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**Regional development and economic instability: Contribution
of the forest products sectors to diversification of the Michigan
economy**

Vega Segura, Carlos Guillermo, Ph.D.

Michigan State University, 1992

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**REGIONAL DEVELOPMENT AND ECONOMIC INSTABILITY:
CONTRIBUTION OF THE FOREST PRODUCTS SECTORS TO
DIVERSIFICATION OF THE MICHIGAN ECONOMY**

BY

Carlos G. Vega Segura

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ABSTRACT

REGIONAL DEVELOPMENT AND ECONOMIC INSTABILITY : CONTRIBUTION OF THE FOREST PRODUCTS SECTORS TO DIVERSIFICATION OF THE MICHIGAN ECONOMY.

by

Carlos G. Vega Segura

Michigan's economy has been heavily dependent on automobile manufacturing for many decades. The automotive industry, although employing a large number of workers and providing an important source of income, is very sensitive to cyclical changes that occur mainly due to external shocks produced by the international economy. This work has hypothesized that to achieve a more stable economy Michigan needs to develop a more diversified economic structure.

In order to evaluate the current situation of the state economy a regionalization was made by using the Q-technique of factor analysis. Once the regionalization was achieved, regional indicators of diversification and instability were calculated. Kort's indexes of diversification were compared with two other measures: the ogive and percentage of durable indexes. After that OLS and WLS regression models were run to establish the relationship between DIV and REI indexes. Several statistical tests were performed to corroborate the hypotheses that were posed in the objectives.

This study found that better sources of data are required to obtain more precise results in absolute terms at this level of analysis. Nevertheless, important conclusions were attained when indicators in relative terms were used. It was found that the economic structure of Michigan has changed significantly during the period 1982-1988. A significant negative relationship between the Kort index of diversification and instability was found, at the level of significance of $\alpha = .05$. The ogive index showed a significant relationship while the percentage of durable goods did not. The analysis corroborated the positive relationship between diversification and regional population size.

The assessment of the forest products sectors showed that most of them have become more important in terms of basic activities when the years 1982 and 1988 were compared. Six of the seven sectors that make up the industry showed positive growth. Finally, some regional policy recommendations are made in order to improve the current regional economic structure. These policies are oriented to add productive capacity in forest products sectors.

Dedicated

**To my wife, Marcia, and my children,
Carlos, Jessina, and Joel for their
confidence and support.**

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Chapter I

Introduction

The economy of Michigan has been characterized by a series of fluctuations that have impeded balanced state economic growth. Various groups in Michigan have argued that these swings of the economy have occurred because of heavy dependence of the State's economy on durable manufactures whose prices have shown an unstable trend during the last years.

Nowadays, Michigan's main industry (automobile manufacturing) is facing a contraction in its sales due to foreign competition (Japan), restrictions to foreign products in others markets, innovations, etc. This situation has created an unstable situation in Michigan that can be translated in lower levels of production, income, and employment. Hence, Michigan's economy needs to be diversified into a structure that guarantees a more stable situation in the future.

This study attempts to analyze the effect of these economic fluctuations, and to measure their magnitudes. The Michigan industrial structure is assessed through indicators of economic diversity and instability. Once the recent situation of the state economic structure has been assessed,

new avenues will be open for those who have the task of promoting and recommending programs and projects that might help to ameliorate the current situation of the state's economy.

It is thought that if in the future Michigan achieves a more diversified economy, then a healthy regional economy could be attained along with a stable economic environment. This chapter emphasizes the problem, provides a conceptual framework, and establishes the objectives of this research.

1.1 Problem Setting.

For many decades Michigan's economy has been led by the automobile manufacturing industry. This fact has created a fragile economic structure based on this industry and the other industries linked directly to it. Measuring specialization in a particular region is never easy because of the complex linkages between a particular sector and the rest of sectors sharing in the process of regional development.

In the particular case of Michigan, dependence of the state's economy on the automobile industry can not be measured based on the contribution of this industry alone. However we are also interested in specialization in other sectors within the state. Information about output,

employment, income, value added, etc. attributable to other sectors linked with the automobile industry has to be taken into account. Therefore, the analysis needs to consider all sectors of the regional economy having transactions with sectors that transact with the auto industry and so on. Total impact would be the summation of the various transactions in the economy that occur as a consequence of the initial transaction (direct effect).

For many years economic leaders in Michigan have agreed that in order to strengthen the regional economy diversification seems to be a necessary step. So, most of them have advocated that private - public sector cooperation be enlisted to promote diversification of the State's economy. The most recent achievements of this type were reached during the beginning of the last decade (1983), when Governor James G. Blanchard assumed office. That year Michigan initiated a target industry program. Initially, the program identified three industrial sectors that showed good perspectives for net growth. The sector or target industries identified in this first stage were:

- (a) The forest products industry.
- (b) The food processing industry (Michigan grows large quantities of diverse agricultural commodities, much of which are processed in other parts of the country).

- (c) The robotics industry (here considering certain especially high value parts of the automobile industry, with strong ties to existing skills of segments of Michigan's labor force).
- (d) Later, a new initiative in resource-based economic development was added, the travel and tourism industry.

According to this program, three of the four target industries are directly linked to natural resources. Based on this fact one could expect that diversification of the State's economy through these sectors will have a strong positive impact on Michigan's rural economy.

In his "Michigan Renewable Resource Development Initiative" Governor Blanchard (1987), addressed the policies and benefits conferred to these target industries:

- Each one shows a high contribution to the existing economic base and to its diversity in terms of value added and employment.
- Each one of them exhibits a suitable growth potential, along with the creation of new jobs.
- The rural and semirural economies likely will benefit from development of these types of industries.

In this study the roles and importance of the forest products sectors are emphasized. So far the forest product industry program has involved several specific efforts in the following areas:

- (a) improving the business environment for forest products sectors;
- (b) assuring a stable and expanding supply of increasingly valuable timber; and
- (c) promoting a stronger coordination of public and private forestry activities.

In order to achieve a suitable increase in economic diversification, it is necessary to foster the effective cooperation of both public agencies and private firms. Also, private firm decisions would have to be implemented wisely since many potential projects that are necessary to fuel increased growth and economic diversification will be undertaken by this sector. On the other hand, public enterprises must be involved in activities related to timber production, the provision of most outdoor recreation, and research dealing with forest and park resources management, in order to complement private effort. It can be noted that successful projects and programs will require the mutual cooperation of the public and private sectors.

Michigan's economy includes several types of regional economies, each one of them showing a particular economic structure and level of diversification. It is our assumption that the most diversified the regional economy will be, the most improvement in stability of employment and income. This issue has been constantly debated by authors in the field (e.g., Richarson, 1969; Hoover, 1963). Initially, it was necessary to assess the existent sources of information providing a disaggregation level that makes feasible the type of regionalization desirable for our analysis.

Once needs have been identified, it is necessary to develop a set of programs and projects related to target industries at the regional level within the state to achieve an environment of economic stability. It is expected that development of these target industries could lead to a more favorable situation for the state. Improvement in the employment situation, new sources of income, and a situation of better well being are some expected results of an appropriate regional diversification policy. However, diversification of regional economies within the state does not guarantee the State's diversification. Regions within Michigan usually show different rates of growth corresponding to different mix of economic activities whose share in terms of employment and income could lead to an

unbalanced situation for the State's economy. So, it is important to diversify through enterprises that behave stably during the business cycle or expand basic industries that show inelasticity in employment and income when exports are involved.

1.2 Concepts and Definitions : Regional Development, Diversification, and Stability

Regional development is defined according to the objective or goals pursued. Hoover (1984, p. 355) said that development of a region needs to be seen in terms of its size, income level, and structure. External conditions of two types could affect the desirable growth of the region -a demand for the region's outputs and the supply of inputs to the region's productive activities. The goal of regional economic development would be to attain a healthy growth of the region and to promote individuals' well-being in terms of opportunity, equity, and social harmony. Some regional economists approach regional development as a "balanced growth". They say that regions need to grow in such a way that inequalities in income and employment are reduced. In general, a regional development goal is achieved when the region's residents improve their levels of well being. A better educational system, an economic structure which provides more and better job opportunities, and enhanced personal income along with a suitable social services system

are some of the requirements to fulfill this goal. When the State lacks a diversified economy, significant changes in the major economic and social variables can occur. Economic fluctuations can affect the well being of the people positively or negatively depending on the orientation of the fluctuation. When this happens we conclude that the State's economy is highly sensitive to business cycles.

"Business cycle" is the economic term used to represent regular oscillations in the level of business activities over a period of years. A concept that is related to business cycle is that of cyclical stability which implies a situation in which an economic variable remains steady through the business cycle.

Regional economic stability in our case will refer to the joint effect of the region's industrial stability on the fluctuations in the total regional employment. That is, in the presence of unexpected economic fluctuations regional employment will remain stable. Regional economic stability could be measured in terms of other economic variables such as regional income, value added, wages etc as well. It could be pointed out that technological change is an important variable to consider when employment stability is one of regional policy objectives. Technological

development might have a negative effect on employment growth.

Another concept that needs to be addressed is that of diversification. Diversification is the opposite of specialization. Diversification involves the presence of contrasting types of economic activities in the same region. According to Hoover (1963, p. 283) "... the terms specialization and diversification pose a problem of definition, since there is no agreed measure of how similar or how different any two industries or occupations are". But as we will see in the next chapter diversification has been measured using several indicators.

Rodgers (1956) says that diversification has been defined in several ways. In a broad sense diversification has been identified with an area having a great number of different types of industries. Others talk of it as a "balanced" industrial structure, but according to this author this definition faces the problem of an appropriate definition of "balance". The term "absolute diversification" has been used in the literature to represent a situation of equal employment in all major industrial groups. This is usually not a desirable situation since productivities vary by type of economic activity.

An issue that is necessary to address when conducting a study of diversification is that of the industrial (or sectoral) composition in an area. Some industries, specially those classified as producing durable goods, tend to be more sensitive to seasonal and cyclical fluctuations of employment than nondurable goods industries.

Richardson (1969, p.276) is another author who addressed the issue of the difficulties in defining "diversification". Diversification, according to Richardson, could mean a balance between nondurable or stable industries and durable or unstable industries or an industrial structure near to that of the national, or nearest approximation to a uniform share in all industries.

The general concensus is that it is healthy that the regional economy include a large and varied number of industrial groups as an important part of its economic base. Industrial diversity provides a shield against external changes that could affect the average level of income and employment among different economic activities that comprise the regional economy.

Industrial diversification has also been approached in terms of balanced employment across industry classes or activities, or in terms of inducing the expansion of a few

stable industries (Conroy,1974). This has been in general regarded as a positive goal in terms of regional economic development. Our study is expected to provide indicators of these differences between industries.

Finally, it is necessary to define industry. In this study, industry represents a group of firms that produces a similar output or service or employs people devoted to similar economic activities. Industry is identified here with manufacturing, so the Standard Industrial Classification (Standard Industrial Classification, 1987) of the federal government is used to identify economic activities. A group of economic activities with similar characteristics represent a sector in our study.

1.3 Study Objectives and Hypotheses.

Regional fluctuations have been seen as matter of great concern among regional economists for several years. These can be classified according to its periodicity in seasonal or short term fluctuations, business cycle or medium term fluctuations, and growth trend or long term shift (Thompson, 1965 p. 133). The usual interests of researchers have been centered in the origin and causes of the business cycle and measures to prevent the likely negative effects brought about by a period of slump in regional economic activity. As it is known, when this occurs regional income and

employment are affected because of reduction in the demand of certain goods produced in the region and the derived demands that these final demands cause.

In order to measure effects of these fluctuations on the region, the starting point of analysis should be focused on the industrial composition of the region under analysis. Authors such as Isard (1960) and Richardson (1969) assert that a large part of the cyclical responsiveness of a specific region depends on the industrial composition of the region. Regions whose structure is more diversified could respond much better to cyclical changes.

Under this view regional cycles are considered local manifestations of cyclical changes in national industries. According to Richardson (1969, p. 275) this type of analysis "... imputes to each regional industry the national average cyclical change in activity in that industry. Any regional cyclical experience not explained by its industry mix can be regarded as a residual". The validity of the analysis will depend on the relative size of this residual whose importance could be large or small depending on the magnitude of the industrial structure of the region. In this arena it is important to evaluate the patterns of certain indicators that could guide policy decision making. The percentage of activities in durable industries, its

degree of diversity and balance, and the rates of growth of each particular industry have been seen as factors that in great part could explain the causes and origins of the business cycle both at the regional and national level (Richardson, 1969, p. 276).

