisions of Manufacturers in the Kansas City Area." Unpublished M.A. Thesis. University of Arizona, Tucson, Arizona.

Morrison, J.L., M.W. Scripter and R.H.T. Smith (1968). "Basic Measures of Manufacturing in the United States, 1958." Economic Geography. Vol. 44, 296 - 311.

Mueller, Eva and James N. Morgan (1962). "Locational Decisions of Manufacturers." American Economic Review, Papers and Proceedings. Vol. 502, 204 - 217.

Nie, Norman, Dale H. Bent and C. Hull (1970). SPSS: Statistical Package for the Social Sciences. New York: Mc Graw Hill Co. Ltd.

Ray, D. Michael (1965). Market Potential and Economic Shadow: A Quantitative Analysis of Industrial Location in Southern Ontario. Chicago: University of Chicago, Department of Geography Research Paper No. 101.

Rusling, John R. (1974). "Factors Influencing the Location of Manufacturing Activity in Cambridge, Ontario." in Walker and Bater, (eds.) Industrial Development in Southern Ontario. Waterloo: University of Waterloo, Department of Geography Publication No. 3, 145 - 166.

Spelt, Jacob and Donald Kerr (1960). "Some Aspects of Industrial Location in Southern Ontario." Canadian Geographer. Vol. 4, No. 15, 12 - 25.

Wong, Cheuk C. (1969). "The Spatial Structure of Manufacturing Industries in Ontario." Ontario Geographer. Vol. 4, 45 - 55.

Industrial Surveys of Ontario. Toronto: Ministry of Industry and Tourism, (1960 - 1972 city data sheets).

Scott's Industrial Directories. Oakville, Ontario: Penstock Publications, (1958-59 to 1974-75 editions).

Strikes and Lockouts in Canada. Ottawa: Department of Labour, (1960 to 1972 editions).

CHAPTER IV

COMPARATIVE ANALYSIS OF THE REGIONAL MULTIPLE REGRESSIONS

This chapter, which presents the results of the analysis conducted, is divided into six sections. These sections, though, can be classified into two general areas of discussion. The initial two sections consist of analysis pertaining to regional variation of both manufacturing employment growth and structural characteristics of manufacturing employment. Essentially, these sections deal with the question of whether or not significant regional differences in the growth rates or structure of manufacturing employment exist between the three defined study regions.

The remaining portion of the chapter presents the analysis of the previously outlined regional regression equations. The third section of the chapter discusses the initial regression results, problems with these results, and the modifications made to resolve these problems. The fourth section provides a general description of the regression equations generated after the modifications were made. The final two sections present comparisons of the generated regional regression equations. Section five analyzes inter - regional variation of the equations in all six time periods.

Section six analyzes intra - regional variation of the equations. These final two sections, which compare the structure of the regional regression equations over space and through time, facilitate the answering of the questions asked by the stated thesis objectives; are factors which account for variation in the growth rate of manufacturing employment consistent between the different regions and through time?

Since the analysis does involve this temporal dimension, the terminology used when referring to specific time periods is as follows. The time horizon analyzed in the thesis extends over twelve years; this period being divided into six two year segments beginning in 1960. When referring to these time segments, the terms "time period one", "time period two", etc., are used to represent the respective intervals rather than the exact dates. Thus, "time period one" represents the initial two year period, 1960 to 1962, while "time period six" represents the final interval, 1970 to 1972.

A final clarification concerns the term "region". Region is used here to denote the three regions defined by the thesis and represented by the ten cities selected from each.

(i) Characteristics of Regional Manufacturing Employment Growth Rates

The original conceptual base on which this thesis was proposed was the belief that there existed between the

various regions of Ontario, a strong difference in the level of manufacturing activity. Collins (1972, p. 78) provides strong evidence of the dominance of Toronto and other south-western Ontario centres with respect to the distribution of manufacturing establishments.[1] Total manufacturing employment figures for the three defined regions also substantiate such a belief. In 1960, the northern region had 39,418 manufacturing employees, the eastern region, 67,781 employees while the southern region had a manufacturing employment of 496,050. [2] However, a question which is often asked about regions which illustrate such large differences in the level of economic activity is whether or not the differences are becoming greater or smaller? Thus, the consideration of the rate of growth becomes an important part of regional analysis. Figure 4.1 illustrates the average rate of growth of manufacturing employment of the selected cities of each of the three defined regions of the province in each of the six time periods. Some interesting observations with respect to the relative positioning of the regions can be made from an examination of this figure.

First, the general path followed by the southern and eastern growth rates is very similar. Both regions decline and rise simultaneously. In the early periods, the southern

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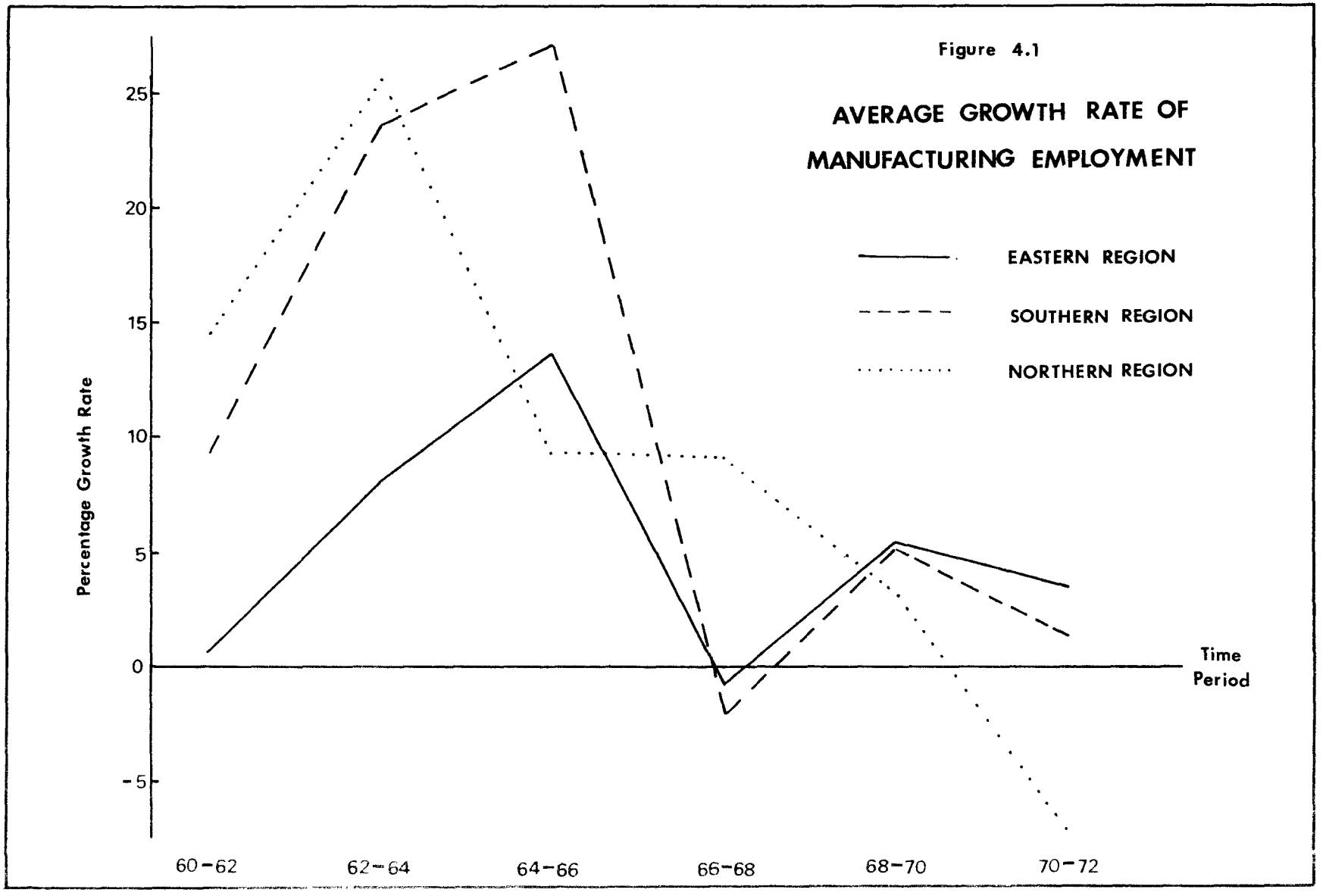
[1] see p. 4

[2] These totals were achieved by aggregating county and district employment figures reported by Statistics Canada Annual Census of Manufacturers.

Figure 4.1


AVERAGE GROWTH RATE OF
MANUFACTURING EMPLOYMENT
EASTERN REGION
SOUTHERN REGION
NORTHERN REGION
Percentage Growth Rate
25
20
15
10
5
0
-5
Time
Period
60-62
62-64
64-66
66-68
68-70
70-72

growth rates are much larger than those in the east. However, beginning in the fourth time period (1966 - 68), the average eastern growth rate actually exceeds the southern rate, but by a very small amount. This possibly provides some indication that these regions are moving relatively closer together. It also indicates that the two regions may be inter-related in some economic aspects since their growth paths are very similar.

On the other hand, the northern region illustrates a growth rate path totally different to that of the other two regions. Like the east and south, the northern region had an increase in the average growth rate during the first time period. However, beginning in the second period, the northern growth rate began to decline, a trend which continued through the remainder of the study periods. Just as the growth paths of the southern and eastern regions suggested that their economies are based on somewhat similar factors, the different path followed by the north suggests that this region may be governed by separate economic factors. The highly resource oriented nature of the northern economy might account for such a relationship.

An actual statistical measurement of variation between the average regional growth rates was conducted using a difference of means test. Results of this test (see Table 4.1) indicated , though, that differences between the regions were seldom significant. In fact, only two of eighteen pos-

Table 4.1

Difference of Means Test
For Regional Variation In
The Growth Rate of Manufacturing Employment

Time Period	North - South	East - South	North - East
1960-62	.597	1.357	1.364
1962-64	.128	2.960*	1.137
1964-66	2.376*	1.775	.674
1966-68	1.386	.280	1.349
1968-70	.397	.016	.270
1970-72	1.375	.371	1.490

* t Value significant at .05 level.

sible pair combinations exceeded the t value needed for significance.

A second test for regional difference in manufacturing employment growth rates was conducted using analysis of variance. However, like the difference of means test, little evidence of regional differentiation was found (see Table 4.2). Only one of the six time intervals tested, the 1964 - 1966 period, was found to exhibit greater inter-regional than intra-regional variation.

The existence of large intra-regional variation in employment growth rates illustrated by the analysis of variance technique suggested further examination of the distribution of growth rates within the three regions. This was carried out through the comparison of Figures 4.2 through 4.4, which present a visual comparison of these distributions as well as the growth paths of the individual cities in the respective regions. A quick glance at each of these figures yields several general observations.

Table 4.2

Analysis of Variance Test of
Regional Manufacturing Employment Growth Rates

Period	1960-62	1962-64	1964-66	1966-68	1968-70	1970-72
F	1.502	1.030	3.299*	1.655	.058	1.809
df	2,29	2,29	2,29	2,29	2,28	2,28

* significant at .05 level

Figure 4.2


60
40
20
0
-20
-40
Percent Growth
Manufacturing Employment
Growth Rates In
Southern Ontario Centres
1 Stratford
2 Brampton
3 Brantford
4 Chatham
5 St. Thomas
6 Guelph
7 Kitchener
8 Woodstock
9 Barrie
10 Whitby
60-62
62-64
64-66
66-68
68-70
70-72
Time Period

Figure 4.3

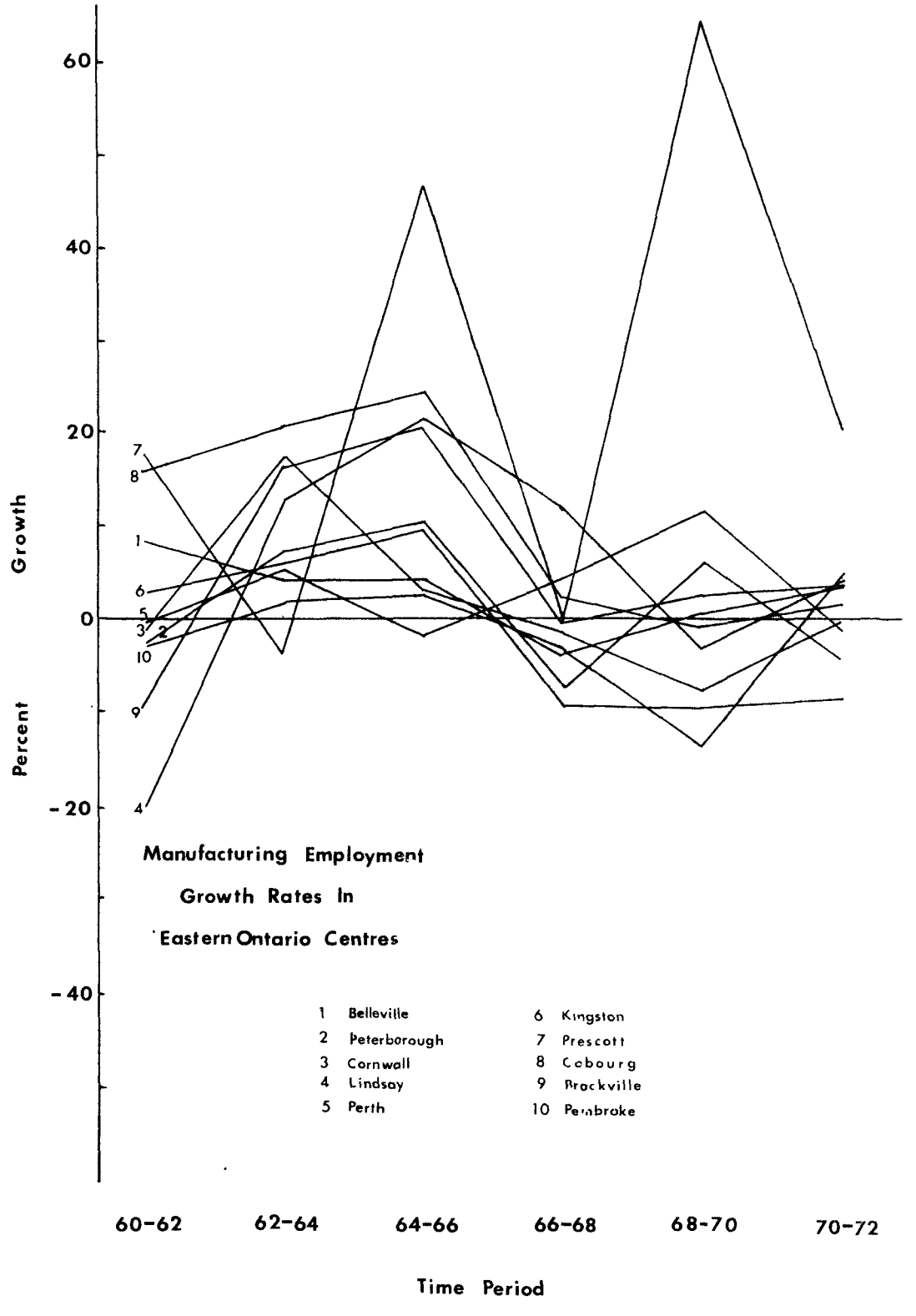
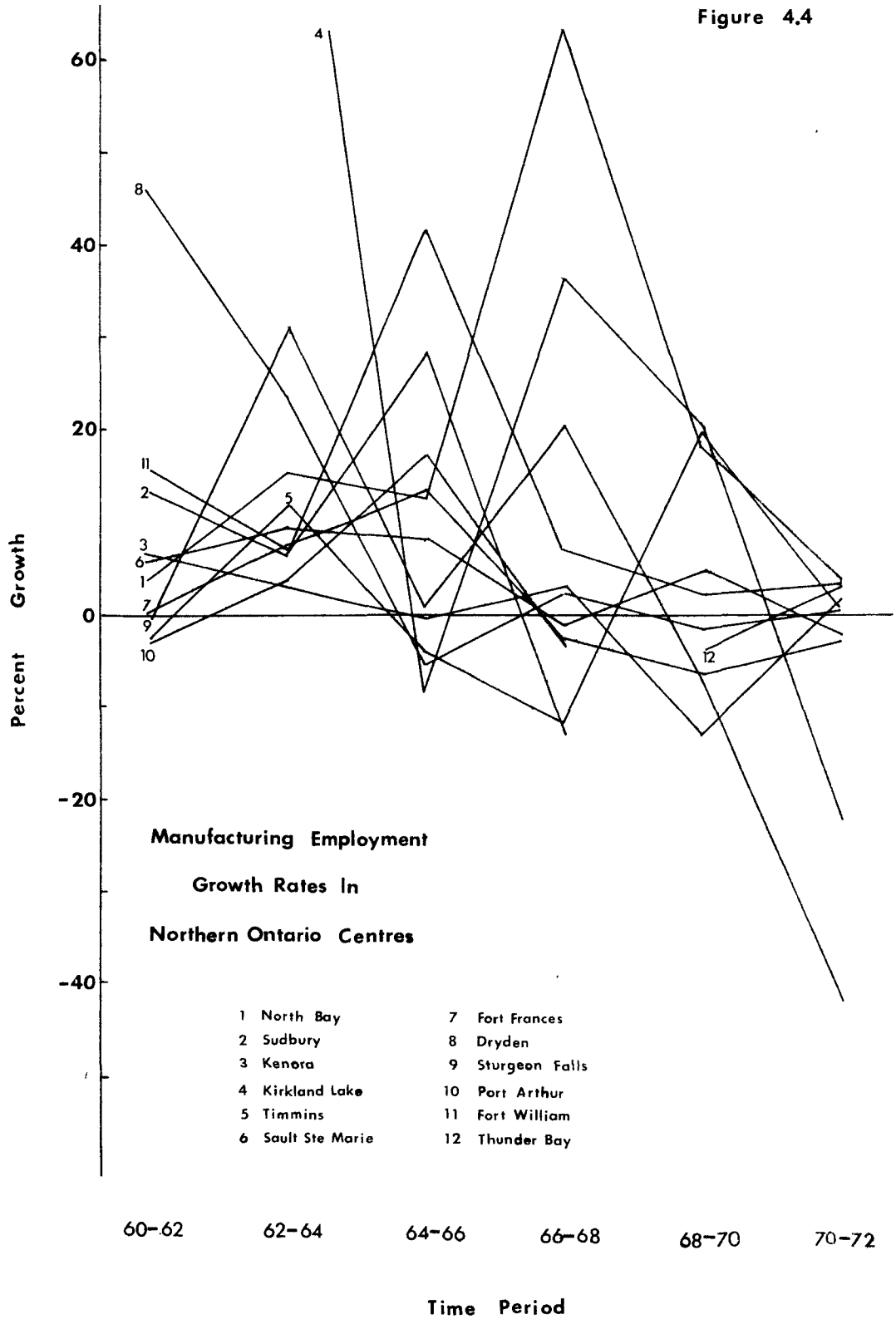

60
40
20
0
-20
-40
Growth
Percent
7
8
1
6
5
3
2
10
9
4
Manufacturing Employment
Growth Rates In
Eastern Ontario Centres
1 Belleville
2 Peterborough
3 Cornwall
4 Lindsay
5 Perth
6 Kingston
7 Prescott
8 Cobourg
9 Brockville
10 Pembroke
60-62
62-64
64-66
66-68
68-70
70-72
Time Period

Figure 4.4


60
40
20
0
-20
-40
Percent Growth
Manufacturing Employment
Growth Rates In
Northern Ontario Centres
1 North Bay
2 Sudbury
3 Kenora
4 Kirkland Lake
5 Timmins
6 Sault Ste Marie
7 Fort Frances
8 Dryden
9 Sturgeon Falls
10 Port Arthur
11 Fort William
12 Thunder Bay
60-62
62-64
64-66
66-68
68-70
70-72
Time Period

First, cities of the southern and eastern regions appear to follow very similar growth paths. This is consistent with the above analysis of the paths followed by the average growth rates in the three regions (see Fig. 4.1). One difference between these two regions is that the southern cities, especially in the first three time periods, have greater growth rates and thereby occupy a higher position in the graph than the eastern centres. In the northern region, though, the city growth rate paths failed to illustrate a general trend. These centres are characterized by large fluctuations in the growth rate paths, which in several cases are accentuated by movements in opposite directions.

This latter point introduces a second general observation concerning the variability of the growth rates in each of the three regions. In the three figures, this can best be seen through an examination of the range of growth rates. With the exception of one or two cases, the range of growth rates in the eastern and southern centres is observed to be relatively small. This follows from the fact that the growth paths of these regions are rather closely tied together. However, in the northern region, the above mentioned fluctuations of city employment growth rates produces a distribution with a much larger range of values. Further regional comparisons of growth rate variablility can be made using the standard deviation as a measure of dispersion. Table 4.3 presents this statistic as well as the mean and

range of the growth rates for each of the three regions in all six time periods. Examining this table in a spatial context (i.e., comparing the three regions in a single time period), northern centres are found to exhibit greater variability than the other two regions in the first, second, fourth, and sixth time periods. In these periods, the standard deviation and range of the northern centres' growth rates exceed considerably those of the southern and eastern centres.

The greater degree of variablility and fluctuation in the northern centres in certain time periods is consistent with what would be expected from the highly specialized and resource oriented northern economy. Centres of such a region would less likely illustrate internal similarity as their markets are primarily located outside the region. Therefore, there is little inter-connectiveness amongst the centres. Also, the highly specialized nature of the region's manufacturing base makes it highly vulnerable to changes in economic conditions which could possibly account for the observed fluctuations in employment growth rates. On the other hand, the southern region centres can be said to belong to some type of central place oriented system, a system which would provide for a greater degree of connectivity between the centres. This connectivity is illustrated by both the closely knit nature of the growth rate paths and the range of growth rates in the southern region. Eastern centres also illustrate some of the same inter-connectiveness, but at a somewhat lesser level than the southern centres. This perhaps, is an

Table 4.3

Descriptive Statistics of the

Growth Rate of Manufacturing Employment

	Eastern Region			Southern Region			Northern Region		
Time Period	Mean	St. Dev.	Range	Mean	St. Dev.	Range	Mean	St. Dev.	Range
1960-62	.76	11.41	38.17	9.22	16.11	57.73	14.72	24.69	79.31
1962-64	8.71	7.63	24.13	23.69	14.04	46.14	25.65	46.45	160.42
1964-66	13.87	14.59	48.13	27.11	18.69	53.52	9.45	15.42	50.10
1966-68	-.91	5.90	20.12	-2.13	12.36	45.12	9.23	23.04	77.11
1968-70	5.37	22.78	80.42	5.25	11.31	32.35	3.17	12.02	33.35
1970-72	2.32	7.51	20.47	1.27	4.84	16.87	-5.52	14.87	45.60

indication of the relatively less developed economy of the eastern region.

It should be mentioned that lack of statistical support for regional variation in growth rates of manufacturing employment does not preclude any further examination of the questions asked by this thesis. If the regions do have similar growth rates of employment in the manufacturing sector, it remains to be determined whether or not the factors which account for the variation within the regions vary between regions.

(ii) Regional Variation in Structural Diversity of Manufacturing Employment

Although no significant regional differentiation was found with respect to the growth rate of manufacturing employment, the degree of diversification or specialization of the manufacturing base was found to exhibit a very pronounced regional structure. Strong regional differences are first illustrated by the results of an analysis of variance test on the specialization indices of the study cities by region. Table 4.4 shows that in every one of the six time periods, variation between the regions is greater than variation amongst the centres within the regions.

Regionalization based on industrial specialization was thus shown to be significant. However, the analysis of variance technique does not pinpoint any specific regional differences between groups. Therefore, an additional

test for differences of means was conducted between all possible regional pairings (i.e., north vs. south, etc.,). These tests provided further evidence of regional variation in the structural base of manufacturing employment. In total, twenty-one difference of means tests were run, seven for each regional pairing. The results, presented in Table 4.5, show that with the exception of the east vs. south comparison in 1960, significant difference between specialization index means of the regions existed in all time periods.

The high level of significance found in almost all the tests for regional variation in manufacturing employment structure suggests that the regions remain significantly different throughout all time periods. To provide further evidence for this case, the indices were analyzed for possible trends through time. This was accomplished by employing simple linear regression to regress the index values of

Table 4.4

Analysis of Variance Test for
Regional Variation in Manufacturing Diversity

Year	1960	1962	1964	1966	1968	1970	1972
F	14.17*	13.65*	13.17*	18.98*	19.70*	22.01*	27.04*
df	2,29	2,29	2,29	2,29	2,29	2,28	2,28

* significant at .05 level

Table 4.5

Difference of Means Test
For Regional Variation in the
Index of Manufacturing Specialization

Time Period	North - South	East - South	North - East
1960	5.223*	1.935	3.539*
1962	4.909*	2.501*	3.092*
1964	4.915*	2.243*	3.130*
1966	5.575*	3.435*	3.476*
1968	6.023*	3.605*	3.349*
1970	5.412*	3.560*	3.057*
1972	6.075*	4.299*	2.921*

* t value significant at .05 level

each region against time. Results of these regressions showed that both the northern and eastern regions exhibited no trend through time as the t value for their slopes were both judged to be not different from a slope of zero (see Table 4.6). The southern region though, illustrated a definite trend towards increased diversification, as its slope was negative and significantly different from zero at the .05 level of confidence.

Therefore, although all three regions have a trend towards decreasing specialization through time as indicated by the negative slopes of the regression lines, the southern region appears to be moving farther away from the other two regions by virtue of its steeper and statistically significant slope. Regional variation in manufacturing mix, therefore, is consistent through time.

Table 4.6

Regression Analysis for
Trends in Specialization Indices

Region	df	Slope (b)	t Value
North	73	-.007	.862
East	68	-.002	.378
South	68	-.010	1.984*

* significant at .05 level

The results of the above analysis, though, should be viewed with some caution. Specialization of the manufacturing base could possibly be a function of population size. If all northern centres were of small population size, this could account for the high degree of specialization in the region. Similarly, if southern cities were of large population size, a high degree of diversification might be expected. A simple correlation analysis between population size and degree of specialization in all study cities in all time periods resulted in an 'r' value of -.40, a result consistent with the above hypothesis. Although this value was found to be significant, the amount of variation in specialization accounted for by population size is only sixteen percent (r^2). This reflects the fact that there are northern centres with large populations (see Table 2.1) which have highly specialized manufacturing bases and southern centres with smaller populations with more diversified manufacturing bases. [1] Therefore, the effect of population size on the degreee of specialization is not that great.

Secondly, it is possible that a different regional boundary system might produce a different set of results. In fact, this point can be applied to all analysis presented in this thesis. However, it is not the aim of this thesis to examine alternative regional breakdowns, but to examine one; a regional breakdown based on economic areas defined

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[1] Appendix I presents index values for specialization.

by the Ontario government. In essence, the regional boundaries established by this thesis were based on spatial location. However, the results of the specialization analysis indicates that these regions can possibly be justified on more grounds than their spatial contiguity.

(iii) Initial Runs of the Regional Multiple Regressions

The first set of regional regression equations generated from the stepwise multiple regression program were based on the dependent variable and the ten independent variables outlined in the previous chapter. A total of eighteen equations were produced, six for each of the three study regions. Analysis of these equations served to delimit a major problem. This pertained to the extremely high level of explanation achieved by the regression analysis (see Table 4.7). Of the eighteen estimated regression equations generated, only two had R^2 values less than .90 Generally speaking, the explanation of any kind of growth rate is thought to be a very complex matter. Therefore, the results obtained from these initial runs were viewed with skepticism. This skepticism was compounded by the fact that multiple correlation coefficients as high as .995 were found to be insignificant.

The major source of this problem were the dimensions of the input data matrix. The combination of each regional regression equation being based on only ten observations and the number of independent variables being entered in the re-

Table 4.7

Results from Initial Regional Regressions

Time Period	Eastern Region			Southern Region			Northern Region		
	R^2	df	F	R^2	df	F	R^2	df	F
1960-62	.834	6,1	.842	.999	8,1	160.589**	.969	8,1	3.936
1962-64	.479	6,1	.153	.988	8,1	21.122	.946	5,4	14.025*
1964-66	.959	6,1	3.977	.972	8,1	4.480	.978	9,1	4.945
1966-68	.992	7,1	20.918	.967	8,1	3.740	.980	5,4	39.857*
1968-70	.999	8,1	337.821*	.943	7,2	4.704	.995	6,1	39.796
1970-72	.994	8,1	23.086	.999	8,1	127.635**	.999	2,5	2896.347*

* significant at .05 level of confidence

** significant at .10 level of confidence

gression had the overall effect of reducing the degrees of freedom of the sum of squares of regression residuals to one. In all cases, this sum of squares was found to be the lesser of the two estimates of variance, explained and unexplained variance. Therefore, in order to establish significance of a total estimated regression equation, an extremely high F ratio was necessary in most situations.

This problem was resolved by reducing the number of independent variables in the regression analysis. The selection of variables to be deleted, though, was a very difficult problem. Since the objective of the analysis was the comparison of estimated regression equations generated in the different regions at different time periods, it was necessary to maintain the same general model for each estimated regional equation. The problem, though, was that some variables accounted for very little explanation in some regional equations while in others, they were very important.

The first two variables to be deleted were the market potential changes at the 500 and 250 mile limits (MC500 and MC250). Examination of the simple correlation coefficients of these two variables and market potential change with no limit imposed (MCZERO) showed a high degree of interdependency of the measures. Therefore, these variables were really measuring the same phenomena. The choice of which market potential variables to delete was made on the basis that the previous studies of market potential in the province

cited above employed a potential measurement with no mileage constraint.

The deletion of these two variables reduced the number of independent variables to eight. However, since the initial stepwise equations entered a maximum of eight variables before the cut-off constraints became a factor, it was still possible with eight variables to obtain results similar to those outlined above. Therefore, to assure that the regression equations generated could be tested for significance without having to work with extremely high F table values, it was decided that an additional two variables should be removed from the list of independent variables.

The initial step in selecting these two variables was a search for variables which did not enter any of the initial regressions, or if they entered, accounted for a very small increment in additional explanation of the dependent variable. None of the variables met these criteria. A second examination of the independent variables was then made recording all cases where a variable accounted for more than five percent additional explanation in its respective regional equation. From this search, the variables with the lowest number of occurrences with this property were deleted. They were the population in the previous time period (POP), and the tax mill rate ratio in the previous time period (TRATE), each with only four occurrences.

The number of independent variables remaining in the

analysis, then, was six. Using these six independent variables, estimated regional regression equations were again generated for each of the six time periods. Overall results from these regressions proved to be somewhat more realistic. Although some very high levels of explanation were still achieved, the problem of their being insignificant did not reappear.

(iv) Description of the Regional Equations Generated

Before intra and inter-regional comparisons of the estimated equations generated are presented, the nature of the regression results in each region are discussed with an emphasis on the observed behavior of the independent variables with respect to their hypothesized relationship with manufacturing employment growth rates.

1. Eastern Region

Of the three regions analyzed, the eastern region was the least receptive to explanation of the variation in employment growth via the multiple regression model technique. Table 4.8 contains the regression statistics after the final variable was entered. The total regression is shown to be significant in only two of the six periods. In these periods, though, (the fourth and fifth) the level of explanation reached levels of eighty-three and ninety-six percent. The overall low significance of the eastern results is also prevalent in the individual variables of the regression.