This work focuses mainly in developing solutions for medium and long term oscillations. It is assumed that if a suitable level of stability is achieved in the medium term, then policy makers might implement an strategy to hold this situation for the future (growth trend stability). A more diversified economy could help to attain this objective. Most regional economists assume that as a region's industrial structure becomes more diversified, its economy becomes less vulnerable to cyclical changes. That is, diversification could lead a region toward a more stable situation in terms of income and employment. Nevertheless, different arguments have been posed against the effectiveness of this strategy. It has been said that as the region becomes more diversified its propensity to import declines since the region is less dependent of other regions and the external world. On the export side, it is said that given an industrial composition of the region as contrasted with the rest of the nation, exports could or could not represent an unstabilizing factor. If exports represent a large share, and most export industries are

unstable, then more sensitive will a given region be to declining national demand (Engerman 1968, p. 296). Low export share is linked then to a lower level of instability and sensitivity to region's external shocks.

However, diversification should be seen as an appropriate solution in many cases. Diversification provides additional alternatives in terms of employment and income distribution. For those regions which rely upon a single or small groups of industries and whose products exhibit a steep decline in demand when a slump in the national economic activity occurs, diversification represents the best stabilizing option.

What diversification does is to dilute the risk brought about by unstable industries which face reductions in demand during the business cycle and creates a kind of self sustenance to the regional economy.

In the case of Michigan, the industrial composition needs to be reinforced. That is, additional industries that allow a more suitable distribution of regional income, and employment need to be promoted in the mid and long term to cope with the swings of the business cycles. A set of fast growth "stable" industries need to be identified in order to initiate the process of diversification in a broader scale.

1.3.1 Research Objectives.

This study attempts to meet the following objectives :

- (a) To analytically investigate diversification that has taken place in Michigan's economy, and quantify it to the extent feasible.
- (b) To investigate if any consistent relationship exists between size of the regional economy and level of diversification.
- (c) To relate diversification with economic instability of regional economies within Michigan.

1.3.2 Hypotheses.

In order to meet our objectives the following hypotheses have been formulated :

- (a) A significant change in the regional industrial structure of the State has occurred during the period of analysis.

We expect that because of frequent fluctuations of Michigan's economy the industrial structure in terms of employment has changed. In this case the economic structure

of Michigan for years 1982 and 1988 will be assessed.

- (b) There exists a negative relationship between regional diversification and regional instability.

We expect that the more diversified the State's economy is, the more stability could be achieved within the State.

- (c) There exists a positive relationship between regional diversification and the size of the region in terms of population.

In this case a comparison between diversification and population will be made. It is expected that the higher the regional population, the more diversified the region will be. So, diversification will be a function of the population size as Kort (1981) and Thompson (1965) have asserted.

These hypotheses will be tested in order to provide a clearer picture of the Michigan economy's behavior during the last ten years. Study findings are expected to increase knowledge regarding stability of the state's economy, and form the basis for recommendations regarding efforts needed in the future to achieve this goal. In order to fulfill our objectives, results of this research are combined with

previous works in the field. Such results will provide guidelines to decision makers, both public and private, concerned with investment related to the forest sector directly and indirectly.

It is expected that the study will indicate activities likely to provide improved economic bases for regional economies within Michigan thereby reducing negative effects of instability caused by the excessive reliance on the automotive industry and other industries characterized by unstable export markets.

From our results and previous investigations we identify potential economic activities that are likely to provide for higher economic growth rates and lead to a more productive use of human resources and capital.

1.4 Scope and Limitations of the Study.

This study is limited to Michigan. Economic regions consisting of counties with a similar mix of economic activities are identified. That is, aggregation of counties is based in their homogeneity in terms of mix of sectors. The research methods chapter will explain how this allocation was carried out.

The study faces certain data limitations. Annual data were used for measuring the indexes of economic diversity and instability . Annual data were used because in this study we are concerned with mid-and long-term movements (i.e., business cycles and long term movements based on the changes of the growth rates of income and employment among industrial activities). However it is important to recognize that the year is made up of seasons, each with certain characteristics which can lead to seasonal economic activities (e.g., recreation). Nevertheless, seasonal movements are not going to be considered here since as it has been pointed out this research is concerned mainly with business cycle effects.

Another point to address is that this study only used secondary data. So, our results rely on the quality of this information. Finally, it is important to point out that some methods applied in the study are in process of improvement, specifically the indexes of diversification and instability. There exist several ways to measure diversification and instability. Strengths and weaknesses of these measures will be examined in the next chapter.

CHAPTER II

LITERATURE REVIEW

This chapter examines three fundamental aspects of this study. First, the progress attained during the past decade in Michigan regarding contributions of forest products to the state's economy. A set of studies that provide evidence of the importance of the forest products sectors in the development of the regional economy are examined focusing essentially in their relationship with the economic diversification and instability aspects.

Second, a survey whose goal was to explore the main measures of diversification and instability was carried out. Each measure has been evaluated to provide further insights about their range of accuracy.

Finally, diversification and instability measures have been used for measuring changes in the industrial structure. Several cases concerned with the United States and other countries are exhibited to show some results that could be expected.

2.1 Progress Attained During the Last Decade Regarding the Economic Contribution of Michigan's Forests Products Industry.

The first effort in this decade was made by James et al. in 1982. The objective of this study was to document the status of the forest products industry as of 1980. The information was developed by a survey of establishments and includes regional location, quantity of timber, employment, raw timber products values and value added by manufacturing. This work showed that employment in the forest products industry appeared to be higher than Census Bureau estimates. This work found 24.6% more employees than the 1977 U.S. Census of Manufacturers and 17.7% more employees as compared to the 1979 County Business patterns. The difference was explained by the fact that this new survey collected information from smaller establishments that were missed by the Census Bureau.

The next step was to carry out research that provided a directory of Michigan forest product industrial establishments (Heinen and Ramm, 1983). The directory constituted the sample frame for the survey of forest products.

The information obtained from the survey facilitated the development of input-output accounts of several forest

product sectors (Chappelle et al., 1986). This information was combined with secondary data for the rest of the State's economy. This demand-driven 1980 input-output model of Michigan economy included 37 sectors, ten of which were forest product sectors. The I/O table allows us to obtain information about direct product coefficients and interdependency coefficients for the forest product sectors. Type I (direct and indirect effects) and Type II (direct, indirect and induced effects) multipliers were calculated for the forest industry sectors. these multipliers were based on information about output, employment and income obtained from the survey. The authors' multiplier analysis indicated that the sector having the greatest impact varied depending on the goal being pursued. Therefore, results appeared to indicate that if the state's goal was to achieve a sales maximization, then the sawmills and planing mill sector should have priority. On the other hand, if income maximization is the target, then wood pallets and skids sector should have priority. If employment maximization is the goal, the integrated pulp and paper or paperboard mill sector should be given priority. Regional and local conditions should also be taken into account to select the most appropriate sectors to be expanded.

A forecast of final demand for each forest sector was derived to obtain estimates of future production. Data

Resources Inc. (DRI) was contracted to do this job. They forecasted final demand for 39 forest industry sectors (four digit SIC codes) for the years 1984, 1985, 1990, 1995 and 2000 in terms of 1972 dollars. This study for Michigan showed that the annual growth rate in final demand was expected to be the highest through the year 2000 for the sawmills and planing mills and the second highest for the wood pallets and skids sector (Data Resources Inc., 1985).

These forecasts allowed sectors to be identified that should be considered in any industrial targeting activity by state government. Final demand forecasts are important since they indicate the likely path of regional economic growth and the movement of the export sector.

The objective of the next study was to forecast total output required to meet forecasted final demands (Chappelle, 1986). We should note that a demand driven I/O model assumes that demands are known. This study indicated sectors that should be targeted for expansion by the State government.

The I/O model described before was driven by 1990 final demand estimates developed in the DRI study for the forest industry sectors and the Regional Economic Models, Inc. (REMI) data base for the remaining sectors of the Michigan economy, with a few exceptions that required forecasting by

the author based on complementary information (e.g., agriculture). Also, results were calculated using forecasts for forest product sectors within the REMI system.

The study showed that forecasted total output varied greatly with respect to the demand forecasts developed by DRI and REMI. Final results indicated that only the wood furniture and fixture sector was expected to grow at or above the expected inflation rate for both series of estimates of final demand. Therefore, it could be concluded that final demands for forest product sectors in the state of Michigan are quite uncertain (Chappelle and Webster, 1987, p.21).

Different studies have shown divergent signals regarding specific forest industry sectors that should be considered for future expansion, given regional, national and international markets. Since the two main sources of information in the future final demand (i.e. DRI and REMI) did not provide similar results, there exists a problem of consistency. According to Chappelle and Webster it is expected that differences in final demand can be explained by differences in export forecasts (Chappelle and Webster, 1987, p.22).

Estimation of the different production levels led to determination of the economic feasibility of locating additional capacity of various types of forest products establishment in the state. This approach will require an additional set of data, namely capacity levels of industrial plants in Michigan.

Since information about the pulp and paper sector and the composite wood panel sector was available at that time, only the wood pallet sector was studied (Obiya, 1986). This particular sector showed the highest income multiplier in the I/O study. The automobile manufacturers were, according to the findings, the major customers of this sector.

Nevertheless, this study of effects of measures constraining expansion of the wood pallet industry in lower Michigan indicated that this particular industry was operating at undercapacity and hence did not appear to be a good choice for expansion, given the current technologies that are utilized and demand levels. A new lower cost technology or increases in demand could change this conclusion and provide new options.

The next study considered the economic importance of the Upper Lake State forest resources (Pedersen and Chappelle, 1988; Pedersen, Chappelle and Lothner, 1989; Pedersen and Chappelle, 1990). In this study the IMPLAN input/output modeling system of the Forest Service, USDA was used to measure impacts of forest products and recreation sectors on the regional economy. This study provided an analytical framework for a Regional Governors' Conference on Forestry, held in April 1987 in Minnesota. The major finding of this study can be summarized as follows:

(Pedersen and Chappelle, 1990)

"The forest products of industry of Michigan, Minnesota and Wisconsin account for about 8% of the region's manufacturing sales, employment and income. In real terms, sales of forest products are forecasted to grow from \$15 billions in 1982 to over \$22 billions by 1995. Sales related to wood energy and outdoor recreation in forest areas of the region account for another \$2 billion. Adding the multiplier effect, economic activity attributable to these three uses of the forest resource is projected to grow from over 30 billions in 1985 to over \$40 billions by 1995."

Pedersen (1990) completed a study that focuses on estimation of economic impact of recreation in the three-state region. He concluded that in order to get reliable estimates of economic impacts of forest-based recreation, the IMPLAN data system must be improved, specifically estimates of regional production as a proportion of regional purchases.

Chappelle and Webster(1990) analyzed possible linkages between unemployment rates and economic bases of multicounty regions within the lake states. The study concludes that it appears that relative magnitudes of regional unemployment is related to regional characteristics, including economic base. Patterns of employment exhibited by the predominant industry is reflected in the regional unemployment patterns. In each of the three states the forest industry development centers and tourism/recreation development centers have lower rate of unemployment than do relatively undeveloped areas. The study found that within the regional patterns mentioned before, Michigan contrasts with Wisconsin and Minnesota. The unemployment rates are appreciably higher in Michigan compared to both Wisconsin and Minnesota.

The most recent study by Chappelle and Pedersen(1991), examines the economic contribution of Michigan forest products during the eighties. They found that although the decade was characterized by an economic pattern of recession in its first years, the rate of growth of employment in forests products firms at State and National level was higher than that of manufacturing firms as a whole. They estimated that the total impact of the sector (direct and indirect) in the employment reached around 134,000 jobs in 1987. The total impact in the value added attributable to the sector was estimated in more than \$6 billion for the

same year. One important finding of this research was that only a half of Michigan's timber consumption came from Michigan timber harvest. So, they conclude that there are good prospects for developing new projects in the sector and to expand the existent industries. Production to export to other regions of the country could be feasible as well.

2.2 A Brief Survey of Industrial Diversification Measures

Through the years, researchers have developed several indicators that attempt to measure industrial diversification. These measures usually differ in complexity. Most of them fulfill the basic requirements of the researchers. The complexity of a measure and its validity generally depend on assumptions behind the indicator used and the objectives pursued. A professionally accepted standard criterion for measuring diversification does not exist so far. However, improvements in measurement have been achieved in recent years.

This work classifies regional diversification measures into four broad categories : measures based on normal proportions; durable goods measures; portfolio analysis approach; and entropy indexes. This classification is based on the type of indicator or index used to measure the

changes in the industrial structure of the region or geographic area of inquiry.