Table 4.8

EASTERN REGION:

FINAL MULTIPLE REGRESSION STATISTICS

Time Period	R^2	Sum Squares Regression	Sum Squares Residual	df	F
1960-62	.345	315.137	595.963	5,2	.211
1962-64	.437	181.273	232.985	5,2	.311
1964-66	.614	906.029	567.512	6,1	.266
1966-68	.963	268.544	10.094	5,3	15.961 *
1968-70	.835	3906.130	767.194	4,5	6.364 *
1970-72	.727	344.881	162.711	5,4	1.965

* significant at .05 level of confidence
** significant at .10 level of confidence

Only eight instances were found in which a variable significantly entered the eastern regression equations (see Table 4.9).

Two of these eight occurrences of significance were found in the market potential variable. Overall, this variable illustrated the expected relationship with employment growth in four of the six equations it entered. Since it was significant only twice though, the results tend to support the findings of earlier researchers, notably Ray (1965) and Spelt and Kerr (1960), who illustrated the unresponsiveness of growth in the eastern portion of the province to market accessibility.

Three of the eight significant occurrences were found in the industrial structure variables. However, the general nature of these variables was somewhat inconsistent. In four of the five time periods in which the change in specialization entered the equations, the hypothesized indirect relationship between increases in specialization and growth was found. However, the variable measuring the average degree of specialization (SIAV) illustrated a direct relationship between higher specialization and growth in each of the five eastern equations it entered. This reversal of relationships with growth could possibly be accounted for if the centres with the highest degree of specialization also experienced the greatest change in specialization or move to diversity.

Table 4.9

Beta Coefficients, t Values, Order of Entrance of the Independent Variables: Eastern Region

Time Period	MCZERO	SIDIFF	SIAV	LI	PIC	CLIMATE
1960-62	.490		.199	.217	.157	.510
	.586	x	.154	.324	.186	.617
	(2)		(5)	(3)	(4)	(1)
1962-64	-1.323	-.143	.285	.938	-.509	
	.624	.240	.260	1.204	.342	x
	(2)	(3)	(5)	(1)	(4)	
1964-66	-.969	-.137	.866	-1.470	.246	.580
	.824	.141	.596	.839	.343	.704
	(3)	(1)	(5)	(2)	(6)	(4)
1966-68	1.142	-.855		-.680	-1.105	-.530
	6.232*	3.671*	x	3.406*	5.560*	2.088
	(1)	(4)		(5)	(3)	(2)
1968-70	.281	-.218	1.366		1.461	
	1.341	1.072	4.289*	x	4.645*	x
	(3)	(4)	(2)		(1)	
1970-72	1.196	.659	1.480	-.418	-.793	.377
	2.149**	1.580	2.171**	.802	1.558	.723
	(2)	(1)	(3)	(5)	(4)	(6)

* t value significant at .05 confidence level
** .10 confidence level
x variable did not enter stepwise regression

As mentioned above, the community variables were entered into the regression equations on the basis of a comment made by Spelt and Kerr (1960) that variation in the growth of manufacturing between eastern and southern parts of the province might better be accounted for by consideration of such things as attitudes towards growth of municipalities and attitudes of labour. The behavior of the variables entered into the analysis to represent these hypotheses in the eastern region though, does not substantiate the hypothesized relationships. For instance, the land index variable was found to be indirectly related to growth in three of the five equations it entered. The tax mill rate ratio variable also did not follow the expected pattern. Again, in three of the six equations it entered, an indirect relationship to growth was found where a direct one was expected. This inconsistency is also evident in the two instances when this variable (PMC) entered the eastern equations significantly. In these two cases, opposite relationships to growth were found. The inconsistency, though, might possibly be explained by the existence of a lag effect. That is, a community may recognize its slow growth and establish incentives or better conditions for growth which do not show their effect until the next time interval.

Finally, the labour climate variable exhibited direct relationships to growth in three of the four cases in

which it entered the eastern equations. This variable was hypothesized, though, to be indirectly related to growth. Also, the fact that the variable only entered four of the equations is another indication of the general unimportance of this variable in the eastern region.

2. Southern Region

With respect to the total amount of significance found in each of the three regions, the southern region was the highest. Of the six time periods examined, only the estimated equation for the second time period was found to be insignificant. In the other five periods, though, the ninety percent explanation level was exceeded in every case (see Table 4.10). With respect to the individual variables, nine cases of significance were found to exist (see Table 4.11). Also, each one of the significant estimated regression equations had at least one significant variable in its structure.

A closer examination of the significant individual variable reveals some interesting characteristics about the southern regional regression equations. Out of the nine significant independent variables, eight were found to be either the market potential change variable (MCZERO) or one of the two specialization variables (SIDIFF or SIAV) while only one of the occurrences was found in the community variables.

Table 4.10

SOUTHERN REGION

FINAL MULTIPLE REGRESSION STATISTICS

Time Period	R^2	Sum Squares Regression	Sum Squares Residual	df	F
1960-62	.960	2243.193	91.210	6,3	12.296 *
1962-64	.663	1178.552	596.876	6,3	.987
1964-66	.920	2869.887	246.787	6,3	5.814 **
1966-68	.930	1281.519	95.353	5,4	10.751 *
1968-70	.940	1084.869	68.116	6,3	7.963 **
1970-72	.987	208.239	2.724	6,3	38.226 *

* significant at .05 level of confidence

** significant at .10 level of confidence

Table 4.11

Beta Coefficients, t Values, Order of Entrance of the Independent Variables: Southern Region

Time Period	MCZERO	SIDIFF	SIAV	LI	PRC	CLIMATE
1960-62	.853	-.436	.289	-.755	.138	-.300
	3.894*	2.131**	.746	1.889	.520	2.086
	(2)	(1)	(5)	(3)	(6)	(4)
1962-64	-.201	1.083	-.981	1.061	-1.037	-.230
	.459	1.802	1.660	1.493	1.575	.644
	(1)	(3)	(2)	(4)	(5)	(6)
1964-66	.585	-.386	-.421	1.190	.729	.352
	2.457**	1.232	.720	2.039	1.739	.982
	(3)	(5)	(6)	(1)	(4)	(2)
1966-68	-.270	.630	.775		-.144	.281
	1.660	3.881*	4.708*	x	.261	.464
	(4)	(2)	(1)		(3)	(5)
1968-70	.941	.072	.579	.817	.019	.297
	3.775*	.246	1.461	3.531*	.114	.829
	(2)	(5)	(3)	(1)	(6)	(4)
1970-72	.748	.013	.360	.070	-.029	.135
	6.451*	.154	3.211*	.471	.353	1.446
	(1)	(6)	(2)	(4)	(5)	(3)

* t value significant at .05 confidence level
** .10 confidence level
x variable did not enter stepwise regression

The importance of market potential change in accounting for the growth of employment in the southern region was found to be clear. In all but one of the five southern estimated regression equations which were significant at the total level, market potential entered significantly and with the hypothesized positive sign on the beta coefficient. These results tend to support the above cited studies of Ray (1965) and McClutcheon (1971), who both delimited the importance of market potential in explaining the locational pattern of manufacturing activity in southern Ontario.

The behavior of the specialization variables, though, was found to be inconsistent with the hypothesized relationships to the dependent variaiable. In three of the four cases in which these variables were significant, the estimated beta coefficient displayed a sign opposite to the one expected. Also, in each of the last three periods, estimated beta coefficient signs indicate that growth in the southern region was directly related to an increase in average degree of specialization. On two occasions, the variable SIAV was also found to significantly enter the equations of these periods. These observed relationships between specialization and growth might possibly reflect the results of Ruslings above mentioned study of firms locating in Cambridge, Ontario (Rusling, 1974). That is, firms locating in southern Ontario centres were chosing locations already tending towards specialization in the area of the locating firm's

product.

A final point to be made is the overall insignificance of the community variables in the southern regression equations. As mentioned above, only one of these variables was found to have a situation where it entered an estimated southern equation significantly, that being the land index (LI) in the fifth time period. The hypothesized relationship of the community variables in most cases did not follow the expected pattern. The labour climate variable was found to have the unexpected positive coefficient in four of the six time intervals while the change in mill rate ratio (PMC) had only two of its cases follow the expected direct relationship with manufacturing employment growth. The exception to this inconsistency was the land index variable. In four of the five equations it entered, it showed the hypothesized positive relationship to growth.

The southern regressions, in summation, were found to be highly significant with the market potential change and industrial specialization variables accounting for most of the variation in manufacturing employment growth.

3. Northern Region

The overall nature of the northern regional regressions illustrated some striking differences from the other two regions, especially the southern region. In general, the total estimated regression equations of the north were significant in three of the six time periods (see Table 4.12)

and nine instances of individual independent variables contributing significantly to the respective equations were established (see Table 4.13).

The most noticeable characteristic of the northern regression equations is that market potential change accounted for only one of the above nine instances of significance. This can best be accounted for by the combined effect of the northern centres being first highly isolated from each other and secondly, as a region, highly isolated from the southern portion of the province. Since the nature of the potential calculations is such that most of a centre's total potential is derived from contact with centres within a short distance, the relative unimportance of this variable in the north is understandable.

Industrial structure variables significantly entered the northern estimated equations three times. Examining first the change in specialization variable (SIDIFF), the expected indirect relationship to employment growth was present three of the five times this variable entered the northern equations. In time period one, the variable was a significant part of the regression equation. The average degree of specialization (SIAV) exhibited an even stronger alliance with the hypothesized relationship to manufacturing employment growth. In all five instances in which this variable entered the northern equations, it had a negative coefficient. In addition, two of these cases were found to

Table 4.12

NORTHERN REGION

FINAL MULTIPLE REGRESSION STATISTICS

Time Period	R^2	Sum Squares Regression	Sum Squares Residual	df	F
1960-62	.999	5485.777	.476	4,5	14377.145 *
1962-64	.721	14012.316	5410.282	5,4	2.071
1964-66	.431	1027.841	1352.716	6,4	.506
1966-68	.917	4383.378	396.155	6,3	5.532 **
1968-70	.919	929.245	81.843	6,1	1.892
1970-72	.999	1546.533	1.334	2,5	2896.347 *

* significant at .05 level of confidence

** significant at .10 level of confidence

Table 4.13

Beta Coefficients, t Values, Order of Entrance of the Independent Variables: Northern Region

Time Period	MCZERO	SIDIFF	SIAV	II	PEC	CLIMATE
1960-62	x	-.068 14.376* (4)	-.661 130.149* (3)	1.740 232.045* (1)	1.127 174.436* (2)	x
1962-64	.562 .973 (1)	-.484 1.046 (5)	x	1.599 2.471** (2)	-1.298 1.810 (3)	-.702 1.637 (4)
1964-66	.224 .447 (4)	.229 .514 (3)	-.510 1.214 (1)	-.641 1.151 (2)	.119 .264 (6)	.281 .515 (5)
1966-68	1.468 2.941* (3)	-.123 .502 (6)	-.243 1.129 (5)	-.753 1.592 (1)	.956 3.122* (2)	-.590 1.580 (4)
1968-70	.619 .148 (6)	.848 2.026 (1)	-.330 .617 (4)	.242 .531 (5)	-.396 .604 (2)	.034 .031 (3)
1970-72	x	x	-.195 13.714* (2)	-.908 63.880* (1)	x	x

* t value significant at .05 confidence level
** .10 confidence level
x variable did not enter stepwise regression

be significant in their respective total equations.

From an overall view, the community variables did not exhibit as much consistency with the expected results as the structural and potential variables. However, they were found to significantly enter the northern estimated equations a total of five times. The most consistent variable with respect to expected relationship with manufacturing employment growth was the change in tax mill rate ratio (PMC). Three of the five times in which this variable entered the northern equations, a direct relationship with employment growth was indicated. Also, in two of these three instances, the variable was found to be a significant part of the total regression equation.

The remaining three significant occurrences of the community variables were in the land index variable (LI). Two of these showed the expected direct association with manufacturing employment growth. However, in the final time period, the amount of available industrial land was indirectly related to employment growth. This can possibly be accounted for by the fact that growth in this last period was most prevalent in the region's larger centres despite the fact that these centres had relatively lower supplies of industrial land. Growth may have been greater in these cities because of the growing acceptance of such centres as Sudbury, Sault Ste. Marie and Thunder Bay as viable industrial locations.

4. General Summation of Regional Differences

From this general descriptive presentation, some differences between the regional regression equations are evident, especially between the northern and southern regions. These two differ dramatically with respect to the importance of both market potential change and community attitude variables. In addition, the specialization variables between the two regions illustrated opposite relationships with the growth rate of manufacturing employment. The eastern region illustrated qualities somewhat similar to both the north and the south. With respect to the south, the eastern region regression equations revealed the lesser importance of market potential changes to the east. With respect to the north, the eastern region showed similarity in that it was found to have a number of community variables enter significantly into its estimated regression equations. However, the basic difference between the east and north was the fact that the eastern equations generally had lower levels of explanatory power.

(v) Statistical Tests for Regional Variation in Regression Equation Structure

The previous section has illustrated through descriptive techniques some basic differences between the estimated regression equations of the three regions. The question still remains though - do the equations generated in one region significantly differ from the equations produced in

a separate region? This question can first be approached from the perspective of total regression equation stucture.

The test used to analyze the difference in structure of two regression equations is one developed by Chow (1960). This test, which for convenience will be referred to as Chow's test, was originally developed in the field of economics to test the stability of time series relationships and the stability of relationships between different economic units. Chow states that these questions can be answered statistically by "testing whether two sets of observations can be regarded as belonging to the same regression model" (Chow, 1960, p. 591).

The Chow test is based on the calculation of an F statistic ratio of the nature

$$(A - B - C)/p \quad \text{to} \quad (B + C)/(n + m - 2p)$$

where A is the sum of square of n + m residuals from the regression estimated by n + m observations

B is the sum of squares of n residuals from the regression estimated from the first n observations

C is the sum of squares of m residuals from the regression estimated from the second m observations

p is the number of independent variables in the regression equation.

The resulting F ratio after these calculations have been made has p, $n + m - 2p$ degrees of freedom.

Chow's test is used in this thesis to test whether regressions estimated from any two independent sets of observations (regions) belong to the same general regression

model. Since the test requires that the two regressions being compared be generated from the same set of independent variables, the eighteen regional equations were again computed but this time with no stepwise option. This allowed each variable to be included in the regression equation. Also, to determine the value 'A' in the ratio formula, it was necessary to run additional regressions combining the observations of each of the three possible regional pairings in each time period. For example, to test for a difference between the estimated regressions of the northern and eastern regions in the first time period, the observations of each of these regions were combined and used as input in a separate regression run. A final aspect of the test that should be mentioned is that the F ratios are tested under the null hypothesis that there is no significant difference between the regression equations being tested.

The Chow test was used, then, to test for existence of different regression models in the northern and southern regions, the northern and eastern regions and the eastern and southern regions in all six time periods. The results from these tests are presented in Table 4.14

Examining first the northern and eastern combination, it was found that in only two of the six time periods could the regional regressions be said to belong to different underlying regression models. The other two regional pairings,

Table 4.14

CHOW'S TEST FOR SIGNIFICANT DIFFERENCE

BETWEEN REGIONAL REGRESSION EQUATIONS

Time Period	North vs South		North vs East		South vs East	
	df	F	df	F	df	F
1960-62	6,9	.45	6,9	.93	6,8	2.23
1962-64	6,9	3.27**	6,9	.94	6,8	2.04
1964-66	6,9	2.29	6,9	1.71	6,8	3.43**
1966-68	6,9	8.19*	6,9	4.89*	6,8	10.31*
1968-70	6,8	10.28*	6,8	5.73*	6,8	5.73*
1970-72	6,8	.277	6,8	1.04	6,8	1.81

* F value significant at .05 level

** F value significant at .10 level

south vs. east and north vs. south were found to be significantly different in three of the six time periods. A closer examination of the exact time periods in which the regional pairings show independence points out an interesting relationship. In the initial time period, none of the regional equations illustrated any signs of independence as no F ratios for this interval were found to be significant. Then, in the second period, the regression equations of the northern and southern regions were found to differ significantly while the relationship between the other two remained constant. In the third period, the south vs. east comparison revealed a significantly different structure in these two regions' equations while the east and the north pairing still remained similar and the north and south comparison returned to a position of no difference. The next two time periods covering the years 1966 through 1970 illustrated some dramatic changes in the total regional equation structure comparisons. During these intervals, all possible regional pairings were found to be independent, indicating a different underlying regression model structure in each region of the province. Just as this change to total independence was dramatic, so was the turn of events in the final period, when all three F ratios indicated once again that there was no significant difference between any of the regional equations.

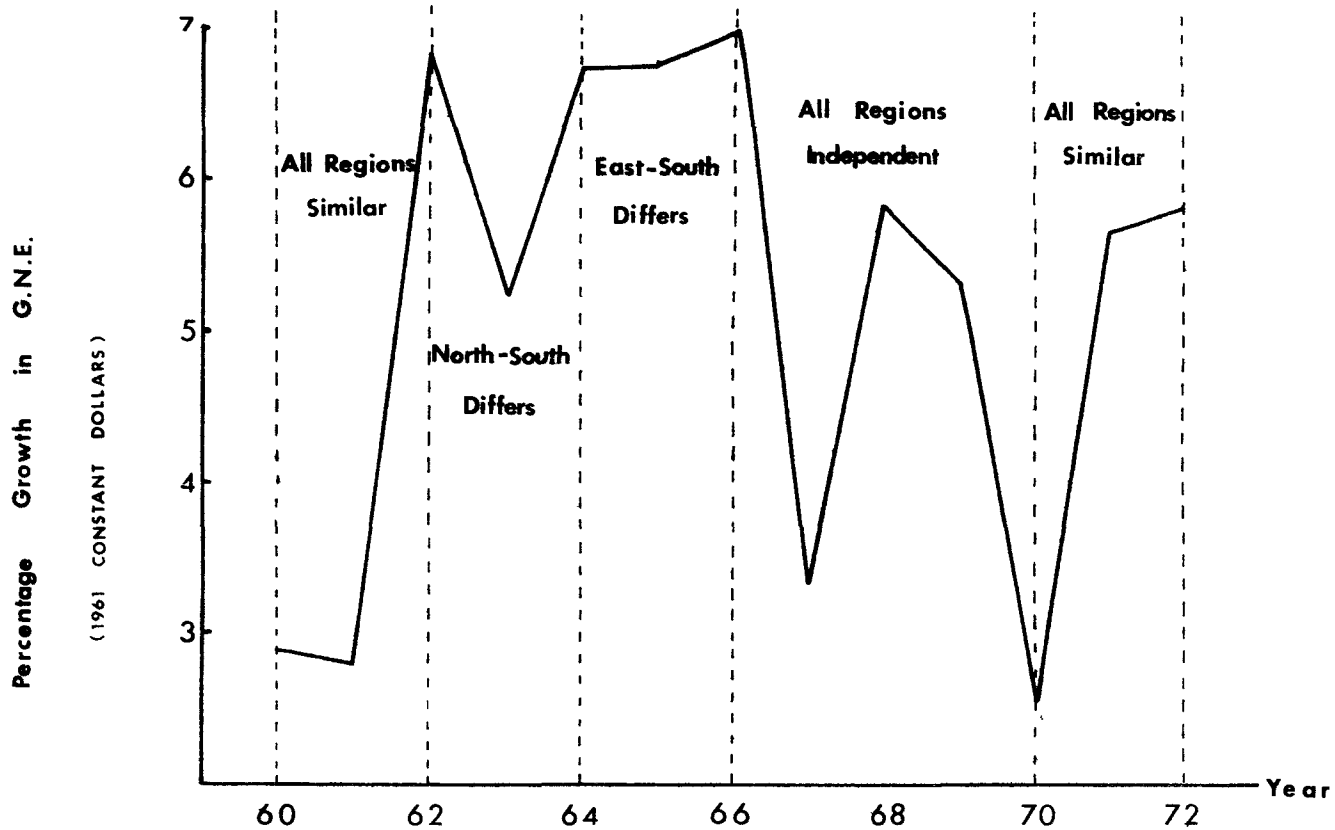
The fact that all three regional comparisons exhi-

bited similar characteristics during this four year period initiated questions as to what might have produced such a large change from the previous years findings. To gain some insight into these findings, it was thought that the national economic picture might provide some type of explanation for the observed behavior. The changes in the Gross National Expenditure in Canada for the years 1960 to 1972 were then plotted and examined for possible hypotheses.

This technique proved rather useful in delimiting a possible explanation for the great degree of regional variation in the fourth and fifth time periods. The following observations can be made from Figure 4.5, the plot of GNE. In the initial period, the national economy was growing quite substantially. The first year, however, showed a small decrease in the growth of GNE but the second year of the period saw the GNE increase by 6.8 percent. During this period of expansion in the national economy, all three regions had similar regression equation structures. In the second time period, the GNE growth rate first declined and then recovered to its level at the start of the period. In this period, the north - south comparison of equations showed a significant difference. In the third time period, the GNE increased gradually and the north-south comparison returned to a no difference state. However, the east - south comparison now was found to show significant difference. These first three observations could possibly indicate that

Figure 4.1

RELATIONSHIP BETWEEN G.N.E. GROWTH AND VARIATION IN REGIONAL REGRESSION EQUATIONS



when the national economy declined slightly, the northern and southern regions begin to separate. The effect on the east from this decline could possibly not be felt until the next period, thus illustrating a type of lag effect.

Although these first three periods generate some possible hypotheses, the events of the next two periods suggest a more definite relationship between the national economy and regional variation in the regression equations. Beginning in 1966, the GNE growth rate fell sharply, recovered slightly and then declined again in the next two years. Its position in 1970 was the lowest of the twelve years plotted. During, this period of recession in the national economy, the regression equations of the three regions showed total independence amongst each other based on the Chow test. Consider once again the nature of the economies of the three regions. The southern region is a highly developed one. The eastern region is often described as developed but somewhat depressed. The northern region is largely undeveloped and can be viewed as a resource oriented region, highly vulnerable to the fluctuations of the national economy. During a period of recession then, it is possible that the northern and eastern regions would be more adversely affected than the south. This in turn might account for the structural variation of the regional estimated equations during the 1966 - 1970 period.

The final time period appears to reinforce the hypthesis that during a slowing of the growth in the national

economy, regional variation in the underlying regression models occurs. Beginning in 1970, the percentage change in the GNE again began to rise. Along with this rise, all three regional equations again were found to return to a state in which no significant difference existed between any of the possible regional pairings.

The question of regional differentiation in regression equation structure can be approached secondly, from an analysis of the individual independent variables. That is, do the independent variables of the estimated regional equations behave differently between regions?

An initial test for variation in the importance of the independent variables to each region was based on the the order in which the independent variables entered the stepwise regression equations. The nature of the regression computer program used is such that the variables are entered into the equation calculations in order according to which ones can account for the most variation in the dependent variable while controlling for the effect of the variables already in the equation. Therefore, if the importance of the variables does vary over space, the order in which they enter each regional equation should differ.

To test for this similarity in the order of entrance, Spearman's rank correlation analysis was applied in the following manner. Theoretically, if the variables entered two different equations in the same order, then a pairing of

of their rankings on the same variable entered into a rank correlation analysis should produce an 'r' value of one. The greater the difference in the order of entrance between the two equations, the smaller the correlation coefficient will be. Thus, if the correlation between two sets of equation rankings is found to be significant, it can be said that the variables of these two equations behave similarily in terms of their relative importance.

Rank correlation tests were then computed for each of the three possible regional comparisons in each of the six time periods. The results of these tests (see Table 4.15) quite conclusively indicated that strong regional variation in the importance of the independent variables does exist. Of all the rank pairings analyzed, only one proved to be significant. This was the comparison of the northern and southern regions in the fifth time period. However, the sign of the coefficient in this case was negative indicating that these two regions had a significant reversal in the order in which the variables entered each equation.

Further examination of the signs of the coefficients of correlation indicates that there may be some similarities between certain regions. In the north - south comparison, four out of five cases for which calculations could be made, had negative coefficients indicating that the difference between these two regions with respect to the importance of the independent variables is quite pronounced. The south to

Table 4.15

Regional Comparison of the

Order of Entrance of the Independent Variables

Using Rank Correlation

Time Period	North - South	North - East	South - East
1960-62	-.429	-.428	-.085
1962-64	.086	.685	.428
1964-66	-.342	.372	.257
1966-68	-.714	.143	-.371
1968-70	-.885*	.029	-.371
1970-72	x	x	-.085

* correlation significant at .05 level of confidence

x insufficient number of variables entered stepwise equation to allow feasible comparisons

east comparison also indicates a trend towards dissimilarity as four out of the six cases had negative 'r' values. However, the north to east comparison illustrated a greater trend towards regional similarity as only one of the five coefficients in this comparison was negative. These results seem consistent with the earlier description of the regional equations in that the two regions found to be the most dissimilar with respect to variables significantly entering the regional equations were the north and the south. This accounts for the presence of the negative signs in this comparison. Secondly, the difference between the southern and eastern regions was basically determined to be the relatively lesser importance of market potential in the east and the minor importance of community variables to the east as opposed to these variables absence from the southern equations. Finally, the north to east comparison is consistent with earlier results in that these areas were shown to be similar with respect to the minor importance of market potential in each region and their common association with the community variables. This could possibly explain the positive 'r' values obtained in the north to east calculations.

Although rank correlation analysis serves to illustrate general patterns of regional similarity and dissimilarity, it does not facilitate the delimitation of the exact relationship between individual independent variables between

the regions. A variable could conceivably have the same ranking in two different equations but account for a significantly different amount of variation in the dependent variable in the two cases. Further regional comparisons of the individual independent variables were carried out by means of analysis of the partial correlation coefficients between the dependent variable and each of the independent variables. To provide for the comparison of identical situations, the estimated regional regression equations used in the analysis were the ones in which all the independent variables were allowed to enter the equation, the non stepwise option. Thus, the partial correlation coefficients represent the amount of variation in the dependent variable accounted for by each independent variable while controlling for the effect of the other independent variables.

To compare the partials of two equations, a confidence interval can be established around one of the partials. The second partial is then examined to see if it falls within the boundaries of this interval. If it does, the partials are said to be not significantly different from each other. This method was used to test for variations in the importance of the independent variables between each of the three regional pairings; north vs. east, north vs. south, and south vs. east. Table 4.16 presents the results of this analysis for five of the six independent variables in each of the six

time periods. Note that the table is five pages in length, one page for each variable. The calculations for variation in the labour climate variable (CLIMATE) are ommitted since only one case, the eastern vs. southern comparison in the first time period, showed a significant difference in partials. To allow for comparison of each regional pairing, 90 percent confidence intervals were first established about the southern partial with the eastern and northern partials being tested for their position with respect to this interval. These tests appear at the top of each of the table pages. Then, confidence intervals were placed about the eastern partial with only the northern partial being compared for significance. This test appears at the bottom of each table page.

Results of this analysis were hindered somewhat by the very broad nature of the confidence intervals generated. This was the result of the small number of observations in each region. However, although the results are not as conclusive as the previous rank correlation analysis, they do illustrate that there is some significant difference between the importance of the various independent variables in the three regions.

By far the greatest regional variation is found between the northern and southern regions. In the comparison of the individual variables between these two regions, a total of seventeen cases were found in which there existed

Table 4.16

ANALYSIS OF REGIONAL VARIATION IN THE INDEPENDENT VARIABLES USING PARTIAL CORRELATION CONFIDENCE INTERVALS[1]

VARIABLE: Market Potential Change (MCZERO)

	South Region Partial	Confidence Interval Low 'r'	High 'r'	South vs. North	East
T1	.917	.383	.992	.337*	.463
T2	-.256	-.891	.719	.658	-.082
T3	.817	-.019	.981	.234	-.171
T4	-.618	-.955	.418	.594*	.933*
T5	.909	.341	.995	-.421*	.434
T6	.965	.689	.996	-.990*	.778

	East Region Partial	Confidence Interval Low 'r'	High 'r'	North Region Partial
T1	.463	-.582	.931	.337
T2	-.082	-.848	.795	.685
T3	-.171	-.871	.759	.234
T4	.933	.930	.999	.594*
T5	.434	-.606	.926	-.421
T6	.778	-.076	.976	-.990*

* denotes significant difference as partial falls outside boundary of interval

___ variable in this time period entered stepwise regression significantly

1 intervals at 90% confidence level

Table 4.16 (cont'd)

VARIABLE: Change in Specialization Index (SIDIFF)

	South Region Partial	Confidence Interval Low 'r'	High 'r'	South vs. North	East
T1	<u>-.776</u>	-.976	.131	<u>-.194</u>	-.131
T2	.721	-.252	.969	.796	.240
T3	-.579	-.949	.466	.249	-.409
T4	<u>.880</u>	.206	.988	.696	<u>-.879</u>*
T5	.141	-.772	.864	.907*	-.227
T6	.089	-.792	.850	-.994*	.674

	East Region Partial	Confidence Interval Low 'r'	High 'r'	North Region Partial
T1	-.131	-.861	.776	<u>-.194</u>
T2	.240	-.727	.888	.796
T3	-.409	-.922	.624	.249
T4	<u>-.879</u>	-.987	-.202	.696*
T5	-.227	-.733	.885	.907*
T6	.674	-.335	.963	-.994*

* denotes significant difference as partial falls outside boundary of interval

<u>____</u> variable in this time period entered stepwise regression significantly

Table 4.16 (cont'd)

VARIABLE: Average Specialization (SIAV)

	South Region Partial	Confidence Interval Low 'r'	High 'r'	South vs. North	East
T1	.396	-.634	.920	-.640*	.280
T2	-.692	-.965	.305	.767*	-.083
T3	-.383	-.917	.643	-.519	.153
T4	.852	.096	.984	.302	.172
T5	.645	-.380	.959	-.932*	.867
T6	.880	.206	.988	-.994*	.782

	East Region Partial	Confidence Interval Low 'r'	High 'r'	North Region Partial
T1	.280	-.706	.896	-.640
T2	-.083	-.848	.794	.767
T3	.153	-.767	.867	-.519
T4	.172	-.759	.872	.302
T5	.867	.149	.986	-.932*
T6	.782	-.116	.976	-.994*

* denotes significant difference as partial falls outside boundary of interval

____ variable in this time period entered stepwise regression significantly

Table 4.16(cont'd)

VARIABLE: Land Index (LI)

	South Region Partial	Confidence Interval Low 'r'	High 'r'	South vs. North	South vs. East
T1	-.737	-.971	.219	.934*	.392*
T2	.654	-.332	.960	.317	.520
T3	.762	-.164	.974	-.499*	-.285*
T4	-.055	-.840	.805	-.563	-.851*
T5	.897	.282	.990	.903	-.001*
T6	.262	-.716	.893	-.999*	-.420

	East Region Partial	Confidence Interval Low 'r'	High 'r'	North Region Partial
T1	.392	-.637	.919	.934*
T2	.520	-.530	.941	.317
T3	-.285	-.897	.703	-.499
T4	-.851	-.984	-.093	-.563
T5	-.001	-.822	.823	.903*
T6	-.420	-.822	.616	-.999*

* denotes significant difference as partial falls outside boundary of interval

___ variable in this time period entered step-wise regression significanly

Table 4.16(cont'd)

VARIABLE: Change in Tax Mill Rate Ratio (PMC)

	South Region Partial	Confidence Interval Low 'r'	High 'r'	South Vs. North	East
T1	-.288	-.701	.897	.911*	.395
T2	-.673	-.963	.337	-.802	.039
T3	.708	-.276	.967	.138	.130
T4	-.138	-.863	.801	.849*	-.914*
T5	.065	-.801	.843	.881*	.840
T6	-.200	-.814	.746	.997*	-.668

	East Region Partial	Confidence Interval Low 'r'	High 'r'	North Region Partial
T1	.395	-.635	.919	.911
T2	.039	-.810	.835	-.802
T3	.130	-.776	.861	.138
T4	-.914	-.992	-.367	.849*
T5	.840	.054	.983	.881
T6	-.668	-.962	.346	.997*

* denotes significant difference as partial falls outside boundary of interval

___ variable in this time period entered stepwise regression significantly

a significant difference between variables of the two equations. The areas of difference between the two regions are also found to be very consistent with the initial descriptive comparison presented earlier in this chapter.