The works of Bahl, Firestine, and Phares (1971); Conroy (1975); and Jackson (1984) are used here to provide a detailed survey of diversification measures.

2.2.1 Measures Based on Normal Proportion

These methods are based on deviation from a normal proportion of employment for each industry. Normal proportion in this study represents an average or expected distribution of employment. Alternative measures of normal proportion have been examined in the literature by Bahl, Firestine, and Phares (1971). These authors considered three groups of measures which fall in this categories (i.e., characterized by a specific definition of "normal" employment). These measures are : (1) equal percentage or ogive; (2) minimum requirements; and (3) national average.

The most frequent of these proportion measures is the equal percentage. This measure assumes that each industrial sector would exhibit an equal percentage of employment if the economy is fully diversified. For instance, if a region comprised of 25 SIC activities, it is expected under this

approach that share of 4 percent should be achieved for each sector to represent total diversification. The usual formula for this measure is :

$$OGI = \sum_i^N \left| \frac{e_i}{e_t} - \frac{1}{N} \right|$$

Where, N = number of individuals sector in the region; and

e_i = the employment in industry i.

e_t = the total employment in the region.

The first to use of this type of index was McLaughlin (1930), followed by the works of Tress (1938), and Rodgers (1957) who modified the measure developed by Tress. Rodgers constructed a Lorenz curve based on the distribution of total employment in sector by manufacturing group for each industrial area¹ and compared this with the average distribution for all industrial areas analyzed (an average or uniform distribution is represented by the main diagonal in a Gini's concentration index model). The term "ogive" is used in the literature to refer to this type of measure. Keinath (1985) used this approach with a slight modification. He computed absolute deviations from the equal percentage value, instead of using the sum of squares

¹ The term "industrial areas" is used in Rodgers's paper in a descriptive sense to indicate a manufacturing area.

deviations as the basis of computation. Both the Rodgers approach or Keinath approach lead to similar results.

This measure has gained wide acceptance because of its easy computation and interpretation. Here based on the assumption of equal proportion for each industrial sector, it is expected that the index will weight heavily the absence of employment in a specific sector without any consideration of the overall employment distribution. In larger urban areas where there is employment in almost all economic manufacturing activities, diversification will be greater.

The major criticism of this approach arises from the weakness of the equal proportion assumption. This measure poses that in order to obtain an optimal diversification it is necessary to attain a uniform distribution of employment in the region or area analyzed, which occurs rarely. More important, this situation is usually not desirable. Technologies vary from one activity to another. So, the magnitudes of employment and income is different for different economic activities.

It is very difficult to get equal proportions in the real world. Other aspects concerned with supply and demand of inputs and final goods are not taken into account using

this approach. Institutional and legal regulations in the industry are ignored as well.

The minimum requirements method was developed by Ullman and Dacey (1960) and by Alexandersson (1956). Here total employment is classified into basic and non basic sectors. The minimum requirement employment is defined as the percentage needed to maintain the internal needs of the region (non-basic sector employment). To obtain the diversity indicator a least squares analysis should be carried out plotting the minimum percent for an activity against the population associated with this activity.

The regression provides expected minimum requirements for each activity. These values are used to compute the final index. According to Ullman and Dacey (1960), the employment percentage in excess of the minimum requirement (non-basic) represent the export or basic employment. The least squares regression takes the form :

$$M_i = \alpha_i + \beta_i \log(\text{Population})$$

Here, $i = 1 \dots n$ SIC codes.

M_i = minimum percent employed for each industry and population.

Based on the result of this regression a diversity index (D) is calculated, as follows :

$$D = \frac{\sum_i^n (P_i - M_i)^2 / M_i}{(\sum_i^n P_i - \sum M_i)^2 / \sum M_i}$$

Here, P_i = percent of employment in the i-th industry class.

It has been pointed out that this procedure does not give results independent of the population size class. Therefore, there exists a positive correlation between basic employment and population size class. Bahl, Firestine, and Phares (1971) assert that the regression process used to estimate the minimum requirement percentages should take into account the city size differential since population is a variable in the regression model exhibited above. The diversification index is corrected for city size by dividing the initial index (unadjusted) by the ratio of squared basic employment percentage and the total minimum requirements employment percentage.

The weakness of this approach is that the minimum requirements percentage is biased with respect to the population size. The index can be corrected for city size by using only the numerator of the current ratio which is based on the results of the regression. The national average approach uses the national average employment as the norm. The national measure refers to the sum of the regional deviations from the national percentages in industrial categories (Jackson, 1984). It is established that the greater is the sum of these deviations, the lower will be the degree of industrial diversity. These groups of measures also are found in the works of Borts (1961) and Florence (1948). Under this approach the national economy is assumed to be diversified and that industrially diversified region's employment percentages should replicate the national economic structure. This last proposition is very difficult to accomplish. This measure can be represented as follows :

$$NAV = \sum_i^N \left| \frac{e_i}{e_t} - \frac{E_i}{E_t} \right|$$

Where, NAV = National Average Measure.

N = number of industrial sectors in region i.

e_i = the employment in industry i.

e_t = total employment in the region.

E_i = national employment in industry i.

E_t = total national employment.

These measures are extremely sensitive to differences in technology and production capabilities between regions, accessibility to resources and other economic variables that could affect each sector's employment share. Weaknesses of this measure are quite similar to those of the ogive approach.

2.2.2 Durable Goods Measures.

Analysts have attempted to explain regional cyclical variations in industry based on an diversification measure made up of the proportion of durable goods in a region. Siegel (1966) and Cutler and Hansz (1971) used this type of indicator to measure industrial diversification. The general form of this measure is :

$$PDUR = (e_{it} / e_t) * 100$$

Here,

e_{it} = employment in durable goods industry i and region t .

e_t = total employment in region t .

The proportion of a region's employment in durable goods production has been usually considered one of the most sensitive to the business cycle. Also, it has been used as an indicator of a region's reliance on export income.

Jackson (1984) says that because durable goods are characterized by a high income elasticity of demand during a period of downturn, one could expect that consumers restrain their purchases of such goods. Then, lower levels of production could occur along with likely labor layoffs in the specific industry and those linked in some way to it. One can conclude that use of this type of measure could bring about serious problems due to its sensitivity to business cycle, and its limitation to diversification analysis since only durable goods activities are taken into account. An important bias against larger urban areas could result as well since most durable goods activities are usually concentrated there. As was the ogive, this measure has been considered overly simplistic and naive.

2.2.3 Portfolio Variance Measure.

The source of this approach can be found in the pioneer work of Markowitz (1959). In this work Markowitz developed a portfolio analysis method whose purpose was to measure risk associated with returns to various portfolios of financial assets and the effect of diversification in reducing the intrinsic risk associated to each portfolio.

In Markowitz's model, financial risk is represented as the historical variability of the return to a dollar, when it is invested in an specific financial asset. Then a

covariance matrix is calculated whose elements represent the similarities in risk fluctuations between the different assets that are part of the portfolio. The portfolio index consist of a weighted average of all values in the covariance matrix.

Conroy (1975) used Markowitz's portfolio variance approach in the analysis of the regional industrial structure. He considered the returns, in terms of employment level, that a region could derive from its economic activity, under a risk of the instability in such returns. Note that under this approach the variability in the employment level for an activity is considered the risk.

This variability in employment is measured through the covariance of the residuals obtained from the time series employment information. The portfolio variance (σ_p) is defined in Conroy's work as :

$$\sigma_p = \sum_i \sum_j w_i w_j \sigma_{ij}$$

Where, w_i, w_j represent the proportion of regional resources (or other relative weights) allocated to i and j . σ_{ij} denotes the covariance of predetermined returns criterion over time for industries i and j .

Jackson (1984) points out that the portfolio variance measure reflects the structural composition of the region's economy in terms of the employment covariation in the sector and between sectors. The measure is dependent upon both the observed variance within categories of industries and the average covariance of each sector with every other sector". Under Conroy's approach a region's portfolio variance measure represents the weighted sum of the time- sectoral variance and covariances. The lower the measure of risk, the more cyclically stable and diversified industrial structure.

Despite the fact that Conroy's approach represents a great advance in measuring industrial diversification (it was the first time that risk is embodied in the economic diversification analysis), some weaknesses have been found in his approach. The first is related to his assumption that the matrix of covariance of employment in alternative industries is identical for all regions. This situation is unlikely to occur. Second, a large amount of data is needed to calculate the full portfolio of activities, so the task of compiling reliable information in terms of periodicity and desegregation is difficult. Brown and Pheasant (1985), found additional difficulties with Conroy's approach. Conroy's work excludes non-manufacturing industries, leaving out important sectors of the economic activity. The scope of his study was limited to metropolitan areas, which could

create a serious bias when economic diversification is measured since one could be omitting important contributions in terms of employment originated from the non-manufacturing industries, such industries usually are not located in urban regions or they may be linked to manufacturing industries not located in urban regions.

2.2.4 Entropy Measures.

Another technique that has been widely used to measure industrial diversification relies on the concept of entropy. Entropy is a term borrowed from the physics. An entropy index attempts to measure the deviation of a given distribution from complete concentration (minimum entropy) or complete dispersion (maximum entropy). In measuring industrial diversity the idea of the index is to compare the diversity of a industrial structure against a uniform distribution of the employment among all industry sectors (Wasylenko and Erickson, 1978). It is measured in general terms as :

$$D(p_1, p_2, \dots, p_n) = -C \sum_i^n p_i \log p_i$$

Here, n = number of industry classes.

p_i = the relative proportion of each industry class.

C = arbitrary constant which determines the scale of measurement.

An application of this sort of measure can be found in Garrison and Paulson (1973), who used this measure to evaluate a geographic concentration of industry in the Tennessee Valley region. Hackbart and Anderson (1975), were the first to apply entropy as a measure of economic diversification. Wasylenko and Erickson (1978), demonstrated that entropy measures yield diversity ranking for regional economies similar to that of ogive index.

The most important recent contribution using this type of index is that of Kort (1981). In his work Kort used the diversification index to predict a measure of regional instability. The relationship used by Kort in his regression model is quite similar to that used by Conroy (1975) and Siegel (1966). Kort (1981, p. 597) suggest that "... the relationship between industrial diversification and economic instability varies with the city size, and that any model explaining variations in REI must accordingly incorporate the relationship among all three variables." So, he incorporates city size to the analysis of regional instability. Kort's relationship between instability and diversification was given by :

$$REI_i * \sqrt{POP_i} = a \sqrt{POP_i} + b (DI_i \sqrt{POP_i}) + E_i \sqrt{POP_i}$$

Here, POP_i = population of regional economy i.

REI_i = instability index of region i.

DI_i = diversification index of region i.

REI and DI formulas will be developed in the research methods chapter.

One important point to note when this approach is used is that a relationship between Regional Economic Instability (REI) and diversification can lead to a likely patterns of heteroscedasticity when ordinary least squares (OLS) is used. A weighted least squares (WLS) could be used to correct the problem. The weights to use can be the population size of each region at that period. Brewer and Moomaw (1986) made a small correction on the weights used in Kort's formula. This new reformulation corrects the regression to a homoscedastic pattern. Therefore, the best linear unbiased estimators² (BLUE) could be maintained.

² Classical assumptions of linear regression model provide the best linear unbiased estimators and equal variances among the different groups regarded.

2.3 Review of Some Important Studies of Industrial Diversification Related to Instability

Several of the most important empirical works are summarized below. Experiences in the United States and Canada will serve to show the usefulness of these measures of diversification and instability in developing guidelines for regional economic decision making.

Siegel (1966) was the first to measure regional economic instability. His index was based on proportions of employment for durable goods sectors. The idea was to compute the standard error of the estimate of a trend line obtained through a time series of the regional employment. The residual of the observed data against the adjusted information was the basis of the regional economic instability index. Siegel (1966, p. 44) was interested in knowing "... whether or not regions differ from each other in cyclical performance for reasons other than industry mix." The research was conducted over the United States, using data from 1949 to 1962. Standard Metropolitan Statistical Areas (SMSAs) were the basis for compilation of information at the two digit level in the industrial classification. He found that SMSAs displayed similar average cyclical amplitudes for durable goods and different average amplitude for non-durable goods. However, his results were not conclusive enough to answer his initial question.

Bahl, Firestine, and Phares (1971) analyzed industrial diversity in urban areas of the United States. They compared several "normal" proportions measures such as minimum requirements, ogive, and national average. They were interested in knowing which of these measures was the best. They used information from the 1960 Industrial Census for 212 SMSAs. They found that the minimum requirements approach yielded the best results. The other measures of diversification produce different and ambiguous results when population is considered in the relationship. Therefore, they argue (p. 419) that "the minimum requirements measure links industry norms to population size". This is coherent with the body of literature that suggests a relationship between employment requirements and population size. The main finding of this study was that population size is associated in both absolute and relative terms to increases in tertiary employment (services). The study concludes (p. 421) that blue-collar work "... will increasingly be located not just in suburban areas but beyond the SMSA", this fact creates strong implications in public policy issues. Some additional evidence has shown that this in fact happened in the US.

Conroy (1975) carried out one of the most important studies in diversification and instability in recent years. He noted that the earlier literature in the field does not

clearly exhibit the actual relationship between regional economic instability and diversification. Conroy's contribution was a new diversification measure that was not used before in the regional economic field -portfolio variance analysis.

The nature of this measure has been explained in section 2.3, above. In his work he tested several measures of industrial diversification for the year 1963 against instability measures, including the new one. The time series of the research was for 1958-67. He included fifty two SMSAs based upon 118 industrial sectors.

From his results he concluded that the portfolio variance measure was the one most highly correlated to regional employment instability. Nevertheless, he notes that one should be careful in using this method because of the strong assumption that interindustry covariances are uniform nationwide.

Since Conroy's work several researchers have tried to improve the portfolio variance method to obtain better results in empirical inquiry. St. Louis (1980), developed a model to measure regional industrial diversification following a Markowitz-Conroy portfolio context. He used annual employment data for nine Canadian provinces and

Canada as a whole. The Standard Industrial Classification (SIC) at the one digit level was used. The idea of this study was to measure industrial diversification using the concept of the regional efficient frontier, which was developed using a quadratic programming technique. The study concludes that this new technique could be used to improve results obtained using Conroy's model. Kurre and Weller (1988) investigated regional cyclical instability based on twenty five years of monthly data for the period 1958-1983 for Erie, Pennsylvania which is a Metropolitan Statistical Area (MSA) consisting of one county of the same name. Information was collected at the two digit SIC level.

This study attempted to measure cyclical fluctuations not only with respect to employment but also to wages and hours worked. The study found that in the case of the wages and hours worked, Erie manufacturers tend to do their adjustment by hiring and firing workers, and to a lesser extent, by adjusting hours worked per week. Conroy's portfolio variance analysis, was used to analyze employment in order to complement this study.

Recently, Board and Sutcliffe (1991) carried out and study using a portfolio model in six regions of Spain. They developed single, aggregate, and multiregional portfolio

model whose objective was to generate frontiers of risk/income efficient industrial mixture for a regional economy. The models were applied to the tourist industry which is responsible for 15% of the Spanish employment. Their results showed that portfolio theory can be an useful tool to analyze the level and stability of regional employment (or income), to produce good estimates of income/risk efficient frontiers. So, the policymakers' task is to choose the appropriate point on such a frontier to meet policy objectives.

Kort (1981), is the most notable recent work in this field. He demonstrated the importance of incorporating the size of population in models that attempt to explain cross sectional variations between regional economic diversification and instability. Using information for 106 SMSAs for the period 1967-1975, Kort applied an entropy index of diversification. Average annual data at the two digit SIC level were obtained from the Bureau of Labor Statistics (BLS). A model that accounts for differences in stability between large and small cities was developed in this study.

One of the most important findings of this study was that the variance of the error term decreased with increased regional size. Kort's major finding was that the

relationship between regions economic instability (REI) and industrial diversification varies by city size. He points out that diversification is not the only factor accounting for variations in REI. More meaningful conclusive results are obtained when the REI/ diversification model is corrected for city size variation (heteroscedasticity), and at least diversification is one factor accounting for REI differences.

Chapter III

Research Methods

3.1 Data Collection and Sources

The information used in this research was entirely compiled from secondary sources. This information was used in the delineation of economic regions, which served as our units of analysis. Initially a sectorization was made in order to define our set of economic activities upon which the regionalization would be based. Once the appropriate sectorization was chosen the information compiled was used to determine economic structure of each county. This last aggregation was the base for our regionalization.

During this stage Michigan's statistics were gathered and assessed. Several sources of data were considered. The best option to choose was the one that could provide suitable information at the level of disaggregation required to calculate diversification and instability indexes.

Four potential sources were evaluated to isolate the one that would best provide a desirable level of sectoral disaggregation likely to lead to rational measurement of impacts of the business cycle on Michigan's economy in the medium term. The following data sources were explored :

- (a) **County and City Data Book.** It was found that this source provides some information at the level of county and city employment and population, but not by economic activity. This information did not fullfill the requirements of disaggregation pursued in this research.
- (b) **The Michigan Employment Security Commission (MESC) Statistics.** This information is compiled monthly and annually. The number of employees, average weekly hours worked, average hourly and weekly earnings at four digit code can be obtained through this source, based on MSAs boundaries³.
- (c) **County Business Patterns.** Data about employment, population, wages, etc. can be obtained from this source at the three SIC digit level and in many cases information is available at the four SIC digit level as well. This information is collected annually.
- (d) **Information compiled through the Center for Redevelopment of Industrialized States (CRIS) at Michigan State University.** The Center collects

³ MSA represents the Metropolitan Statistical area classification and its boundaries, as defined on June 30, 1983.

much information on many economic and social variables. This source can provide annual employment and wages data at the level of three digit SIC code for the period 1982-1987. County population data can also be obtained from this source for the period 1982-1990. CRIS information is a combination of information from County Business Patterns and other Michigan Market Statistics.

An annual time series of employment based on CRIS' database and County Business Patterns was gathered for the period 1976-1989. CRIS information covered the 1982-1987 period and was complemented with information gathered from the 1988 CBP annual report. This information was collected at the three digit SIC level for most of the economic activities and the four digit SIC level for the forest products industry. Employment data by economic activity from 1976 to 1987 based on the 1982 Standard Industrial Classification was adjusted to the 1987 Standard Industrial Classification. It was expected that this information fulfills the requirements of data necessary to meet the study objectives.

3.2 Sectorization by Economic Activity

Sectorization was made with a focus on three important research objectives of :

- (a) It was necessary to use a sectorization that reflected the current economic structure of Michigan.
- (b) To obtain suitable indicators of diversification and instability.
- (c) To measure the importance of the forest products industry in Michigan's economy.

To meet these objectives, it was necessary to use a sectorization that was as disaggregated as possible. A significant level of sectoral disaggregation is an important ingredient to achieve better knowledge of the effect of diversification on the region as a whole.

The criterion to choose a specific sector for delineation was its importance on the local economy. This means that only those sectors whose economic contributions were important for the local economy were considered as potential candidates. The number of firms in the sector, sales, and number of employees were variables taken into account for the final decision. Under this criterion a

sectorization that is a slight modification of that used by Chappelle et al. (1986, p. 6) was considered. Chappelle's sectorization provided a suitable framework for the type of sectorization required in this research. Few changes have been made. Economic activities were aggregated at the three SIC digit level for most economic activities and the four digit SIC level for the forest product activities. In a few cases the two digit SIC code was used. Table 3.2, shows the sectorization used.

**Table 3.2. Sectors of the Michigan Economy and their
Standard Industrial Classification (SIC) Codes.**

Sector	Description	SIC Codes
1	Fishing, Hunting, and Agr. Services	071-078, 091-097
2	Metals Mineral, Crude Petr. and Natural Gas	101-109, 122-124 131-138, 141-149
3	Construction	part 138, 152-179
4	Food and Kindred Products	201-209
5	Textiles and apparel	221-229, 231-239
6	Logging contractors	2411
7	Sawmills and planing mills	2421
8	Millwork, flooring, Struct. members	2426, 2431, 2439
9	Wood furniture and Fixtures	2434, 2511, 2512, 2517, 2521, 2531, 2541
10	Wood pallets and Skids	2448
11	Veneer and Plywood, other Lumber and Wood Products	2429, 2435, 2436, 2441, 2449, 2451, 2452, 2491, 2492, 2499
12	Paper and Allied Products	2611, 2621, 2631, 2661, 265, 267
13	Printing and Publishing	271-279
14	Chemicals and Petroleum Prod.	281-289, 291-299
15	Rubber and Leather Products	301-308, 311-319
16	Stone, Clay, Glass, and Concrete Products	321-329
17	Primary Metals Industries	331-339

Table 3.2 (cont'd.)."

Region	Activity	SIC Code
18	Fabricated Metal Products, Excp. Machinery and Transp. Equipment	341-349
19	Machinery and Equipment	35(except 355, 356, 358, 359) 361-369, 37
20	Transportation and Public Utilities	40-42, 44-49
21	Misc. Manufacturing	381-399, and all 24,25,26 excluded above.
22	Wholesale and Retail trade	501-599
23	Finance, Insurance, and Real Estate (F.I.R.E.)	601-679
24	Other Services	08, 355,356, 358,359, 701-899 (excl. 88)

Twenty four sectors were selected to represent the industrial economic structure of the State. These sectors comprise SIC categories which range from 01 to 89. Sectorization of the Michigan economy was a required step before delineating regions needed in the diversification analysis.

3.3 Regionalization

The delimitation of regions has been seen as a problem whose nature depends mainly on specific research objectives. Czamanski (1973, p. 3) pointed out that it is necessary to make the distinction between the concepts of a region and area or zone. An area represents any part of a two dimensional space. A zone could be considered as a special area which has some "characteristics or characteristic in contradiction to the remaining part of a given space". Region is a term that implies an area within the national economy (in our case Michigan) that is sufficiently comprehensive in structure that it can function independently and that is linked with the rest of the economy.

Usually three approaches are considered when regions need to be defined - uniform or homogeneous regions, nodal or polarized regions, and programming or planning regions. Homogeneous regions are defined by Richardson (1969, p. 19) in terms of "...unifying characteristics, and where internal differences and intra-regional interactions are considered unimportant." Here, certain areas cohere together to define a region when they are homogeneous from the view of sharing an specific characteristic. For instance, like occupational distribution of the manpower or production structures quite similar, or similar per capita income etc.

Nodal regions are based on the functional integration principle, which emphasizes the relationships and linkages of the different spacial and economic units within the region. According to Richardson (1969, p. 227) " Nodal regions are composed of heterogeneous units, but these are closely interrelated with each other functionally ".

Planning regions are defined based on the coherence and unity of economic decision making. So, regions are defined as political jurisdictions whose sizes and levels will depend on the policy objective that the government pursues. In general, once the main criterion is chosen, it is possible to integrate elements of the other criteria into the regionalization.

3.3.1 Delimitation of Regions

Regions were defined based principally on the criterion of homogeneity in this study. The delineation of the regional boundaries was based on economic base and regional characteristics. Counties were used as building blocks of regionalization.

An economic region was constructed in such away that its internal structure reflected not only some degree of homogeneity among its most important economic activities - given by the sectorization -but also exhibited the existing degree of diversification among the set of activities characteristic of such a region. Regions, under our classification, reflect significant differences in terms of types and mixes of economic activities. Summing up, a region is defined here as a group of counties that share similar economic structures in terms of sectoral employment.

3.3.2 Use of Factor Analysis to Allocate Counties into Regions

Factor analysis was used to define economic regions. Information from Table 3.1 provided the sectorization used in the model. Data base information of employment by economic activities at the appropriate SIC code was then used to feed the factor analysis model.

Factor analysis (Kim, 1978 p. 9) refers to "...a variety of statistical techniques whose common objective is to represent a set of variables in term of a smaller number of hypothetical variables or factors"(factors). Factor analysis is a multivariant statistical technique that is based on partial correlations.

Factor analysis starts by considering a square simple correlation matrix. This matrix is factored generating the principal factor solution. Following that, a rotation of the principal factor is made in order to maintain principal factors orthogonal. This rotation does not affect the proportion of the total variance explained by the factors. Nevertheless, it redistributes their explanatory function among corresponding number of new factors (Harman, 1967). Each variable loads on each factor, and the loading can be considered equivalent to a simple correlation between a variable and a factor. The value of a factor loading varies from -1 to +1 with the sign indicating the direction of the correlation between the variable and the factor. Our model was designed to maximally reproduce correlations, the general form is:

$$Z_i = a_{i1} F_1 + a_{i2} F_2 + \dots + a_{im} F_m + a_i U_i$$

Where,

$i = 1, 2, \dots, n$ variables (or type of employment in the economic activity i).