Examining first the market potential variable, four of the six periods illustrate a significant difference between the respective equations in the importance of this variable. Three of these four cases can be attributed to the highly important role market potential change plays in the southern region as compared to the relatively unimportant role this variable plays in the northern region in the same time interval. In fact, two instances where a significant difference occurs between the regions are the result of the northern region illustrating a strong inverse relationship between change in market potential and growth of manufacturing employment.

The fourth instance of difference between the southern and northern equations illustrates some peculiar properties. In time period four, market potential change appears to reverse roles. In the south, its estimated beta coefficient, although insignificant, does have a negative sign while in the north, change in potential was positively correlated with manufacturing employment growth at a level high enough for the variable to significantly enter that estimated regional equation. It was during this period that

the second mileage matrix, which incorporated several major changes in the connectivity of the Ontario highway network, came into effect in calculations of market potential values. It is possible, then, to account for the significant positive relationship between market potential change and manufacturing employment growth in the northern region at this point in time because of the sudden increase in the potential of some of the northern centres. However, the significance of this occurrence is questionable when one considers the events of the next two periods. Here the market potential change had an indirect relationship with the growth rate of manufacturing employment. This point reinforces the position that market potential change is not an important variable in any of the northern equations, and that the surprising occurrence in the 1966-68 time period cannot be logically accepted on the basis of the following years events.

Another variable portraying a high degree of variation between the north and south is the average degree of specialization (SIAV). Four of the six time intervals were significantly different because in each case, exactly the opposite relationship between the dependent variable and specialization existed in the two regions. The reversals in relationship direction were also fairly consistent. Except for time period two, each of the northern cases had an indirect relationship with manufacturing employment growth while each of the southern cases in question had a direct

relationship between specialization and growth.

The reversal of the correlations between specialization and employment growth in the northern and southern equations should not be interpreted as a rejection of the hypothesis presented in the methodological portion of this thesis. This hypothesis was based on the logic that the cities with the highest degree of specialization in their manufacturing base would be more vulnerable to changes in general economic conditions and thus less likely to experience sustained growth. In the northern region where the majority of centres are characterized by a highly specialized industrial structure, the results tend to support the hypothesis. In both time period one and six, the regression equations indicated that the variable measuring this relationship (SIAV) was a significant part of the estimated equations with a negative coefficient. The fact that southern centres illustrate the opposite relationship does not logically fit into the specialization hypothesis. Southern centres can be said to be highly specialized only with respect to other southern centres, because when they are compared to northern centres, they can be said to have low degrees of specialization. Therefore, the positive relationship between manufacturing employment growth and specialization degree in the south would more likely be caused by some other phenomena. A possible explanation for this relationship in the south was presented in the general de-

scription of the southern equations earlier in this chapter. Briefly, it was noted that in a study of a southern Ontario community, firms stated that their decision to locate in the centre was based on the already large supply of labour with skills compatible to the requirements of the firm. Thus, southern communities which show a slight tendency towards specialization in one manufacturing sector might continue to attract new industry and growth in the same sector because of the centre's labour pool characteristics.

The mill rate ratio variable comparison between the north and the south also showed four cases to be significantly different. These differences once again were attributable to the reversal of the direction of correlations between this variable (PMC) and the growth rate of manufacturing employment. In all four instances, the southern region had an indirect relationship with growth. Meanwhile, the northern region had a direct relationship between change in the mill rate ratio and employment growth in each case, with two of the cases entering northern equations significantly. On the other hand, none of the six southern estimated equations had this variable (PMC) as a significant part.

The importance of this community variable in the northern regression equations might possibly be attributed to the absence of the influence of market potential change in this region. Since most centres of the north are highly

isolated from the southern region of the province, the variation in the market potential values amongst the northern centres is not that large. Therefore, growth in the north could be more responsive to the variables associated with community attitudes such as the tax mill rate ratio.

Contrary to the comparison of the northern and southern regions, the remaining two regional pairings failed to produce any definite pattern of regional variation in the independent variables. In total, the independent variables of the northern and eastern equations differed significantly in their explanatory capacity twelve times. On two occasions, variation was located in market potential change. In the fourth time period, the eastern partial was significantly higher than the northern partial on this variable. This was the same time period in which the north illustrated a positive relationship between employment growth and change in market potential, a finding discussed above and dismissed as being insignificant due to the nature of the change in mileage matrices. The second case was in the final period in which the northern region illustrated a strong indirect relationship between market potential change and employment growth. Overall, these differences are not that outstanding since the market potential variable was found to be very ineffective in both regions in accounting for growth in manufacturing employment.

The average degree of specialization (SIAV) in the

north to east comparison was found significantly different in the last two time periods. Once again, the inverse relationship of the correlation coefficient signs was present. This situation is similar to that of the north - south case also in that where the regions did vary, the variables were found to be a significant part of the respective equations in three of the four observations in question. The same explanation presented in the above case could, then, also apply to the findings in this pairing.

With respect to community variables, difference between the northern and eastern regression equations can also be best accounted for by the same explanation offered in the north - south case. That is, the general low level of explanation accounted for by the community variables in the eastern regional equations when compared to the relatively high importance of these same variables in the northern regional regression equations results in the generation of significantly different cases between the two regions. From an overall perspective, the small amount of explanation achieved in the majority of the eastern equations makes comparisons between this region and others rather meaningless.

Similarily then, the east to south regional analysis of the independent variables produced few significant results. This regional pairing had the lowest number of significantly different pairs of observations of the three groups examined, with only nine cases of statistically im-

portant variation. A discussion of these cases would be rather fruitless for one particular reason. Six of the observed differences occured in the community variables, the same variables which were earlier described as playing a minor role in the eastern region and an even lesser important part in the southern region.

A final point to be made in the discussion of the regional variation in the importance of individual independent variables is the relationship between the results of this analysis and the previous analysis of variation between the total regional regression equations. It was shown in the latter that in the fourth and fifth time periods, the regional equations were all statistically independent of each other, thereby indicating the presence of different underlying models in each region. It was hypothesized that this strong difference in regional models was directly related to a downturn in the total Canadian economy as measured by changes in the Gross National Expenditure. The analysis of the individual variables provides further evidence of strong regional variation in the 1966-68 and 1968-70 time periods. Of all the partial correlation coefficient comparisons made, a total of thirty-eight were found to be significantly different. Of these thirty-eight cases, seventeen were in the fourth and fifth time periods. Thus, almost fifty percent of cases exhibiting regional variation in individual variables fell into the same time period in which

the overall regional equations differed the greatest.

In summation, the most significant results derived from this analysis were the strong regional variation between the northern and southern regions with respect to market potential changes, average degree of specialization and the percentage change in the tax mill rate ratio. Also, a variation between the northern and eastern regions with respect to average degree of specialization was noted, as well as a minor difference with respect to market potential change. Variation between the east and south was dismissed as unimportant.

(vi) Statistical Analysis of Intra-regional Variation in Regression Equation Structure

The previous section illustrated the existence of some inter-regional variation in the structure of the regression equations. In this section, the same analytical techniques are used to consider the final question posed by the thesis objectives. That is, does the structure of the equations estimated within each respective region remain consistent through time? Once again, this question can be approached from the total equation and the individual parts of the equations. Analysis of the overall equations was based on another application of the Chow test. This test involved the comparing of consecutive period equations to determine if their structure could be said to belong to the same general model. Analysis of the equation parts followed

similar lines as the comparison between regions of the independent variables. Using the same 90 percent confidence intervals established for the above analysis, the partial correlation coefficients between the independent variables and manufacturing employment growth were compared with the previous period's confidence interval to see if a significant difference occurred. Generally speaking, the findings presented in this section have already appeared in the text in some form. Therefore, this section my seem repetitious but it serves the purpose of tying up loose ends. Since no inter-regional comparisons are presented in this section, the discussion of each region's estimated regression equations is presented in a separate section.

1. Eastern Region

From an overall view, the regression equations of the eastern region were found to have the least amount of internal variation of the three regions. Results of the total equation analysis (see Table 4.17) indicated that a significant change in the eastern equations in consecutive years occurred only once. This was between the equations of the fifth and sixth time periods. This could possibly be accounted for by the fifth period equation being significant at the total level while the sixth period equation was not. However, the same move from total significance to insignificance was also present between the third and fourth time periods but no structural difference between these equa-

Table 4.17

Chow's Test for Intra-regional

Stability of the Regression Equations

Region	T1 - T2	T2 - T3	T3 - T4	T4 - T5	T5 - T6
East	.577	1.082	2.322	.494	5.058*
South	6.802*	4.153*	8.117*	5.031*	5.765*
North	.505	3.223**	3.166**	3.443*	7.862*

* F value denotes significant difference between consecutive periods at .05 confidence level

** F value denotes significant difference between consecutive periods at .10 confidence level

tions was delimited. This tends to indicate that even during the time periods in which the regional equations illustrated significance, there was still no difference between these and the equations which failed to account for any substantial portion of the variation in manufacturing employment growth.

The absence of total structure change in the eastern equations is accompanied by few variations in the independent variables. Of the thirty total comparisons of partial correlations made (five for each of the six time intervals), only five cases of significant change between consecutive periods were found. Table 4.18 illustrates these changes by presenting the partials for each time period. An asterisk between partials of any two time periods indicates that a significant difference exists between these two partials. The most striking observation made from the eastern partials is the perfect stability of the land index (LI), labour climate (CLIMATE), and the two specialization variables (SIAV, SIDIFF). The explanatory power of these variables was consistent throughout each of the six time periods examined. An example of inconsistency in the eastern equations was the behavior of the change in tax mill rate ratio variable (PMC). This variable entered both the fourth and fifth time period equations significantly but with opposite relationships to the dependent variable, thus accounting for the confidence tests showing significant changes between these periods.

Table 4.18

Partial Correlation Confidence Interval Analysis of the Independent Variables: Eastern Region

Variable	T1	T2	T3	T4	T5	T6
MCZERO	.463	-.082	-.171	.933 *	.434	.778
SIDIFF	-.131	.240	-.409	-.879	-.227	.674
SIAV	.280	-.083	.153	.172	.867	.782
LI	.392	.520	-.285	-.851 *	-.001	-.420
CLIMATE	.402	.185	.575	-.735	-.041	.385
PFC	.395	.039	.130 *	-.914 *	.840 *	-.668

* denotes significant difference between partials of consecutive time periods

___ variable significantly entered stepwise regression equations

A final observation from the eastern equations is the consecutive years of significant contribution to the overall equation of the average degree of specialization (SIAV). The fact that this variable did play a significant part in these two regression equations accompanied by its consistent behavior throughout all six eastern equations establishes it as one of the better explanatory variables in the east.

In total though, the eastern estimated regression equations' overall stability is possibly the result of this region's slower economic pace. The depressed region is least likely to illustrate significant changes in its structure.

2. Southern Region

Results of the Chow test for stability of the southern region regression equations (see Table 4.17) illustrate a tremendous amount of flexibility between all time periods. This is even more significant when one considers the fact that five of the six southern equations were earlier shown to have statistically good fits of the overall regression. This great amount of flexibility is also illustrated by the individual independent variables. A total of seventeen significant differences between consecutive time periods were observed in the independent variables (see Table 4.19).

The majority of the significant cases illustrated in Table 4.19 can be attributed to the large number of reversals in coefficient signs. For example, the market po-

Table 4.19

Partial Correlation Confidence Interval Analysis of the Independent Variables: Southern Region

Variable	T1		T2		T3		T4		T5		T6
MCZERO	.917	*	-.256	*	.817	*	-.618	*	.909		.965
SIDIFF	-.776	*	.721	*	-.579	*	.880	*	.141		.089
SIAV	.396	*	-.692		-.383	*	.852		.645		.880
LI	-.737	*	.654		.762		-.055	*	.897	*	.262
PMC	-.288		-.672	*	.708		-.138		.065		-.200
CLIMATE	-.769		-.349		.493		.153		.432		.641

* denotes significant difference between partials of consecutive time periods

___ variable significantly entered stepwise regression equation

tential change variable (MCZERO) exhibits a significant change between each of the first five periods. This is caused by periods two and four having opposite relationships to employment growth as the same variable in the other four periods. A closer examination of the confidence intervals though, indicates that if only those market potential cases which contributed significantly to the total regressions are considered, there is no significant change in the amount of explanation they supply.

The great amount of flexibility in the south can better be explained by examining the columns of Table 4.19 with particular attention paid to the underlined figures (those variables which significantly entered the stepwise regression equations). It can be seen that in each of the five equations, excepting time period two, the same combination of significant variables did not exist twice. Overall, the market potential variable was the most dominant but the remainder of the variation was explained by different variables in each time period, thus accounting for the observed changes in total structure in Table 4.17 (Chow test).

A possible explanation of the large changes which occur in the southern equations through time also relates to the general economic nature of the region. The fact that market potential change plays such an important role in the southern region is an indication of the area's high level of urbanization. It could be that growth is a natural phenomena

in such a heavily populated area and that other factors such as community variables indicating attitudes towards growth have little effect on growth. However, when the market potential changes do not account for a significant portion of the growth rate, the region, because it is highly developed, adapts to other factors. When market potential does account for significant amounts of explanation, though, it takes such a dominat position that the other variables entering play only a minor role. The resultant of these variables continually playing this minor role is the failure of these variables to develop any consistent importance in the southern region.

3. Northern Region

The Chow test for total regression equation structure stability in the northern region revealed that four of the five consecutive time periods compared had significant differences (see Table 4.17). These results, though, cannot be interpreted the same way that they were in the southern region. The reason for this is that in the north, no two consecutive time periods were found to have significant total regression equations. Therefore, the resultant F ratios may simply be indicating the effect of interchanging occurrence of significant and insignificant regional regression equations. These fluctuations are possibily another indication of the instability of the resource oriented, highly specialized northern economy.

Time horizon comparisons of the independent variables in the northern region regression equations are presented in Table 4.20 The number of significant differences between consecutive time period partial correlation coefficients observed is fourteen, three less than in the southern region. However, like in the southern region, most of these significant differences in the partials were the result of reversals in the direction of the relationship between the independent and dependent variable. Some interesting observations, though, can be made from these comparisons.

The small degree of importance attributed to changes in market potential in the northern region is once again evident. The only case in which a significant difference existed between consecutive time periods was the result of an even stronger indirect relationship between changes in potential and employment growth, not a reversal in signs. This was between the fifth and sixth time periods. Another notable point is the lack of significant differences between the third and fourth and fourth and fifth time periods. It was in the fourth time period that this variable (MCZERO) significantly entered the stepwise regression. However, this period shows no significant difference from its surrounding periods which did not have the market potential variable significantly enter their equations. This appears to support the earlier suggestion that the effect of the change in the mileage matrices used to calculate potential values was responsible for the

Table 4.20

Partial Correlation Confidence Interval Analysis of the Independent Variables: Northern Region

Variable	T1		T2		T3		T4		T5		T6
NCZERO	.337		.685		.234		.594		-.421	*	-.990
SIDIFF	-.194		.796		.249		.696		.907	*	-.994
SIAV	-.640	*	.767	*	-.519	*	.302	*	-.932	*	-.994
LI	.934	*	.317		-.499		-.563	*	.903	*	-.999
PMC	.911	*	-.802	*	.138		.849		.881	*	.997

* denotes significant difference between partials of consecutive time periods

___ variable significantly entered stepwise regression equation

significance of market potential change in this period.

The most flexible variable in the northern region was observed to be the average degree of specialization (SIAV). Four of the five changes in this variable were the result of a reversal in the sign of the partial correlation coefficients between consecutive periods. Despite the fact that the fifth and sixth periods did not illustrate a change in signs of the partials, a significant change was still observed. The strong negative relationship between degree of specialization and employment growth rate was, therefore, strongly reinforced between the last two periods.

This characteristic of significantly different partials with the same directional relationship with employment growth rates is also seen in three other cases. These are the land available index (LI) between the first and second period, the change in tax mill rate ratio (PMC) between the fifth and sixth periods as well as the market potential change variable (MCZERO) between the fifth and sixth periods.

One variable which does show some consistent properties in the northern equations is the change in the tax mill rate ratio. If the relationship between this variable and employment growth in the second time period is excluded, a consistent positive coefficient sign is noted. As mentioned above, this positive relationship becomes significantly stronger in the final period.

Finally, with respect to variables which significantly

entered the stepwise regression equations, the greatest inconsistency is illustrated by the industrial land available index (LI). In the first and second time periods, a positive relationship between this variable and growth of manufacturing employment existed. However, a significant difference between the two periods was still present. On the other hand, a strong negative relationship with growth characterized the variable in the final period. Therefore, on all three occasions when the variable significantly entered the regression equations, a significant difference existed between the relative importance of each to its respective equation.

The results, then, of the intra-regional analysis of the regression equations can be summarized as follows. The eastern region was found to have the greatest amount of consistency within its equations and independent variables. The southern and northern regions, though were characterized by a large amount of significant changes in their regression equations. In the former, the changes were observed to be the result of the dominance of the market potential variable combined with the importance of different combinations of significant variables in different periods. Thus, no two periods illustrated the same structure. In the latter, fluctuation was also caused by changing importance of variables but cases were observed where a variable's relationship to employment growth was consistent but the degree of the relationship changed significantly.

References

Chow, Gregory C. (1960). "Tests of Equality Between Sets of Coefficients in Linear Regressions." Econometrica. Vol. 28, No. 3, 591 - 605.

Collins, L. (1972). Industrial Migration in Ontario. Ottawa: Statistics Canada.

McClutcheon, R.P. (1971). "Market Potential as a Factor in Changes in Manufacturing in Ontario, 1951-1961." Unpublished M.A. Thesis. University of Western Ontario, London, Ontario.

Ray, D. Michael (1965). Market Potential and Economic Shadow: A Quantatative Analysis of Industrial Location In Southern Ontario. Chicago: University of Chicago, Dept. of Geography Research Paper No. 101.

Rusling, John R. (1974). "Factors Influencing the Location of Manufacturing Activity in Cambridge, Ontario." in Walker and Bater (eds.) Industrial Location in Southern Ontario. Waterloo: University of Waterloo, Dept. of Geography Publication No. 3, 145 - 166.

Spelt, Jacob and Donald Kerr (1960). "Some Aspects of Industrial Location in Southern Ontario." Canadian Geographer. Vol. 4, No. 15, 12 - 25.

CHAPTER V

SUMMARY AND CONCLUSIONS

(i) Summary of Results

The analysis of the growth rate of manufacturing employment in the three regions of Ontario, as delimited by this thesis, was initiated by an examination of the growth rates themselves. Statistical tests performed on the growth rates (analysis of variance and difference of means) of the cities representing the three regions failed to show any definite regionalization based on this phenomena. However, a general classification of the regions was made based on a visual examination of the distribution of the growth rates within each region. It was found that the northern cities had a greater degree of variablility in their growth rates with very little noticeable internal similarity. The southern and eastern regions, on the other hand, illustrated a tendency towards greater internal similarity and stability. This was suggested to be a possible result of the greater degree of inter-city linkages in these areas of the province as compared to the northern region.

Although no statistical regionalization was established with respect to employment growth rates, an examination of the structural diversity or specialization of the

cities within the three regions using the same statistical techniques produced a more definite picture of regional differentiation. An additional analysis for possible trends in the level of specialization in the three regions also indicated that the existing ranking of the south as the most diversified and the north as the least diversified in the initial time period remained constant over the entire study period.

The delimitation of regionalization based on manufacturing diversity or specialization was a very significant result for two reasons. First, it added further justification to the selection of the three study regions and second, it provided an initial foundation on which results could be referenced to.

The major component of the regional analysis conducted consisted of the comparison of the structure of the estimated regional regression equations. Comparisons indicated that a defininte distinction between the northern and southern regression equations existed while the differences between the other regional pairings were not as clear. The major north - south differences were three. First, the improtance of changes in market potential were found to be a very dominant explanatory variable in the south but a very weak one in the north. Secondly, the variables measuring the community attitudes towards industrial growth were found to play a significant part in the northern equations while in

the south, only one instance was found where one of these variables significantly contributed to a regression equation. Thirdly, the relationship of specialization of the manufacturing base to manufacturing employment growth was found to have opposite direction in the two regions. In the north, centres with greater degrees of specialization were found to have the slowest growth rates. These results were believed to support the hypothesis that a greater diversified centre has a more likely chance to experience sustained growth. In the south, though, those centres with the highest specialization values were found to have the highest growth rates. This phenomena was viewed in a different perspective than the northern case. It was noted that the southern centres with the highest degrees of specialization were still relatively more diversified than almost all the northern centres. Therefore, in the south, the relationship between employment growth and specialization could have been the result of those centres with a relatively specialized labour force attracting more growth because of the availability of this resource.

Comparisons of the northern and eastern equations served to delimit their common association with the unimportance of market potential changes. The southern and eastern comparison also showed this difference in the market potential variable. Other differences between the two regions, as indicated by the partial correlation analysis, were deemed

meaningless since almost all instances of significant difference occurred in the community variables. Neither of these two regions were shown to have important relationships between growth and these variables.

The reason for the lack of notable comparisons between the east and the other two regions was determined to be the general low level of explanation achieved in the eastern regression equations. The low explanatory value of market potential change was consistent with earlier studies in the litereature but the other variables also failed to account for any significant variation in the growth rate of manufacturing employment. Several reasons could be offered for this poor showing of the eastern results. First is the unsuitablility of the surrogate measures for community attitudes towards industrial growth. However, because these variables were shown to be important in the northern region, their validity as surrogates is strengthened. A second possible hypothesis is that the population size of the eastern centres could have been the cause of the insignificant results. This is an interesting hypothesis since the size of the eastern centres had the lowest regional average size in each of the six time period. Perhaps the deletion of the population variable from the analysis was the prime reason for the low eastern results. The third hypothesis is one from the literature. Ray (1965) delimited the concept of economic shadow. Briefly, this concept represented the effect

of American branch plants locating in southern Ontario. Ray hypothesized that these plants would prefer to locate somewhere between their home office and the main market in the province of Ontario. Thus, the area between Toronto and the American border along the Niagara River would be a prime location based on such criteria. Ray stated that because of these preferences, Toronto was casting an economic shadow on the eastern portion of the province. This latter explanation appears to be the most plausible one.

Inter-regional comparison of the equations based on total regression structure served to delineate a very interesting hypothesis. Using Chow's test for comparison of two linear regression equations, it was found that the basic underlying structure of the three regions equations differed during the period 1966 to 1970. During this period, it was shown that the Gross National Expenditure suffered a fall in its rate of growth. The coincidence of these two events suggested that in periods where the national economy is suffering from an economic downturn, the three regions have different capacities to adapt to worsening conditions and thus, their underlying regression structure differs. During periods of growth in the economy, the structure of the regional regression equations were found to be similar.

The analysis of intra-regional variation in regression structure also served to support results obtained in the previous analysis. From a total equation perspective,

the southern equations were shown to be the most flexible. Despite the fact that overall structure significantly changed between each of the consecutive time period comparisons, all but one of the southern equations maintained a level of explanation greater than ninety percent. This was attributed to the importance of the market potential change variable in four of the six southern equations combined with the varying importance of the remaining variables.

In the eastern region, depressed economic conditions were again cited as a possible explanation for the great amount of stability exhibited in the independent variables of this region's estimated regression equations. Of the three regions, the eastern region had the least number of significant changes in the independent variables.

The northern equations illustrated some fluctuation in the independent variables but this was determined to be in most cases, the result of alternating years of poor and good explanatory power in which changes of partial correlation coefficient signs were not uncommon. However, several cases were noted where a significant change in the partial correlation between variables and employment growth occurred where no reversal in coefficient sign was present. Comparing the fluctuations of the north and the south, it was hypothesized that that northern fluctuations were again a result of the resource oriented and highly specialized nature of the region's economy. Such an economy would be more vulnerable to

changes in economic conditions than the more specialized economy of the southern region. A more diversified region would be able to adapt to changing conditions. The flexibility of the southern equations and their retainment of high levels of explanation was cited as a possible indicator of this ability to adapt to changing conditions.

(ii) Some Policy Implications

The underlying objective of any regional development policy in the province of Ontario is generally recognized to be the encouragement of more growth in the eastern and northern portions of the province and the curtailment of further growth in the already highly developed southern portion of the province. The results of this thesis have several implications for policies aimed at obtaining these objectives, particularily with respect to the northern and southern regions.

The independent variables of this study which are the most adaptable to any government policy are the land index and the tax mill rate ratio. The variables which are the least adaptable to any policy are the specialization and market potential concepts. With respect to the northern region, these community variables were shown to play an important role in several of the six regional regression equations. On the other hand, the market potential concept was a very poor explanatory factor of growth rates of manufacturing employment in the northern centres. This suggests

that policies directed towards creation of large industrial land supplies and the offering of tax break incentives to industry may serve to attract more growth to the north. The institution of policies to increase the accessibility of the north to the south, however, would possibly have no effect at all. In fact, such a policy might produce the opposite effect by creating a situation in which large southern producers could more easily reach the northern markets from southern locations. If an accessibility policy is to be instituted, it should be directed towards improving linkages within the northern region rather than between the south and north. Obviously, any policy dealing with such accessibility concepts is a long range one whereas the policies pertaining to land availability and tax rates could be instituted very quickly.

With respect to curtailment of growth in the south, the regression equations generated suggested that an objective of this nature may be hard to meet without bold government action. It was shown that community variables in the south played a very small part in accounting for variation in the growth rate of manufacturing activity. In fact, the dominance of the market potential variable in the south prompted the suggestion that growth in this highly urbanized area is a natural phenomena, unaffected by community variables. This further suggests, then, that incentive policies against growth in the south will have little effect and that

a direct move by government to limit growth is the only way to stop sprawl.

The relationship of the specialization variables to possible policies is limited. One possible suggestion is that specialization concepts could be used as criteria for setting growth limiting policies. That is, once a certain amount of growth in one sector has been reached in a region, no more would be allowed. This would serve to both encourage diffusion of growth and the creation of a more spatially diversified manufacturing structure.

This thesis has also indicated that the explanatory factors of growth, although generally consistent over the entire set of regional equations, do fluctuate with respect to their significant entrance into the regression equations. This also has important implications for regional growth policies with respect to the length of periods of implimentation. Usually, programs exhibit no flexibility. They carry on without regard for changing conditions. However, if results like those in the northern and southern cases are true indications of the way in which factors accounting for growth behave, there is some ground for more adjustable programs, programs which are directed towards different factors in different years.

(iii) Areas of Possible Further Research

The underlying causal relationships of the rate of growth of any phenomena are very complex. Thus, the results

of the analysis presented in this thesis must be viewed with discretion, especially since they are based on such a small sample size. The results, however, should not be ignored. Despite the small sample, some definite trends towards regional differentiation of the factors accounting for variation in the growth rate of manufacturing employment were observed. Of particular importance are the significant results obtained with some of the community attitude variables introduced by this thesis. Also, the fact that separate analyses always pointed to similar and consistent interpretations of results suggests that some profitable contributions have been made by this research.

One possible area of further research, then, would be to take the general findings of the thesis and investigate them on a smaller scale. This would involve, say, the analysis of land supply policies or tax incentive policies within individual cities to ascertain a more detailed knowledge of their relationships to growth. In a sense then, the findings of macro-scopic research would be applied on a micro-scopic scale.

A second possible area of further research pertains to a previously stated question. That is, would similar results be achieved if the regions and/or observation units of this thesis were defined by some other criterion other than their spatial contiguity. One such alternative criterion might be actual rates of employment growth. Analysis

could be conducted then, to determine whether the factors accounting for growth were the same in areas of different rates of growth? A second possibility might be regionalization based on population size of the communities being considered. Such analysis might produce results that suggest that different policies should be applied in different sized cities.

The results of analysis derived from alternative regionalization criteria would also serve as criteria for the evaluation of the current regional planning programs of the Ontario government. At present, regional planning in the province revolves on spatially contiguous regions. As stated above, the government's use of these planning regions was an important reason behind the selection of the study regions of this thesis. However, if analysis based on one of these or any other alternative classification method provided a more suitable and reliable explanation of variation in the growth rate of manufacturing employment, then the regional planning perspective in Ontario is not a proper one.

In conclusion, it should be remembered that a regional planning program embraces much more than the growth rate of manufacturing employment. Judgement, therefore, of the Ontario program on the basis of a single aspect would not be a fair one. The results of this thesis, then, must also be viewed in a proper perspective. They are a contribution towards the formulation of an overall and comprehensive plan-

ing policy for the province of Ontario, not an absolute answer to the problem of regional economic disparities.

References

Ray, D. Michael (1965). Market Potential and Economic Shadow: A Quantitative Analysis of Industrial Location in Southern Ontario. Chicago: University of Chicago, Dept. of Geography Research Paper No. 101.

APPENDIX I

INITIAL DATA BASE

This appendix includes all the data used in the calulation of the independent variables and the dependent variable of the stepwise regression analysis, with the exception of the two Ontario highway mileage matrices. With respect to the specialization indices, only the final indices are presented because of the large amount of space that would be required to present the sector employment breakdowns of each of the study cities.