$m = 1, 2, \dots, m$ counties.

a_{im} is the factor loading for the i th variable on factor m , with F_i being common factors⁴ and a_i and u_i being

⁴ Common factors are those that are involved in the creation of more than one observed variable while those that are used in creating only one observed variable are called unique factors. Likewise, factor loadings are equivalent

the unique factor loading and unique factor respectively. Z_i represents the standardized variable $Z_i = (X_i - \bar{X}) / s$, where X_i is the employment in sector i , $\bar{X}$ is the average employment, and s is the respective standard deviation. Z_i is distributed $N(0,1)$. Factor loadings were determined by fitting this model (i.e., the a_{im} s).

The a_{im} is the proportion of variance of variable i explained by factor m . The proportion of total variance explained by a factor is :

$$VAR_m = \sum_i a_{im}^2 / (\text{trace of the factor matrix})$$

The communality of a variable is defined as the portion of a variable's total variance that is accounted for by the common factors. Communality is determined as follows :

$$h^2 = a_{i1}^2 + a_{i2}^2 + \dots + a_{im}^2$$

Only loading of the common factors are utilized in computing communality. Two types of factors were introduced:

- (a) Common factors which involve more than one variable.
 - General factor (almost all variables load highly on one factor).
 - Group factor (more than one variable is taken into account, but not all variables loaded on the factor).
- (b) Unique factor which involves a single variable.

to correlations between factors and variables where only a single common factor is involved.

It is important to note that common factors account for variable interrelations (Harman, 1967) whereas unique factors represent that part of a variable not accounted for by its correlations with other variables.

Factor analysis can be performed mainly through two types of techniques; the R-Technique and the Q- technique. Most studies in the field use R- technique, which provide the usual covariance matrix. That is, given an entity mode (rows) which represent objects or cases, the resultant covariance matrix is for the relationship among the components of the variable mode (columns). Meaning that the R- mode produces a correlation matrix of the characteristics inherent to our objects or cases.

The Q-mode is the transposed factor technique and was used in this work. This variant of the general factor analysis produced groups of counties sharing similar economic activities in terms of employment participation. The common rotated factors obtained represent our regions.

In summary, at this stage our goal was to create economically uniform regions made up of a group of counties (m) characterized by certain variables (n economic activities) which were reduced into a small number of factors (regions). These regions are characterized by a high degree of uniformity in terms of economic structure. The main characteristic used was a maximum variance between groups and minimum within groups variance.

Finally, in order to define the regionalization to be used in this research, the Q-mode factor analysis procedure was applied to two nonsuccessive years (1982 and 1988). After that, having the two regional cross-sections, it was feasible to evaluate if our regionalization changed

meaningfully or not. Based on this information a regionalization year was chosen. Results of this analysis are discussed in chapter four.

3.4 Measures of Diversification and Instability

A second set of methods are required for measurement of diversification and instability. These indexes are developed to provide information about the degree of vulnerability of the Michigan's economy to external shocks. At this stage a model quite similar to that used by Kort (1981) was applied to evaluate diversification and instability. Results of this analysis were compared with and ogive index, and a percentage of durable goods index⁵.

3.4.1 Relationship between Economic Diversification and Instability

Until a few years ago, experts in the field doubted the real existence of a relationship between regional economic instability (REI) and regional diversification (DI). Hoover (1985, p.371) for example, remarked that "...Actually this is neither true nor logical, as was showed quite a long time ago by Glenn E. McLaughling. Diversification is roughly neutral in its effects on cyclical instability". This general thought remained until recently when two important works made important contributions to this area.

The works of Conroy (1974, 1975) and Kort (1981) were pioneering in demonstrating existence of an important relationship between REI and DI.

For our purpose Kort's methodology was used. Some reasons for this decision were:

⁵ The description and mathematical representation of the last two indexes are found in Chapter 3.

- (a) Kort's indexes of diversification and instability can be easily calculated from quite disaggregated industrial data.
- (b) Kort's model can take into account the scale effect measured by the size of the region. The method provided weights that allow for estimation of economic instability as related to the economic structure of the State, particularly in terms of employment.
- (c) The method facilitates measuring the extent to which diversification of Michigan's economy through expansion of forest product sectors may contribute to economic stability.

3.4.1.1 Measurement of Regional Economic Instability (REI)
 Regional Economic Instability was measured based on the following relationship :

$$REI_i = \left\{ \sum_i \left((e_{it} - \hat{e}_{it}) / \hat{e}_{it} \right)^2 / T-2 \right\}^{1/2}$$

Where,

$i = 1, 2, \dots$ regions.

e_{it} = total yearly employment for region i at time t .

$\hat{e}_{it}$ = linear approximation of the long run growth trend in employment in region i at time t .

T = Number of time periods.

Higher values of the REI indicate greater relative economic instability.

3.4.1.2 Measurement of Industrial Diversification (DI_i)

An index of industrial diversification (DI) was calculated for each region based on the following formulation :

$$DI_i = \sum_j \frac{e_{ij}}{e_i} \ln \frac{1}{e_{ij} / e_i}$$

which is equivalent to

$$DI_i = - \sum_j \frac{e_{ij}}{e_i} \ln \left(\frac{e_{ij}}{e_i} \right)$$

Where,

e_{ij} = employment in region i, industry j.

e_i = total employment in region i.

$\ln$ = natural log.

A higher DI_i value indicates greater relative diversification, while a lower value indicates less relative diversification, or alternatively greater relative specialization. After calculating this measure for each region the next step was to measure the relationship between regional economic instability (REI) and regional industrial diversification (DI).

Previous experiences have shown that use of ordinary least (OLS) to measure this relationship leads to inappropriate results since the assumption of constant variance between regions does not hold. REI models as we know are characterized by heteroscedastic error variances and the variances likely decrease with increased region size (scale effect). Therefore, our model was build taking into

account this fact. A weighted least squares model (WLS) which corrects the problem of unequal variances was then applied. The model included the correction in weights suggested by Brewer and Moomaw (1986).

$$REI_i * POP_i^{1/4} = a * POP_i^{1/4} + b(DI_i * POP_i^{1/4}) + E_i * POP_i^{1/4}$$

Where,

POP_i = population in region i.

a,b are estimated parameters.

E_i = disturbance error in region i.

If the index of diversification (DI) increases in value as the level of industrial diversification increases, and if the REI index increases in value as the level of economic instability increases, then the sign of the coefficient b will be negative ($b < 0$). If the level of diversification decreases with higher diversification values, then $b > 0$ (Kort, 1981).

These indexes of diversification and instability were compared with those obtained from the ogive and percentage of durable goods indexes. Results are shown and analyzed in chapter five.

Chapter IV

An Economic Regionalization for Michigan

The objective of creating an economic regionalization for Michigan is to provide a tool that allows one to measure changes in employment in most of the economic activities within regions (in this case, groups of counties not necessarily contiguous). The regionalization delineated groups of counties that share similar economic structure in terms of employment.

4.1 Factor Analysis Results

Michigan's economic regionalization was carried out through a Q-mode factor analysis approach. This technique was applied initially on economic information for the year 1988. Economic activities at the level of three and four digit SIC codes were grouped into economic sectors.

Q-mode factor analysis provides for aggregation of counties. Initially, a correlation matrix among counties is obtained. This correlation matrix served as the basis of the factor analysis. Correlations between two counties indicates the extend to which the two counties analyzed resemble each other with regard to employment patterns.

A point that needs to be addressed is that in this particular case the correlation matrix may show clusters or groups of counties that are alike but which have no particular similarity to those in some other groups. According to Cattell (1952, p. 92) "...Q-technique is an ideal method for finding types if such types actually exist with respect to the variables in question. The individual who shows the highest mean intercorrelation with all others in the cluster is the most perfect representative of the type".

In order to apply the Q-mode technique, the matrix of information was standardized before starting the correlation of the counties. The standardization process transformed the information into a Normal distribution with mean zero and variance one. That is, one was assuming that counties had the same means and the same variances. After that, factor analysis was carried out for the year 1988.

A varimax rotation was done in order to preserve orthogonal factors. A number of six rotated factors (Regions) were considered appropriate to initiate the allocation of counties for both years. Allocation of counties into each factor was based on the highest rotated loading for the county. Absolute values of the loadings were taken into account (see appendix B). For the year 1988

the six rotated factors selected explained more than 95 percent of the variance.

In factor analysis it is important to distinguish the difference between positive and negative factor loadings. Factors are usually named according to the majority of variables having the same direction in relation to the component. Some variables could be negatively correlated with the factor. So, bi-polar factors will be those that load positively on some variables and negatively on others. Factor analysis showed a large concentration of counties in rotated factor 1 (Region 1). In fact, sixty one (61) counties were included in this region. Region 2 included thirteen counties (13), followed by Region 3 with four counties (4); Region 4, three counties, and Regions 5 and 6, which comprised single counties.

The constraint of contiguity was not considered in this regionalization due the fact that it was an objective to group counties with similar economic structure. This type of grouping does not necessarily lead to contiguous regions, but rather homogeneous regions. Table 4.1 and Figure 4.1 show our results.

Table 4.1. Economic Regionalization of Michigan. Year 1988.

Region	Counties**
Region 1	1,2,3,4,5,6,7,8,9,11,12, 14,15,16,17,18,20,21,23, 24,25,26,27,28,29,30,31, 32,33,35,36,37,38,39,41, 43,45,46,49,50,52,53,54, 55,56,57,58,59,60,61,63, 65,68,69,73,74,78,79,81, 82,83
Region 2	10,13,19,34,44,51,62, 64,67,70,75,76,80.
Region 3	40,66,71,77.
Region 4	22,42,47.
Region 5	72
Region 6	48

** See Appendix A for the key to the counties.

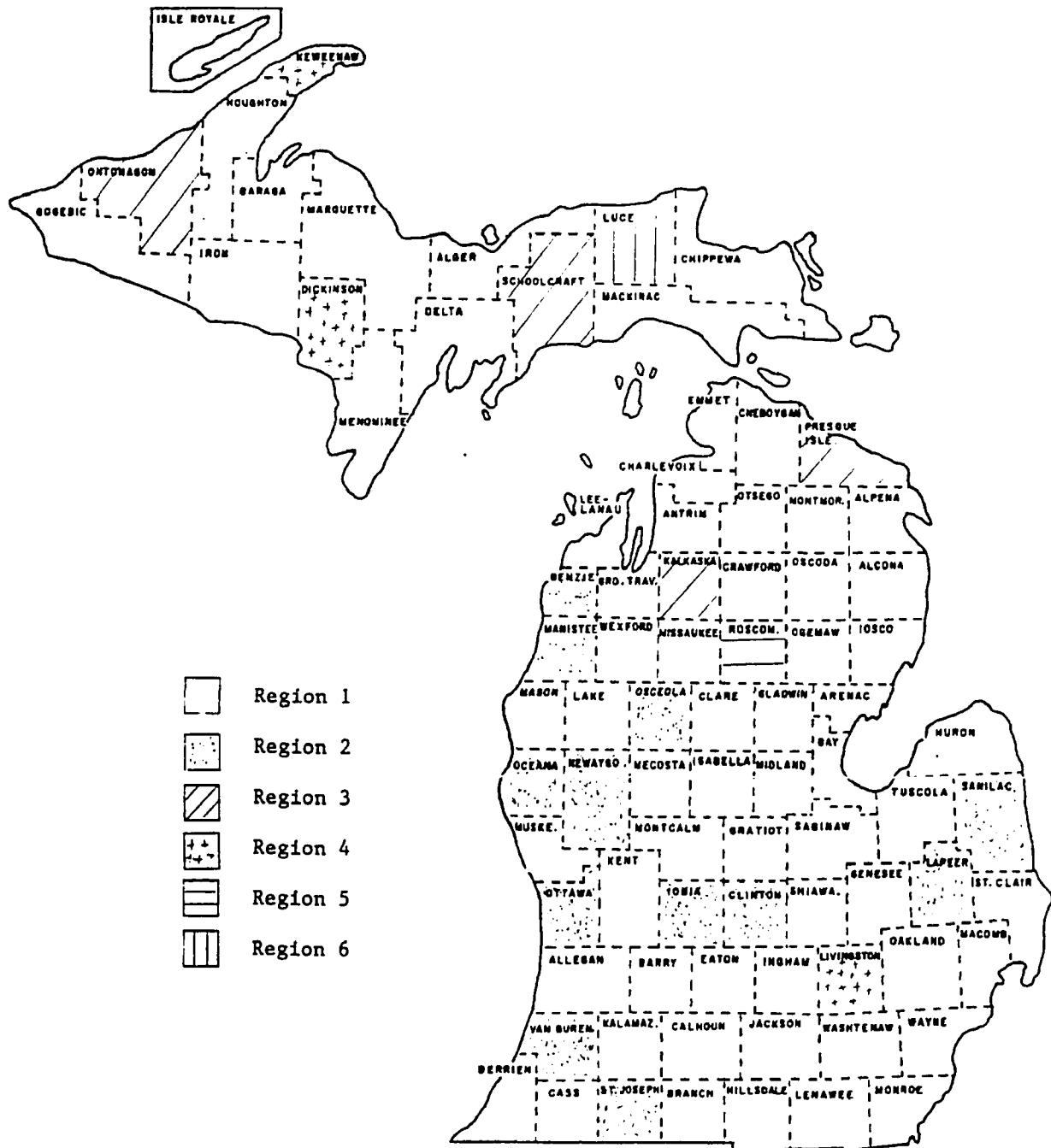


Figure 1. Michigan Regionalization. 1988.

Factor analysis was also applied to year 1982 to see if regional structure for both years (1982 and 1988) were comparable. The results showed some differences in the composition of the regions. Differences in raw data such as number of activities involved each year, non available information etc., made the comparison fairly weak. So, results for year 1982 were considered unsuitable for comparing the two years. Appendix C shows the 1982 factor analysis results. Therefore, year 1988 was chosen as the base year for our regionalization. This year provided a suitable regional framework for the development of indexes of diversification and instability. Having identified the regions, the next step was to assess the economic bases of these regions.

Chapter V

Regional Economic Base of Michigan

In order to assess the economic base of each region the economic composition of employment at county and sector level was analyzed for the year 1988. Several tables were analyzed to obtain a clear picture of the economic composition of each region. Results of this analysis are important in order to determine the economic composition of each region in terms of regional employment.

5.1 Michigan's Basic Activities.

The development of basic activities is an important component of regional economic development. Basic activities in our case are those that export to the outside world or other states generating significant increases in value added, services, taxes, residences, etc. for the local economy. In this work it is important to consider basic employment, e.g., the employment engaged in basic activities.

A location quotient technique⁶ was used to determine

⁶ Location quotients were calculated, considering
i = 1,...24 activities (sectors)
j = 1,...6 regions

then,

basic activities. Location quotients shows the degree of specialization of a sector in a region belonging to a system of regions. Basic activities are those whose location quotients were greater than one. Table 5.1 shows our results.

A location quotients greater than one indicates that the activity is providing export jobs. That is, employment engaged in exporting activities to the rest of the country or to the outside world.

Economic base activities in region 1 are located in sectors 1, 3, 7, 10, 15, 19, 23, and 24 . The reader should see Table 3.2 (pp. 51-52) in order to identify sector's names. Most basic activities here are miscellaneous industries that usually are linked to some kind of service.

where,

LQ_{ij} = location quotient for activity i and region j.
 E_{ij} = employment in activity i and region j.
 E_i = employment in activity i for the entire State.
 E_j = employment in region j.
 E = employment in the entire State.

Table 5.1 . Michigan Location Quotients. 1988.

Sector	Region1	Region2	region3	Region4	Region5	Region6
sect1	1.11	0.38	0.00	0.22	0.00	0.00
sect2	0.84	0.42	199.74*	0.21	0.00	0.00
sect3	1.01	0.51	0.86	2.02	0.00	9.71
sect4	0.76	3.55	0.00	0.08	0.00	0.00
sect5	0.97	0.51	0.77	2.93	0.00	0.00
sect6	0.86	0.00	110.10*	1.92	0.0	1088.34*
sect7	1.09	0.45	0.00	0.33	0.00	0.00
sect8	0.90	2.34	0.00	0.00	0.00	0.00
sect9	0.99	1.37	0.00	0.41	0.00	0.00
sect10	1.03	1.18	0.00	0.00	0.00	0.00
sect11	0.62	4.75	0.00	0.27	0.00	0.00
sect12	0.65	4.52	0.00	0.00	0.00	0.00
sect13	0.94	0.56	0.92	3.32	0.00	0.00
sect14	0.90	2.22	0.00	0.31	0.00	0.00
sect15	1.06	0.75	1.93	0.26	0.00	0.00
sect16	0.95	0.68	0.00	2.91	0.00	0.00
sect17	0.71	4.01	0.00	0.12	0.00	0.00
sect18	0.96	0.48	0.87	3.18	0.00	0.00
sect19	1.01	1.13	0.91	0.35	0.00	0.00
sect20	0.94	1.08	0.57	2.22	0.00	0.00
sect21	0.89	1.68	0.45	1.70	0.00	0.00
sect22	0.94	1.46	0.31	1.29	0.00	0.00
sect23	1.09	0.49	0.61	0.19	10.47	0.00
sect24	1.09	0.55	0.06	0.21	0.71	0.00

* Note: These are labor intensive activities such as mining, crude petroleum production, and timber production located in low populated areas (Kalkaska, Ontonagon, Luce, Presque Isle, and Schoolcraft).

Region 2 is the more diversified in terms of basic activities because there are more sectors that are basic. Sectors 4, 8, 9, 10, 11, 12, 14, 17, 19, 21, and 22 are considered basic. Region 3, basic sectors are linked to activities identified as labor intensive (sectors 2, 6, 15). Region 4 basic activities are located in sectors 3, 5, 6, 13, 16, 18, 20, 21, and 22. Most of these activities have been labeled as conventional or traditional. Examples of this type of activities are: construction; textile production; timber production; clay and concrete products etc. On the other hand, what has been called new industries are those characterized by technologies that are changing periodically (food production processes, chemical processes and so on). Regions 5 and 6 are not diversified. These regions are engage in very few activities.

It is important to note that some service activities have qualified as basic in the analysis due to the link that those activities have with the manufacturing sector, some services are part of the chain that make an activity basic.

An important point to address is the location of the automotive industry. It is located in several sectors of regions 1 and 2.i.e., sectors 5, 11, 14, 15, 19, 20, and 21 are related to different stages of automobile manufacturing. One could increase the number of sectors if the

distributional component is considered (wholesale and other services).

Finally, it is necessary to point out that the location quotient technique is not a quite exact technique in the sense that it should be applied under very special conditions. The location quotient technique assumes that for a specific region :

- Locals residents face the same demand schedule that prevail at the state level.
- They face the same level of productivity in terms of output per employee through the system of regions.

Nevertheless, location quotient technique is an accepted rough way of delineating basic sectors.

5.2 County Economic Structure.

Once regional basic activities were specified, the next step was to identify basic activities within counties in order to identify the economic potential of each of them. Table 5.2, depicts the share of the employment in each county by sector in terms of basic activities for the year 1988. The table identifies counties strongly involved in a specific economic activity or sector.

Table 5.2 Percentage of Total Nongovernmental and Nonagricultural
Employment Involved in Economic Base Activities.
Michigan 1988.

SECTOR	ALCONA	ALGER	ALLEGAN	ALPENA	ANTRIN	ARENAC	BARAGA
sect1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect3	0.0	0.0	6.1	13.9	9.8	0.0	0.0
sect4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect7	0.0	0.0	1.0	0.0	0.0	0.0	0.0
sect8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect10	50.0	0.0	0.0	3.4	0.0	0.0	0.0
sect11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect15	0.0	0.0	4.6	0.0	0.0	0.0	0.0
sect16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect17	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect18	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect19	0.0	0.0	6.3	0.0	9.8	0.0	0.0
sect20	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect21	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect22	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect23	0.0	0.0	8.5	21.4	9.8	5.8	0.0
sect24	50.0	100.0	73.6	61.3	70.7	94.2	100.0
For. Prod. Industry	50.0	0.0	1.0	3.4	0.0	0.0	0.0

Note: Sector names are defined in Table 3.2.

Table 5.2 (cont'd.).

SECTOR	BARRY	BAY	BENZIE	BERRIEN	BRANCH	CALHOUN	CASS
sect1	0.0	0.0	0.0	0.4	0.0	0.6	0.0
sect2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect3	5.9	6.4	0.0	7.1	0.0	4.8	0.0
sect4	0.0	0.0	8.1	0.0	0.0	0.0	0.0
sect5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect7	3.0	1.3	0.0	1.7	0.0	0.6	0.0
sect8	0.0	0.0	8.1	0.0	0.0	0.0	0.0
sect9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect12	0.0	0.0	8.1	0.0	0.0	0.0	0.0
sect13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect14	0.0	0.0	8.1	0.0	0.0	0.0	0.0
sect15	0.0	2.9	0.0	2.5	0.0	1.0	0.0
sect16	5.9	0.0	0.0	0.0	0.0	0.0	0.0
sect17	0.0	0.0	8.1	0.0	0.0	0.0	0.0
sect18	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect19	0.0	6.6	0.0	8.4	0.0	2.5	0.0
sect20	8.8	0.0	8.1	0.0	0.0	0.0	0.0
sect21	0.0	0.0	8.1	0.0	0.0	0.0	0.0
sect22	0.0	0.0	24.3	0.0	0.0	0.0	0.0
sect23	11.8	11.2	0.0	12.9	16.4	13.7	13.2
sect24	64.5	71.6	19.0	67.0	83.6	76.8	86.8
For. Prod. Industry	3.0	1.3	16.2	1.7	0.0	0.6	0.0

Table 5.2 (cont'd.).

SECTOR	CHARLEVOIX	CHEVOYAN	CHIPPEWA	CLARE	CLINTON	CRAWFORD	DELTA
sect1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect3	27.4	16.3	5.3	0.0	0.0	0.0	2.7
sect4	0.0	0.0	0.0	0.0	4.8	0.0	0.0
sect5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect7	0.0	4.9	0.0	0.0	0.0	0.0	0.0
sect8	0.0	0.0	0.0	0.0	4.8	0.0	0.0
sect9	0.0	0.0	0.0	0.0	4.1	0.0	0.0
sect10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect14	0.0	0.0	0.0	0.0	9.2	0.0	0.0
sect15	5.2	3.5	0.0	0.0	0.0	0.0	0.0
sect16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect17	0.0	0.0	0.0	0.0	4.8	0.0	0.0
sect18	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect19	5.2	6.5	0.0	0.0	4.0	0.0	0.0
sect20	0.0	0.0	0.0	0.0	18.6	0.0	0.0
sect21	0.0	0.0	0.0	0.0	15.6	0.0	0.0
sect22	0.0	0.0	0.0	0.0	34.0	0.0	0.0
sect23	0.0	11.4	15.8	17.2	0.0	9.4	15.9
sect24	62.1	55.4	78.9	82.8	0.0	90.6	814
							0
For. Prod. Industry	0.0	4.9	0.0	0.0	8.9	0.0	0.0

Table 5.2 (cont'd.).

SECTOR	DICKINSON	EATON	EMMET	GENESEE	GLADWIN	GOGEBIC	GRAND_TRAVERSE
sect1	0.0	0.7	0.0	0.7	0.0	0.0	0.0
sect2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect3	15.9	7.7	6.8	8.4	11.2	0.0	11.2
sect4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect5	8.7	0.0	0.0	0.0	0.0	0.0	0.0
sect6	1.1	0.0	0.0	0.0	0.0	0.0	0.0
sect7	0.0	2.3	1.3	0.1	11.2	0.0	1.4
sect8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect13	9.5	0.0	0.0	0.0	0.0	0.0	0.0
sect14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect15	0.0	1.3	0.0	2.8	0.0	0.0	1.5
sect16	8.7	0.0	0.0	0.0	0.0	0.0	0.0
sect17	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect18	8.7	0.0	0.0	0.0	0.0	0.0	0.0
sect19	0.0	6.0	3.2	6.0	11.2	0.0	4.6
sect20	18.2	0.0	0.0	0.0	0.0	0.0	0.0
sect21	9.5	0.0	0.0	0.0	0.0	0.0	0.0
sect22	19.7	0.0	0.0	0.0	0.0	0.0	0.0
sect23	0.0	30.1	7.2	11.2	11.2	14.8	10.5
sect24	0.0	51.9	81.4	70.8	55.1	85.2	70.5
For. prod. Industry	1.1	2.3	1.3	0.1	11.2	0.0	1.4

Table 5.2 (Cont'd.).