A. TOTAL MANUFACTURING EMPLOYMENT IN THE STUDY CITIES.

City	1960	1962	1964	1966	1968	1970	1972
Belleville	3,372	3,649	3,798	3,952	3,797	3,823	3,948
Peterborough	8,649	8,424	9,020	9,930	9,179	9,716	9,290
Cornwall	5,043	4,984	5,867	6,046	5,892	5,437	5,398
Lindsay	1,792	1,442	1,602	1,942	2,167	2,102	2,185
Perth	863	862	908	892	931	1,037	1,023
Kingston	5,678	5,842	6,188	6,733	6,159	5,629	5,202
Prescott	451	530	509	745	738	1,231	1,483
Cobourg	1,214	1,404	1,692	2,105	2,150	2,136	2,160
Brockville	3,028	2,730	3,170	3,812	3,796	3,896	4,047
Pembroke	1,429	1,387	1,418	1,450	1,402	1,211	1,266
Stratford	3,305	3,442	4,400	5,408	5,449	5,547	5,527
Brampton	2,249	3,385	5,293	8,343	5,584	6,564	6,294
Brantford	10,118	10,000	12,066	13,436	12,484	11,915	11,456
Chatham	3,672	3,407	4,001	4,651	5,061	5,200	5,252
St. Thomas	2,418	2,515	3,414	3,916	4,063	4,767	4,785
Guelph	6,456	7,113	7,916	9,248	9,132	8,929	8,827
Kitchener	16,001	16,555	18,249	21,312	20,488	21,082	21,537
Woodstock	4,113	4,400	4,951	6,143	6,311	5,971	6,025
Barrie	2,068	2,471	2,924	3,679	3,527	3,365	3,532
Whitby	1,221	1,244	1,574	2,595	2,908	3,691	4,162

MANUFACTURING EMPLOYMENT (cont'd)

City	1960	1962	1964	1966	1968	1970	1972
North Bay	631	656	757	852	1,400	1,655	1,719
Sudbury	974	1,103	1,175	1,666	1,789	1,829	1,896
Kenora	1,182	1,258	1,294	1,292	1,330	1,155	1,172
Kirkland Lake	145	256	674	618	842	1,012	786
Timmins	348	339	379	363	321	381	385
S.S. Marie	8,828	9,326	10,252	11,062	10,905	11,405	11,144
Fort Frances	977	978	1,047	1,188	1,157	1,082	1,052
Dryden	960	1,400	1,731	1,637	1,671	1,647	1,655
Sturgeon Falls	518	518	679	685	824	762	444
Fort William	2,696	3,115	3,327	4,270	3,724		
Port Arthur	2,392	2,326	2,416	2,832	2,737		
Thunder Bay						6,233	6,439

B. NUMBER OF MANUFACTURING ESTABLISHMENTS

City	1960	1962	1964	1966	1968	1970	1972
Belleville	65	64	61	55	53	57	54
Peterborough	86	81	76	75	76	73	75
Cornwall	54	54	55	61	60	63	64
Lindsay	39	39	39	41	42	41	42
Perth	27	23	20	19	19	18	17
Kingston	71	77	77	74	72	68	75
Prescott	15	15	12	17	17	15	15
Cobourg	33	29	26	26	23	26	27
Brockville	44	43	42	36	34	34	33
Pembroke	30	27	24	24	26	24	20
Stratford	74	68	67	71	68	66	62
Brampton	54	65	75	82	89	92	93
Brantford	171	162	161	165	167	157	155
Chatham	76	80	79	74	72	71	68
St. Thomas	60	59	61	60	59	58	59
Guelph	113	117	133	130	140	135	137
Kitchener	201	204	202	221	211	210	212
Woodstock	43	45	50	50	56	54	52
Whitby	17	19	20	23	29	34	43

NUMBER OF MANUFACTURING ESTABLISHMENTS (cont'd)

City	1960	1962	1964	1966	1968	1970	1972
North Bay	30	31	37	36	42	48	49
Sudbury	30	34	41	53	67	73	69
Kenora	9	9	11	13	17	16	18
Kirkland Lake	11	11	12	10	14	18	20
Timmins	26	24	24	20	21	18	19
S.S. Marie	45	47	48	50	49	47	46
Fort Frances	19	18	24	25	27	28	29
Dryden	1	1	6	6	7	7	9
Sturgeon Falls	3	3	4	4	6	6	6
Fort William	66	57	49	48	43		
Port Arthur	59	54	50	52	49		
Thunder Bay						90	92

C. INDEX OF MANUFACTURING SPECIALIZATION

City	1960	1962	1964	1966	1968	1970	1972
Belleville	.427	.428	.432	.485	.387	.364	.377
Peterborough	.531	.516	.535	.523	.507	.523	.561
Cornwall	.673	.678	.609	.617	.599	.588	.608
Lindsay	.499	.480	.395	.447	.426	.445	.474
Perth	.691	.683	.605	.614	.653	.599	.630
Kingston	.443	.454	.521	.529	.556	.591	.604
Prescott	.728	.692	.707	.628	.599	.589	.641
Cobourg	.606	.619	.593	.613	.598	.599	.564
Brockville	.494	.595	.663	.562	.615	.592	.618
Pembroke	.674	.556	.601	.648	.631	.606	.671
Stratford	.451	.405	.523	.369	.351	.392	.416
Brampton	.503	.390	.355	.395	.302	.378	.351
Brantford	.337	.332	.300	.306	.310	.273	.335
Chatham	.496	.505	.462	.515	.490	.441	.474
St. Thomas	.436	.438	.511	.500	.450	.454	.483
Guelph	.403	.401	.379	.382	.380	.397	.381
Kitchener	.455	.453	.442	.417	.409	.430	.388
Woodstock	.454	.486	.508	.488	.457	.492	.443
Barrie	.528	.529	.536	.386	.406	.377	.387
Whitby	.660	.682	.638	.636	.591	.574	.563

INDEX OF MANUFACTURING SPECIALIZATION (cont'd)

City	1960	1962	1964	1966	1968	1970	1972
North Bay	.600	.504	.523	.496	.538	.461	.531
Sudbury	.598	.517	.551	.584	.531	.554	.567
Kenora	.904	.848	.824	.828	.802	.777	.791
Kirkland Lake	.763	.803	.711	.716	.704	.648	.665
Timmins	.743	.759	.706	.701	.726	.717	.751
S. S. Marie	.755	.762	.781	.790	.757	.753	.751
Fort Frances	.810	.811	.777	.766	.779	.760	.776
Dryden	.939	.942	.872	.881	.902	.870	.865
Sturgeon Falls	.897	.901	.908	.903	.905	.917	.911
Fort William	.574	.579	.568	.581	.538		
Port Arthur	.565	.543	.550	.573	.572		
Thunder Bay						.529	.509

D. TOTAL INDUSTRIAL LAND AVAILABLE IN ACRES

City	1960	1962	1964	1966	1968	1970	1972
Belleville	44	44	97	500	1,210	844	375
Peterborough	x	x	x	650	248	200	750
Cornwall	450	1,400	1,400	1,340	x	2,030	800
Lindsay	160	160	160	160	260	150	140
Perth	120	40	30	40	260	240	140
Kingston	781	780	774	783	907	580	464
Prescott	150	150	135	138	81	110	56
Cobourg	300	300	500	431	482	120	207
Brockville	350	350	500	500	368	498	489
Pembroke	250	250	250	200	192	265	310
Stratford	1,200	1,275	1,275	825	860	700	365
Brampton	550	500	500	450	125	265	210
Brantford	300	421	421	350	500	500	500
Chatham	500	500	500	500	500	267	92
St. Thomas	320	320	320	330	330	485	440
Guelph	800	600	300	200	182	310	500
Kitchener	740	750	950	110	110	110	110
Woodstock	350	350	350	350	290	500	523
Barrie	200	200	400	740	686	550	530
Whitby	700	1,100	575	492	2,099	1,478	1,455

TOTAL INDUSTRIAL LAND AVAILABLE IN ACRES (cont'd)

City	1960	1962	1964	1966	1968	1970	1972
North Bay	60	60	60	10,700	10,600	676	221
Sudbury	1,280	2,600	2,600	2,600	1,223	620	467
Kenora	100	100	100	225	275	160	90
Kirkland Lake	x	x	5,000	4,500	x	x	647
Timmins	40	40	126	78	78	236	750
S.S. Marie	5,000	5,000	5,000	10,500	10,500	2,601	144
Fort Frances	260	250	250	150	110	200	350
Dryden	100	50	50	1,135	1,135	380	300
Sturgeon Falls	100	300	300	400	2,150	2,075	200
Fort William	1,185	1,860	1,850	1,780	1,891		
Port Arthur	935	780	700	690	600		
Thunder Bay						1,125	1,420

x denotes missing information

E. RESIDENTIAL / INDUSTRIAL TAX MILL RATES

City	1960	1962	1964	1966	1968	1970	1972
Belleville	79.50	89.40	30.70	30.40	41.70	48.03	51.1[illegible]
	86.[illegible]0	95.90	34.30	36.00	46.30	52.08	56.40
Peterborough	61.30	64.61	70.44	79.48	93.98	98.72	100.17
	65.50	70.59	77.91	87.23	104.60	108.82	109.74
Cornwall	58.65	65.46	72.77	87.18	106.25	115.83	111.56
	61.70	69.00	81.53	96.66	119.64	129.95	122.50
Lindsay	61.70	71.00	74.40	87.70	101.40	114.00	117.00
	67.80	78.23	82.60	96.00	114.80	125.50	128.10
Perth	58.00	66.50	75.00	85.00	100.00	109.00	116.00
	63.00	73.00	84.00	92.00	111.00	121.00	127.00
Kingston	81.15	74.67	79.40	87.90	105.90	112.70	119.28
	86.61	79.38	88.40	96.70	117.80	124.60	130.27
Prescott	73.00	73.57	76.35	77.18	86.42	94.28	90.80
	77.80	79.71	85.35	86.25	98.53	105.30	101.83
Cobourg	47.00	64.50	64.50	69.37	94.00	94.00	100.63
	51.00	70.80	70.80	77.25	106.37	105.90	111.13
Brockville	65.00	76.00	84.00	96.00	102.00	119.00	131.60
	71.00	81.00	94.00	107.00	116.00	135.00	145.00
Pembroke	74.14	80.84	84.98	91.29	110.62	122.25	124.85
	80.62	86.74	95.06	101.25	123.94	137.58	137.91

RESIDENTIAL / INDUSTRIAL TAX MILL RATES (cont'd)

City	1960	1962	1964	1966	1968	1970	1972
Stratford	80.70	84.79	88.40	101.00	122.09	144.92	134.86
	86.90	93.40	89.90	111.66	142.86	159.34	146.33
Brampton	70.40	70.40	68.60	78.90	79.70	98.50	18.60
	74.60	74.50	72.60	87.90	89.40	108.70	20.50
Brantford	52.80	54.15	57.70	63.40	76.77	84.30	85.37
	56.00	59.20	63.30	68.80	85.72	92.50	92.60
Chatham	60.00	63.00	68.00	75.00	88.00	98.00	90.46
	65.20	69.00	76.00	83.00	99.00	109.00	100.92
St. Thomas	59.18	69.07	71.59	78.08	83.28	101.70	109.43
	63.35	74.97	79.12	85.68	104.67	112.20	118.99
Guelph	92.00	95.00	98.90	117.00	27.70	28.90	30.60
	100.00	104.50	109.60	128.00	30.70	31.59	33.57
Kitchener	48.00	52.50	55.90	61.90	72.40	84.10	85.17
	51.50	57.02	62.00	68.10	80.98	93.04	93.21
Woodstock	62.50	69.00	68.60	74.10	91.40	108.81	104.20
	66.80	75.40	76.10	81.70	102.30	120.71	115.00
Barrie	71.00	78.00	81.53	92.82	106.30	121.33	21.38
	77.00	83.00	88.65	102.07	118.30	134.58	23.49
Whitby	57.00	78.30	72.80	87.40	102.68	99.60	113.40
	60.40	57.30	79.70	95.50	112.80	110.20	123.40

RESIDENTIAL / INDUSTRIAL TAX MILL RATES (cont'd)

City	1960	1962	1964	1966	1968	1970	1972
North Bay	57.75 61.25	57.00 60.75	62.60 69.45	74.20 81.46	89.10 95.00	103.20 116.17	109.18 120.18
Sudbury	62.50 66.10	68.43 74.74	74.44 81.89	79.00 86.00	89.69 101.62	33.64 37.85	28.02 31.18
Kenora	79.00 84.00	78.70 86.00	95.50 106.00	99.95 110.89	25.92 29.02	30.85 34.72	29.70 33.17
Kirkland Lake	95.20 103.33	95.20 103.33	92.15 104.11	93.15 102.70	114.89 132.66	84.16 93.04	130.42 145.46
Timmins	48.70 53.30	62.60 67.20	68.00 76.00	84.00 92.00	85.00 96.00	104.80 119.40	106.10 118.85
S.S. Marie	31.15 32.26	31.51 39.20	35.10 38.47	39.37 42.92	47.18 52.04	58.05 64.31	54.25 59.49
Fort Frances	51.00 54.20	67.00 70.20	64.69 71.70	78.98 83.25	83.43 92.25	92.13 101.24	122.40 135.10
Dryden	91.00 95.00	106.50 112.50	73.00 80.94	80.00 88.60	95.12 108.50	108.04 121.93	103.58 115.52
Sturgeon Falls	149.67 160.76	72.84 78.00	77.16 85.83	84.00 91.00	94.13 105.10	111.00 126.00	29.08 33.14
Port Arthur	60.00 63.50	67.00 72.00	70.50 77.50	83.25 92.25	92.95 103.75		
Fort William	67.00 72.00	71.00 76.60	76.00 84.00	98.70 109.50	110.20 123.30		
Thunder Bay						111.40 124.00	111.11 122.52

F. TOTAL NUMBER OF MAN-DAYS LOST DUE TO STRIKES AND LOCKOUTS

City	1960 & 1961	1962 & 1963	1964 & 1965	1966 & 1967	1968 & 1969	1970 & 1971
Belleville	-	-	-	-	-	12,220
	-	-	-	6,630	-	-
Peterborough	-	-	-	260	17,120	-
	-	-	6,160	10,210	1,610	-
Cornwall	-	-	-	-	-	15,670
	2,340	-	-	3,190	-	-
Lindsay	-	-	-	11,150	800	-
	-	-	-	750	170	-
Perth	-	-	-	390	960	-
	-	-	-	-	-	-
Kingston	-	-	7,430	-	16,320	11,930
	250	8,110	26,350	40	-	270
Prescott	550	-	-	-	-	550
	-	-	-	-	-	-
Cobourg	-	-	-	-	-	-
	-	-	7,700	-	3,470	400
Brockville	-	-	-	-	-	-
	-	-	4,720	-	-	5,670
Pembroke	-	-	-	2,580	-	-
	-	-	-	3,710	2,380	-

TOTAI NUMBER OF MAN-DAYS LOST DUE TO STRIKES AND LOCKOUTS (cont'd)

City	1960 & 1961	1962 & 1963	1964 & 1965	1966 & 1967	1968 & 1969	1970 & 1971
Stratford	-	-	-	490	350	-
	350	-	-	9,670	-	-
Brampton	-	-	2,300	5,850	1,140	10,380
	-	540	31,050	-	29,970	1,260
Brantford	-	-	4,940	-	317,970	32,840
	3,380	-	46,230	18,160	22,520	35,150
Chatham	-	-	-	8,800	35,400	14,410
	-	-	8,300	5,270	610	7,580
St. Thomas	32,100	-	-	-	13,840	-
	-	-	-	48,670	1,200	1,580
Guelph	-	-	1,700	70	24,260	-
	3,770	-	1,280	410	13,490	1,140
Kitchener	21,400	-	-	350	34,470	4,620
	330	800	-	-	-	2,800
Woodstock	-	-	-	8,920	-	2,750
	2,950	11,130	-	-	2,880	2,000
Barrie	-	-	-	-	22,770	1,580
	4,810	-	470	-	31,680	430
Whitby	-	-	290	-	1,040	5,620
	-	-	6,240	1,800	-	-

TOTAL NUMBER OF MAN-DAYS LOST DUE TO STRIKES AND LOCKOUTS (cont'd)

City	1960 & 1961	1962 & 1963	1964 & 1965	1966 & 1967	1968 & 1969	1970 & 1971
North Bay	-	-	-	-	-	-
	-	-	-	-	-	-
Sudbury	-	-	950	308,520	560	4,500
	4,730	1,400	-	5,610	1,512,344	-
Kenora	9,300	-	-	-	-	-
	-	-	-	-	-	-
Kirkland Lake	-	-	2,170	-	-	-
	-	-	60	-	-	-
Timmins	-	-	-	530	-	-
	-	-	-	-	-	-
S.S. Marie	-	-	9,250	5,660	1,800	22,120
	-	880	11,390	39,301	536,390	1,570
Fort Frances	-	-	-	-	7,720	-
	-	-	-	1,380	-	-
Dryden	-	-	-	-	-	-
	-	8,500	-	-	-	-
Sturgeon Falls	-	-	-	-	-	-
	-	-	-	2,750	-	-
Lakehead*	960	-	1,440	4,250	115,320	36,290
	3,130	-	750	-	12,210	2,880

* Lakehead represents combined totals of Fort William and Port Arthur up to 1968, then Thunder Bay data.