SECTOR	GRATIOT	HILLDALE	HOUGHTON	HURON	INGHAM	IONIA	IOSCO
sect1	0.0	0.0	0.0	0.0	0.9	0.0	0.0
sect2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect3	3.8	2.8	10.7	6.1	8.0	0.0	8.7
sect4	0.0	0.0	0.0	0.0	0.0	8.5	0.0
sect5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect7	0.0	0.0	0.0	0.0	0.6	0.0	0.0
sect8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect9	0.0	0.0	0.0	0.0	0.0	5.5	0.0
sect10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect11	0.0	0.0	0.0	0.0	0.0	4.2	0.0
sect12	0.0	0.0	0.0	0.0	0.0	4.2	0.0
sect13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect14	0.0	0.0	0.0	0.0	0.0	5.7	0.0
sect15	1.7	0.0	0.0	6.1	1.5	0.0	0.0
sect16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect17	0.0	0.0	0.0	0.0	0.0	4.2	0.0
sect18	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect19	1.7	0.0	0.0	6.6	3.1	11.2	0.0
sect20	0.0	0.0	0.0	0.0	0.0	12.5	0.0
sect21	0.0	0.0	0.0	0.0	0.0	11.5	0.0
sect22	0.0	0.0	0.0	0.0	0.0	32.4	0.0
sect23	12.9	11.6	21.7	28.3	16.0	0.0	34.1
sect24	79.8	85.6	67.6	50.9	69.9	0.0	57.2
For. Prod. Industry	0.0	0.0	0.0	0.0	0.6	13.9	0.0

Table 5.2 (Cont'd.).

SECTOR	IRON	ISABELLA	JACKSON	KALAMAZOO	KALKA.	KENT	KEWEENAW
sect1	0.0	0.0	0.6	0.6	0.0	0.7	0.0
sect2	0.0	0.0	0.0	0.0	90.2	0.0	0.0
sect3	0.0	8.3	8.7	7.7	0.0	11.1	10.0
sect4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect5	0.0	0.0	0.0	0.0	0.0	0.0	10.0
sect6	0.0	0.0	0.0	0.0	9.8	0.0	0.0
sect7	0.0	0.0	1.2	1.0	0.0	1.2	0.0
sect8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect10	0.0	0.0	0.0	0.0	0.0	0.1	0.0
sect11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect12	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect13	0.0	0.0	0.0	0.0	0.0	0.0	10.0
sect14	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect15	0.0	1.4	1.6	2.0	0.0	2.7	0.0
sect16	0.0	0.0	0.0	0.0	0.0	0.0	10.0
sect17	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect18	0.0	0.0	0.0	0.0	0.0	0.0	10.0
sect19	0.0	1.4	3.7	3.4	0.0	5.4	0.0
sect20	0.0	0.0	0.0	0.0	0.0	0.0	20.0
sect21	0.0	0.0	0.0	0.0	0.0	0.0	10.0
sect22	0.0	0.0	0.0	0.0	0.0	0.0	20.0
sect23	33.3	14.5	12.6	11.2	0.0	12.3	0.0
sect24	66.7	74.5	71.6	74.1	0.0	66.4	0.0
For. Prod. Industry	0.0	0.0	1.2	1.0	9.8	1.3	0.0

Table 5.2 (Cont'd.).

SECTOR	LAKE	LAPEER	LEELANAU	LENAWEE	LIVINGSTON	LUCE	MACKINAC
sect1	0.0	0.0	0.0	0.6	0.0	0.0	0.0
sect2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect3	0.0	0.0	19.9	4.8	10.5	46.5	23.8
sect4	0.0	5.1	0.0	0.0	0.0	0.0	0.0
sect5	0.0	0.0	0.0	0.0	9.8	0.0	0.0
sect6	0.0	0.0	0.0	0.0	0.1	53.5	0.0
sect7	0.0	0.0	0.0	0.8	0.0	0.0	0.0
sect8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect9	0.0	9.3	0.0	0.0	0.0	0.0	0.0
sect10	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect12	0.0	5.1	0.0	0.0	0.0	0.0	0.0
sect13	0.0	0.0	0.0	0.0	9.2	0.0	0.0
sect14	0.0	6.7	0.0	0.0	0.0	0.0	0.0
sect15	0.0	0.0	0.0	1.2	0.0	0.0	0.0
sect16	0.0	0.0	0.0	0.0	9.9	0.0	0.0
sect17	0.0	5.1	0.0	0.0	0.0	0.0	0.0
sect18	0.0	0.0	0.0	0.0	9.4	0.0	0.0
sect19	0.0	7.7	0.0	2.0	0.0	0.0	0.0
sect20	0.0	20.4	0.0	0.0	19.9	0.0	0.0
sect21	0.0	8.5	0.0	0.0	9.7	0.0	0.0
sect22	0.0	32.1	0.0	0.0	21.5	0.0	0.0
sect23	0.0	0.0	0.0	12.7	0.0	0.0	16.8
sect24	100.0	0.0	80.1	78.0	0.0	0.0	59.4
For. Prod. Industry	0.0	14.4	0.0	0.8	0.1	53.5	0.0

Table 5.2 (Cont'd.).

SECTOR	MACOMB	MANISTEE	MARQUETTE	MASON	MECOSTA	MENOMINEE	MIDLAND
sect1	1.1	0.0	0.0	3.8	0.0	0.0	0.0
sect2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect3	12.7	0.0	6.1	9.4	5.1	12.9	18.2
sect4	0.0	9.1	0.0	0.0	0.0	0.0	0.0
sect5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect7	1.7	0.0	0.8	0.0	0.0	0.0	3.0
sect8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect9	0.0	9.1	0.0	0.0	0.0	0.0	0.0
sect10	0.2	0.0	0.0	0.0	0.0	5.9	0.0
sect11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect12	0.0	9.1	0.0	0.0	0.0	0.0	0.0
sect13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect14	0.0	9.1	0.0	0.0	0.0	0.0	0.0
sect15	2.5	0.0	1.7	0.0	0.0	0.0	3.5
sect16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect17	0.0	9.1	0.0	0.0	0.0	0.0	0.0
sect18	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect19	6.2	9.1	2.5	3.8	0.0	0.0	7.2
sect20	0.0	9.1	0.0	0.0	0.0	0.0	0.0
sect21	0.0	9.1	0.0	0.0	0.0	0.0	0.0
sect22	0.0	27.3	0.0	0.0	0.0	0.0	0.0
sect23	10.3	0.0	12.6	22.1	14.4	23.5	6.4
sect24	65.5	0.0	76.3	61.0	80.5	57.7	61.8
For. Prod. Industry	1.8	18.2	0.8	0.0	0.0	5.9	3.0

Table 5.2 (Cont'd.).

SECTOR	NISSAUKEE	MONROE	MONTCALM	MONTMORE.	MUSKEGON	NEWAYGO	OAKLAND
sect1	0.0	0.8	0.0	0.0	0.0	0.0	0.9
sect2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect3	0.0	9.3	2.6	17.5	11.4	0.0	9.3
sect4	0.0	0.0	0.0	0.0	0.0	9.1	0.0
sect5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect7	0.0	1.3	0.0	0.0	1.0	0.0	1.1
sect8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect9	0.0	0.0	0.0	0.0	0.0	9.1	0.0
sect10	0.0	0.0	2.5	0.0	0.0	0.0	0.0
sect11	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect12	0.0	0.0	0.0	0.0	0.0	9.1	0.0
sect13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect14	0.0	0.0	0.0	0.0	0.0	9.1	0.0
sect15	0.0	3.4	0.0	0.0	4.0	0.0	1.7
sect16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect17	0.0	0.0	0.0	0.0	0.0	9.1	0.0
sect18	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect19	0.0	4.6	2.5	0.0	5.8	9.1	3.6
sect20	0.0	0.0	0.0	0.0	0.0	9.1	0.0
sect21	0.0	0.0	0.0	0.0	0.0	9.1	0.0
sect22	0.0	0.0	0.0	0.0	0.0	27.3	0.0
sect23	10.5	10.5	12.1	0.0	10.0	0.0	17.0
sect24	89.5	70.1	80.4	82.5	67.7	0.0	66.4
For. Prod. Industry	0.0	1.3	2.5	0.0	1.0	18.2	1.1

Table 5.2 (Cont'd.).

SECTOR	PRESQUE ISLE	ROSCOMM	SAGINAW	ST CLAIR	ST JOSEPH	SANILAC	SCHOOLCR
sect1	0.0	0.0	0.8	0.0	0.0	0.0	0.0
sect2	74.5	0.0	0.0	0.0	0.0	0.0	67.3
sect3	0.0	0.0	8.7	9.6	0.0	0.0	0.0
sect4	0.0	0.0	0.0	0.0	8.1	7.9	0.0
sect5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect6	0.0	0.0	0.0	0.0	0.0	0.0	32.7
sect7	0.0	0.0	2.1	1.1	0.0	0.0	0.0
sect8	0.0	0.0	0.0	0.0	8.1	0.0	0.0
sect9	0.0	0.0	0.0	0.0	0.8	5.9	0.0
sect10	0.0	0.0	0.2	0.0	0.0	0.0	0.0
sect11	0.0	0.0	0.0	0.0	1.9	2.0	0.0
sect12	0.0	0.0	0.0	0.0	0.0	7.9	0.0
sect13	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect14	0.0	0.0	0.0	0.0	8.1	7.9	0.0
sect15	25.5	0.0	3.2	1.2	0.0	0.0	0.0
sect16	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect17	0.0	0.0	0.0	0.0	8.1	7.9	0.0
sect18	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sect19	0.0	0.0	6.6	3.8	2.6	7.9	0.0
sect20	0.0	0.0	0.0	0.0	11.5	12.2	0.0
sect21	0.0	0.0	0.0	0.0	18.1	10.1	0.0
sect22	0.0	0.0	0.0	0.0	32.7	30.4	0.0
sect23	0.0	100.0	12.0	14.0	0.0	0.0	0.0
sect24	0.0	0.0	66.4	70.2	0.0	0.0	0.0
For. Prod. Industry	0.0	0.0	2.3	1.1	10.8	15.8	32.7

Table 5.2 (Cont'd.).

SECTOR	SHIAWASSEE	TUSCOLA	VAN BUREN	WASHTEN	WAYNE	WEXFORD
sect1	0.0	0.0	0.0	1.3	0.4	0.0
sect2	0.0	0.0	0.0	0.0	0.0	0.0
sect3	6.8	7.3	0.0	7.8	6.3	0.0
sect4	0.0	0.0	8.6	0.0	0.0	0.0
sect5	0.0	0.0	0.0	0.0	0.0	0.0
sect6	0.0	0.0	0.0	0.0	0.0	0.0
sect7	0.0	3.6	0.0	0.6	1.3	0.0
sect8	0.0	0.0	0.0	0.0	0.0	0.0
sect9	0.0	0.0	7.0	0.0	0.0	0.0
sect10	0.0	0.0	0.0	0.0	0.0	6.2
sect11	0.0	0.0	2.9	0.0	0.0	0.0
sect12	0.0	0.0	5.7	0.0	0.0	0.0
sect13	0.0	0.0	0.0	0.0	0.0	0.0
sect14	0.0	0.0	6.1	0.0	0.0	0.0
sect15	1.9	0.0	0.0	1.7	2.4	0.0
sect16	0.0	0.0	0.0	0.0	0.0	0.0
sect17	0.0	0.0	8.6	0.0	0.0	0.0
sect18	0.0	0.0	0.0	0.0	0.0	0.0
sect19	1.9	3.6	10.3	3.2	4.4	0.0
sect20	0.0	0.0	11.7	0.0	0.0	0.0
sect21	0.0	0.0	9.4	0.0	0.0	0.0
sect22	0.0	0.0	29.7	0.0	0.0	0.0
sect23	16.1	16.0	0.0	9.4	14.1	8.6
sect24	73.3	69.5	0.0	76.1	70.9	85.2
For. Prod. Industry	0.0	3.6	15.6	0.6	1.4	6.2

For instance, sector 2 which is related to non-renewable resources such as metals, minerals, crude petroleum etc. is heavily represented in Schoolcraft, Presque Isle, Kalkaska, and Ontonagon counties. That is, these counties have a higher proportion of employment in these activities compared with other counties in Michigan. Activities related to food and kindred products (sector 4), have important relative contribution in employment in Ionia, Manistee, Newaygo, Oceana, Osceola, and Van Buren counties.

Rubber and leather product industries are important components of employment in Presque Isle, Huron , and Charlevoix. Stone and concrete products industries have an important employment share in Livingston and Dickinson counties.

In the same way, activities related to forest products such as veneer and plywood production are important components of Ionia and Van Buren counties' economic activity.

Forest Products Activities (sectors 6 to 12) represent an important component of the basic economy of the following counties : Benzie (16.2 %), Luce (53.5 %), Manistee (18.2 %), Newaygo (18.2 %), Oceana (18.2 %), and Schoolcraft (32.7 %). The forest products sectors

contribute 2% of the state basic activities in terms of employment. This figure should be taken as a minimum given the constraints in the data used.