G. POPULATION OF STUDY CITIES

City	1960	1962	1964	1966	1968	1970	1972
Belleville	28,700	29,070	30,332	31,960	32,785	32,908	34,498
Peterborough	45,248	46,424	51,907	52,185	56,177	54,782	57,498
Cornwall	42,267	43,488	43,200	43,536	45,766	45,145	46,429
Lindsay	10,404	11,052	11,328	11,375	12,090	11,756	12,705
Perth	5,579	5,831	5,529	5,682	5,559	5,334	5,539
Kingston	47,611	48,028	48,842	51,541	59,004	56,159	61,870
Prescott	5,351	5,351	5,201	5,216	5,176	5,518	5,178
Cobourg	9,388	9,445	9,775	10,020	11,524	10,662	11,214
Brockville	16,222	17,124	17,949	18,753	19,266	19,830	19,830
Pembroke	15,826	16,214	16,376	16,154	16,262	15,142	15,142
Stratford	20,189	20,432	20,857	21,744	23,068	23,341	23,863
Brampton	15,241	17,835	22,101	29,634	36,264	37,324	41,238
Brantford	53,201	53,316	54,372	56,070	59,854	60,140	62,583
Chatham	28,439	29,271	29,681	30,534	32,424	31,938	34,601
St. Thomas	19,617	22,348	22,399	22,549	22,983	23,206	25,062
Guelph	37,123	38,323	40,077	41,993	51,377	53,329	58,364
Kitchener	69,622	72,961	77,190	82,674	93,255	99,021	110,198
Woodstock	19,458	19,923	20,585	22,214	24,027	24,626	25,559
Barrie	20,899	20,899	22,048	23,502	24,016	25,841	34,498
Whitby	11,943	12,501	13,620	14,243	17,273	23,562	25,291

POPULATION OF STUDY CITIES (cont'd)

City	1960	1962	1964	1966	1968	1970	1972
North Bay	22,684	23,010	23,186	23,349	23,635	46,392	46,392
Sudbury	78,782	77,356	80,523	78,061	84,888	86,291	86,291
Kenora	10,407	10,495	10,892	10,970	11,295	10,990	10,889
Kirkland Lake	15,366	15,366	15,366	15,366	15,366	14,008	14,008
Timmins	28,325	28,424	29,116	28,950	29,303	28,013	28,252
S.S. Marie	41,343	42,356	44,031	69,678	74,594	74,922	78,175
Fort Frances	8,982	9,117	9,362	9,356	9,524	9,105	9,698
Dryden	5,475	5,740	6,248	6,349	6,732	6,727	6,935
Sturgeon Falls	6,281	6,281	6,442	6,690	6,430	6,300	6,300
Fort William	42,900	43,968	45,698	46,662	48,208		
Port Arthur	41,761	42,581	44,419	45,416	48,340		
Thunder Bay						96,548	111,492

Appendix II

Sample Calculations of Regression Analysis Variables

Included in this appendix are sample calculations of all the variables which were retained in the modified stepwise regression analysis outlined in Chapter IV Section (iii), with the exception of the market potential change variable.

1. Percentage Growth in Manufacturing Employment

   Example: Belleville 1960 - 1962

$$\% \text{ Growth} = \frac{\text{Employment(1962)} - \text{Employment(1960)}}{\text{Employment(1960)}} (100)$$

$$= \frac{3649 - 3372}{3372} (100)$$

$$= 8.25$$

2. Change in Specialization Index (SIDIFF)

   Example: Belleville 1960 - 1962

$$\text{SIDIFF} = \text{Index(1962)} - \text{Index(1960)}$$

$$= .428 - .427$$

$$= .001$$

3. Average Degree of Specialization (SIAV)

   Example: Belleville 1960 - 1962

$$\text{SIAV} = \frac{\text{Index(1962)} + \text{Index(1960)}}{2}$$

$$= \frac{.428 + .427}{2}$$

$$= .4275$$

4. Available Industrial Land Index (LI)

Example: Belleville 1960 - 1962

$$LI = \frac{\text{Industrial Land Available (1960)}}{\text{\# of manufacturing establishments (1960)}}$$

$$= \frac{44}{65}$$

$$= .68$$

5. Percent Change in Tax Mill Rate Ratio (PMC)

Example: Belleville 1960 - 1962

$$\text{Mill Rate Ratio(1960)} = \frac{\text{Residential Rate(1960)}}{\text{Industrial Rate (1960)}}$$

$$= \frac{79.50}{86.50}$$

$$= .919$$

$$\text{Mill Rate Ratio(1962)} = \frac{\text{Residential Rate(1962)}}{\text{Industrial Rate (1962)}}$$

$$= \frac{89.40}{95.90}$$

$$= .932$$

$$PMC = \frac{\text{Ratio(1962) - Ratio(1960)}}{\text{Ratio(1960)}} \times 100$$

$$= \frac{.932 - .919}{.919} \times 100$$

$$= 1.145$$

6. Labour Climate Index (CLIMATE)

Example: Peterborough 1968 - 1970

$$\text{CLIMATE} = \frac{\frac{\text{Man-Days Lost}(1968) + \text{Man-Days Lost}(1969)}{2}}{\text{City Population}(1970)}$$

$$= \frac{\frac{17,120 + 1,610}{2}}{54,782}$$

$$= .17$$

SELECTED BIBLIOGRAPHY

Alexander, John W. "Location of Manufacturing: Methods of Measurement." Annals of American Association of Geographers 48 (1958): 20-26.

Alexander, John W. "Manufacturing in the Rock River Valley - Location Factors." Annals of the American Association of Geographers 40 (1950): 237-253.

Alexander, J.W. and J.B. Lindberg. "Measurements of Manufacturing: Coefficients of Correlation." Journal of Regional Science 3 (1961): 71-81.

Ballabon, M.B. "Areal Differentiation of the Manufacturing Belt in Central Canada." Ph.D. dissertation, McGill University, 1955.

Berlinguette, Vincent R. "Classifications, Concepts and Confidentiality and the Use of Statistics on the Manufacturing Industries by Geographers." Canadian Geographer 11(1967): 1-15.

Berry, Brian J.L. "Approaches to Regional Analysis: A Synthesis." Annals of the American Association of Geographers 54 (1964): 2-11.

Berry, Brian J.L. "Identification of Declining Regions: An Empirical Study of the Dimensions of Rural Poverty." in Wood, W.D. and R.S Thoman (eds.) Areas of Economic Stress. Kingston: Industrial Relations Centre, Queens University, 22-66.

Byers, William B. "Growth Centres and Interindustry Linkages." Proceedings of the American Association of Geographers 5 (1973): 18-21.

Bowden, Elvert. "The Theory and Practice of Regional Development Economics." Land Economics 47 (1971): 113-121.

Brewis, T.N. Regional Economic Policies in Canada. Toronto: MacMillan and Co, 1969.

Britton, John H. Regional Analysis and Economic Geography. London: Bell, 1967.

Britton, John N. "A Geographical Approach to the Examination of Industrial Linkages." Canadian Geographer 13 (1969): 185-198.

Britton, J.N. and Gerald Barber. "Forecasting the Regional Economy of Ontario." in Bourne, L. et. al (eds.) Urban Futures for Central Canada. Toronto: University of Toronto Press, 1974.

Camu, Pierre, E.P. Weeks, and Z.W. Sametz. Economic Geography of Canada. Toronto: MacMillan of Canada Ltd., 1964.

Chinitz, Benjamin. "Appropriate Goals for Regional Economic Policy." Urban Studies 3 (1966): 1-7.

Chinitz, B. and R. Vernon. "Changing Forces in Industrial Location." Harvard Business Review 38 (1960): 126-136.

Chow, Gregory C. "Tests of Equality Between Sets of Coefficients in Two Linear Regressions." Econometrica 28 (1960): 591-605.

Cohen, K. and R. Cyert. "New Considerations in the Theory of the Firm." in Karaska, G. and D. Bramhall (eds.) Locational Analysis for Manufacturing. Cambridge: M.I.T. Press, 1969.

Collins, L. Industrial Migration in Ontario. Ottawa: Statistics Canada, 1972.

Due, John F. "Studies of State - Local Tax Influences on Location of Industry." National Tax Journal 14 (1961): 163-173.

Easterlin, Richard A. "Long-term Regional Income Changes: Some Suggested Factors." Papers and Proceedings of the Regional Science Association. 4 (1958): 313-325.

Estall, R.C. and R.O. Buchanan. Industrial Activity and Economic Geography. London: Hutchinson and Co. Ltd., 1961.

Frank,R.H., S.M. Batrik, and D. Haronitis. "The Input-Output Structure of the Ontario Economy." Ontario Economic Review 8 (1970): 3-33.

Friedman, John. "Regional Economic Policy for Developing Areas." Papers and Proceedings of the Regional Science Association 11 (1963): 41-61.

Gilles, A.J. "Municipal Industrial Development with Specific Reference to Kitchener." in Walker, D. and J. Bater (eds.) Industrial Development in Southern Ontario. Waterloo: University of Waterloo, 1974.

Gilmour, James M. "The Joint Anarchy of 'Confidentiality' and Definitional Change." Canadian Geographer 10 (1966): 40-48.

Greenhut, Melvin. "Integrating the Leading Theories of Plant Location." Southern Economic Journal 18 (1951): 225-228.

Greenhut, M.L. and M. Colberg. Factors Influencing the Location of Florida Industry. Talahassee: Florida State University, 1962.

Hansen, Niles M., ed. Growth Centres in Regional Economic Development. New York: The Free Press, 1972.

Hansen, Niles M. Location Preferences, Migration and Regional Growth. New York: Praeger Publishers Inc., 1973.

Harris, Chauncey D. "The Market as a Factor in the Location of Industry in the United States." Annals of the American Association of Geographers 33 (1943): 315-348.

Hay, Keith A.J. "Trends in the Location of Industry in Ontario." Canadian Journal of Economics and Political Science 31 (1965): 368-381.

Hoover, E.M. The Location of Economic Activity. New York: McGraw Hill Book Co. Inc., 1948.

Hoover, E.M. An Introduction to Regional Economics. New York: Knoff Inc., 1971.

Isard, Walter. Methods of Regional Analysis: An Introduction to Regional Science. Cambridge, Mass: M.I.T. Press, 1960.

Karaska, Gerald and David F. Bramhall, eds. Locational Analysis for Manufacturing: A Selection of Readings. Cambridge, Mass: M.I.T. Press, 1969.

Keeble, D.P. and D.P. Hauser. "Spatial Analysis of Manufacturing in Outer- Southeast England, 1960 -1967. I Hypotheses and Variables." Regional Studies 5 (1971): 229-261.

Keeble, D.P. and D.P. Hauser. "Spatial Analysis of Manufacturing Growth in Outer-Southeast England, 1960-1967. II Methods and Results." Regional Studies 6 (1972): 11-36.

Laird, William E. and James Kinehart. "Neglected Aspects of Industrial Subsidy." Land Economics 43 (1967): 25-31.

Lasuen, J.R. "On Growth Poles." Urban Studies 6 (1969): 137-161.

Lloyd, P.E. and P. Dicken. Location in Space: A Theoretical Approach to Economic Geography, New York: Harper and Row, 1972.

Logan, M.I. "Locational Decisions of Industrial Plants in Wisconsin." Land Economics 46 (1970): 325-328.

Lonsdale, Richard E. "Barriers to Rural Industrialization in the South." Proceedings of the American Association of Geographers 1 (1969): 84-88.

Mathias, Philip. Forced Growth. Toronto: James Lewis and Samuel, 1971.

McClutcheon, Richard. "Market Potential as a Factor in Changes in Manufacturing in Ontario, 1951 - 1961." M.A. Thesis, University of Western Ontario, 1971.

McDowell, J. Hampton. "Factors Influencing the Locational Decisions of Manufacturers in the Kansas City Area." M.A. Thesis, University of Arizona, 1973.

Morrison, J.L., M.W. Scripter, and R.H.T. Smith. "Basic Measures of Manufacturing in the United States, 1958." Economic Geography 44 (1968): 296-311.

Mueller, Eva and James N. Morgan. "Locational Decisions of Manufacturers." American Economic Review, Papers and Proceedings (1962): 204-217.

Myrdall, Gunar. Economic Theory and Underdeveloped Regions. London: Muthuen & Co. Ltd., 1957.

Nesbitt, J.G. "Regional Differences in the Structure and Growth of Manufacturing in British Columbia." M.A. Thesis, University of British Columbia, 1973.

North, D.C. "Locational Theory and Regional Economic Growth." Journal of Political Economy 63 (1955): 243-258.

Parr, John B. "Out Migration and the Depressed Area Problem." Land Economics 42 (1966): 149-159.

Ray, D. Michael. Market Potential and Economic Shadow: A Quantatative Analysis of Industrial Location in Southern Ontario. Chicago: University of Chicago, Dept. of Geography Research Paper NO. 101, 1965.

Richter, Charles E. "Impact of Industrial Linkages on Geographic Association." Journal of Regional Science 9 (1969): 19-28.

Robarts, John. Design for Development. Statement by the Prime Minister of Ontario on Regional Development Policy. Tuesday, April 5, 1966.

Rusling, John R. "Factors Influencing the Location of Manufacturing Activity in Cambridge, Ontario." in Walker, D. and J. Bater, eds., Industrial Development in Southern Ontario. Waterloo: University of Waterloo, 1974.

Siefried, N.R. "An Analysis of Recent Changes in Manufacturing in Alberta." The Albertan Geographer 5 (1969): 55-60.

Siebert, H. Regional Economic Growth, Theory and Policy. Scranton: International Textbook Co., 1969.

Smith, David M. "On Throwing Weber Out with the Bathwater: A Note on Industrial Location and Linkage." Area 2 (1970): 15-18.

Spelt, Jacob and Donald Kerr. "Some Aspects of Industrial location in Southern Ontario." Canadian Geographer 4 (1960): 12 - 25.

Stafford, Howard A. "An Industrial Location Decision Model." Proceedings of the American Association of Geographers 1 (1969): 141-145.

Steed, Guy P.F. "Location Implications of Corporate Organization of Industry." Canadian Geographer 15 (1971): 54-56.

Taylor, Michael J. "Location Decisions of Small Firms." Area 2 (1970): 51-54.

Thoman, Richard S. "Initial Policies and Strategies for Development of Ontario." Ontario Geography 4 (1969): 5-12.

Thoman, Richard S. Design for Development in Ontario. The Initiation of a Regional Planning Program. Toronto: Allister Typesetting, 1971.

Tiebout, C.M. "Exports and Regional Economic Growth." Journal of Political Economy 64 (1956): 160-164.

Wood, P.A. "Industrial Location and Linkage." Area 1 (1969): 32-39.

Wong, Cheuk C. "The Spatial Structure of Manufacturing Industries in Ontario." Ontario Geography 4 (1969): 45-55.

Zelinsky, Wilbur. "A Method for Measuring Change in the Distribution of Manufacturing." Economic Geography 34 (1958): 95-126.

Data Sources

Annual Census of Manufacturers. Ottawa: Statistics Canada, 1960 - 1971.

Economic Review. Ottawa: Information Canada, 1975.

Industrial Surveys of Ontario. Toronto: Ministry of Industry and Tourism, 1960 - 1972 city data sheets.

Official Road Map of Ontario. Toronto: Ontario Dept. of Higways, 1960 and 1966 edition.

Scott's Industrial Directories. Oakville: Penstock Publications, 1958-59 to 1974-75 editions.

Strikes and Lockouts in Canada. Ottawa: Dept. of Labour, 1960 - 1971 editions.