Tertiary activities such as transportation and public utilities, wholesale and retail trade, finance, insurance, and real estate are the most important components in most counties. Oakland and Wayne counties are the most important centers that concentrate most of the heavy, medium, and basic industries.

5.3 Regional Economic Basic Structure.

In order to accumulate more evidence on Michigan's economic structure, Table 5.3 was built. This table attempts to provide further insights on Michigan's economic structure in terms of employment distribution. The share of each sector in each of the six regions determined in the factor analysis is evaluated in terms of basic economic activities for year 1988. Most sectors are strongly represented in Regions 1 and 2, while the other regions show a lower share in the economic employment distribution.

The regionalization provided by the factor analysis provides a kind of hierarchical classification in terms of specialization in employment. Region 1 shows a great concentration of tertiary activities (F.I.R.E. and other

Table 5.3. Basic Sectors Share by Region. Michigan 1988.

Sector	Region1	Region2	Region3	Region4	Region5	Region6
sect1	0.6	0.0	0.0	0.0	0.0	0.0
sect2	0.0	0.0	96.0	0.0	0.0	0.0
sect3	8.5	0.0	0.0	11.0	0.0	100.0
sect4	0.0	8.2	0.0	0.0	0.0	0.0
sect5	0.0	0.0	0.0	9.7	0.0	0.0
sect6	0.0	0.0	0.0	0.1	0.0	0.0
sect7	1.2	0.0	0.0	0.0	0.0	0.0
sect8	0.0	2.9	0.0	0.0	0.0	0.0
sect9	0.0	2.9	0.0	0.0	0.0	0.0
sect10	0.0	0.0	0.0	0.0	0.0	0.0
sect11	0.0	3.5	0.0	0.0	0.0	0.0
sect12	0.0	5.4	0.0	0.0	0.0	0.0
sect13	0.0	0.0	0.0	9.2	0.0	0.0
sect14	0.0	8.8	0.0	0.0	0.0	0.0
sect15	2.2	0.0	3.5	0.0	0.0	0.0
sect16	0.0	0.0	0.0	9.8	0.0	0.0
sect17	0.0	6.8	0.0	0.0	0.0	0.0
sect18	0.0	0.0	0.0	9.4	0.0	0.0
sect19	4.4	4.2	0.0	0.0	0.0	0.0
sect20	0.0	12.7	0.0	19.7	0.0	0.0
sect21	0.0	12.7	0.0	9.7	0.0	0.0
sect22	0.0	32.0	0.0	21.3	0.0	0.0
sect23	13.7	0.0	0.0	0.0	100.0	0.0
sect24	69.2	0.0	0.0	0.0	0.0	0.0
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0
F. Prod.	1.3	14.7	0.0	0.1	0.0	0.0

Note: Figures represent percentages of nonagricultural and nongovernmental employment engaged in basic activities. Sector name can be found in Table 3.2.

services). Most populated and developed counties are represented in this region.

Region 2 includes mostly a group of counties usually less developed in terms tertiary activities than those in the first region. Food and kindred products production, forest products sectors (except those associated with sawmills and planing mills) are located in this region. Chemical and petroleum products, primary metals industries, manufactures in general, and machinery and transportation are part of the region as well. Wholesale and retail sales are the only significant component of the service sector in this region.

It can be noted that this region includes counties whose activities are related to the use of natural and agricultural resources. Also, it can be remarked that some of these types of industries involve production processes characterized as potentially harmful to the natural environment. Likely this region along with region one will need to maintain suitable environmental regulations that will guarantee the well being of the people and species living in the region.

Region 3 is strongly linked to a set of counties involved with primary activities such as metals, minerals, crude oil, and natural gas production.

Region 4 includes a group of counties engaged in some basic economic activities. Construction, textiles and apparels, printing and publishing, fabricated metal products, and stone, clay etc. are some of the activities developed in this region. Activities of transportation, some manufactures, and wholesale and retail sales are also important components of the economic structure of the region.

Regions 5 and 6 represent single counties regions with few industrial economic activities, and are likely engaged in agricultural activities.

Our characterization of this economic regionalization for Michigan is :

Region 1 : Services and miscellaneous industries.

Region 2 : Food production, new industries⁷ (forest products, chemicals, machinery and transportation, other manufactures), and distribution (wholesale and retail sale).

Region 3 : Extractive industries.

Region 4 : Conventional or basic industries and distribution.

Region 5 : Basic agriculture and forestry.

⁷ New industries here represent those industries whose technology is changing periodically. They do not represent new entering industries in the market.

Region 6 : Other basic industries.

This classification could not be taken as entirely exact, but as an attempt to associate a specific label to each delineated region.

5.3.1 Delimitation of Planning Regions.

Our economic regions can become functional regions for policy objectives. Within each economic region (mainly regions 1 and 2) counties can be grouped according to certain characteristics (contiguity, population size or similarities in the development of certain economic and activities). For instance, within a specific economic region incentive policies for expansion of manufacturing capacities could be applied to certain counties and not necessarily to the whole group in the region.

The configuration or type of planning region defined within our economic regions is going to depend on the type of policy the policy-makers have in mind. In other words, given a set of policies to be performed and knowing the economic regionalization of Michigan, planning regions could be delimited based on objectives to be pursued by the policy.

5.4 Sectoral Employment by Region.

The distribution of the employment was assessed for year 1988 and compared with that of 1982. Table 5.4 indicate the non-agricultural and nongovernmental employment obtained from our regionalization. These figures could be low due to the problems of disclosure that one faces when using this source of information.

Activities as was expected were concentrated in region 1. Region 1 contains around 85 % of the State employment. Region 2's share is 10% and the rest is distributed among the other four regions. The automotive industry is located in several sectors of regions 1 and 2.

Table 5.4. Sectoral Employment by Region. 1988.

Sector	Region1	Region2	Region3	Region4	Region5	Region6	TOTAL
sect1	7382	285	0	67	0	0	7734
sect2	5208	295	1650	60	0	0	7213
sect3	97509	5522	110	8907	0	60	112108
sect4	23502	12316	0	120	0	0	35938
sect5	56675	3317	60	7826	0	0	67878
sect6	1639	0	145	87	0	69	1940
sect7	2056	649	0	195	0	0	2900
sect8	478	3000	0	0	0	0	3478
sect9	8000	1366	0	534	0	0	9900
sect10	1634	106	0	0	0	0	1740
sect11	3000	613	0	120	0	0	3733
sect12	6500	14000	0	0	0	0	20500
sect13	46421	3104	60	7438	0	0	57023
sect14	47649	13178	0	753	0	0	61580
sect15	24830	1958	60	274	0	0	27122
sect16	56648	4543	0	7917	0	0	69108
sect17	16059	10216	0	120	0	0	26395
sect18	49931	2808	60	7545	0	0	60284
sect19	100601	11692	60	800	0	0	113153
sect20	147421	19091	120	15914	0	0	182546
sect21	90660	19080	60	7852	0	0	117652
sect22	274956	48073	120	17194	0	0	340343
sect23	157163	7799	116	1239	175	0	166492
sect24	791949	45124	60	7063	60	0	844256
TOTAL	2017871	228135	2681	92025	235	129	2341016

Note: Sector names can be found in Table 3.2. Figures represent only nonagricultural and nongovernmental employment.

5.5 Development of the basic Forest Products Industries: Comparison of years 1982 and 1988.

The contributions of the forest products sectors (sectors six to twelve) were analyzed from an economic base perspective. Years 1982 and 1988 were analyzed using the 1988 regionalization scheme. At this stage the 1987 SIC classes were used to modify the 1982 data to reflect those standards. Relative figures were evaluated in order to avoid likely undercounting in sectorial employment due to the way our information was collected and aggregated.

The impact of basic forest products industries was measured for each of the seven sectors that made up the industry as a whole. Table 5.5 depicts the percentage of change in each sector for the period 1982-1988.

Table 5.5. Percentage Change in Forest Products Basic
Activities : periods 1982 -1988.

Sector	Activity	Percentage Change in Employment
6	Logging contractors	86.7
7	Sawmills and planning mills	840.6
8	Millwork, flooring, structural members	2503.4
9	Wood furniture and fixtures	25.7
10	Wood pallets and Skids	-19.2
11	Veneer and plywood, other lumber and wood products	183.6
12	Paper and allied products	194.3

Most sectors showed a positive increase in employment, but sector 10 (wood pallets and Skids) had a 19.2 % decrease. Sectors 7 and 8 showed the highest increase while sectors 6 and 12 were characterized by a moderate increase. Sector 9 showed a small increase during the period of analysis. Summing up, basic forest products employment as a whole grew overall 2.5 times the employment existent in 1982. Therefore, forest products activities have made an important contribution to Michigan's economic diversification.

Forest product basic activities were analyzed at the level of county for each one of the six sectors involved for years 1982 and 1988. Appendix D, shows maps for each sector for both years.

Sector 6 activities have improved a little bit in 1988 as compared with 1982. In this case the possibility of undercount should be considered (see for example, Chappelle et al., 1996). Counties in several regions are engaged in these types of activities.

Sector 7 is highly related to counties in region 1. This sector has shown significant increase in 1988 compared with 1982. The core of this industry is concentrated in Michigan's central counties.

Sector 8 represents activities carried out by counties in region 2. Most counties increased their shares in the activity during the 1982-1988 period.

Sector 9 characterizes another activity of region 2 which has been growing during the period of analysis. Sector 10 is an activity that was carried out in many counties located in regions 1 and 2 in 1982. The activity now is concentrated in a few counties of region 1.

Sectors 11 and 12 represent activities that have been increasing during the 1982-1988 period. Region 2 counties perform these type of activities.

5.6 Comparison of Recent Studies.

Forest products employment for the whole activity was compared with a recent study developed by Chappelle and Pedersen (1991). Percentage change between years 1988/1982 (our study) and 1987/1982 (Chappelle-Pedersen study) were calculated for each sector. This comparison allows us to evaluate the precision of our figures since both of them used Census information. Table 5.6 shows both results. Some classes have been adjusted to make the comparison feasible.

Table 5.6. Michigan Forest Products Industry Employment:
Comparison of Two Recent Research Studies.

Sector	1982- Base Year		% of Change	
	1991-Study*	1992-Study	87/82 1991-Study*	88/82 1992-Study
6- LOGGING	1100	1062	55	73
7- SAWMILLS	2400	1920	8	51
8- MILLWORK	2700	1586	67	119
9- W.PALLETS	7825	9913	7	0.4
10- W.FURNIT.	1500	1199	33	45
11- VENNER..	2900	3489	38	7
12- PAPER...	20000	18482	3	11
F. PRODUCTS	38425	37651	14	17

* Chappelle and Pedersen, 1991.

From the above table, it can be noted that the differences in total forest products is small for both studies but when the analysis is done by sector in some cases the differences appear important. It is likely that problems of disclosure of some figures and undercounting of sectoral employment are factors that cause these differences, along with the way in which the information was aggregated for each sector. Nevertheless, the comparison indicates a positive growth for all forest products sectors.

5.7 Share of Forest Products Sectors Employment in Michigan.

Forest products employment contribution to the whole economy has increased when years 1982 and 1988 were compared. Only direct jobs are included here. Table 5.7 show our figures.

Table 5.7. Share of the Forest Products Activities in Michigan Employment*: 1982 and 1988.

Year	State Employment	Forest Products Employment	Percentage
1982	2,305,470	37,651	1.6
1988	2,341,016	44,141	1.9

* Nonagricultural and Nongovernmental employment. Direct jobs only.

Forest products employment share increased from 1.6 % in 1982 to 1.9% in 1988. These figures indicate that the activity as a whole has increased, although the difficulties that have been affecting other sectors related to forest products activities (e.g., automotive industry). A very low nongovernmental of economic growth during the last years combined lately with long period of recession have reduced the demand for certain goods that use forest products as input.

Chapter VI

Results

Michigan's regionalization was the key step for calculating indexes of diversification and instability. These indexes are the result of several processes of aggregation. Starting from a specific sectorization, counties were grouped by region based on the type of economic activities they best performed. Many of these activities were defined at three and four digit SIC codes. Hence, it is necessary to point out that our information could suffer from lack of accuracy in the sense that part of it could show some degree of undercounting that likely arises from several sources.

As it is known, County Business Pattern information at the county level are not published entirely for industries at four and three digit SIC levels because of disclosure problems. This information is included in the total of the next broader industry (i.e., the two digit SIC level). This undercounting required analysis primarily in relative terms. Nevertheless, County Business Pattern information is considered "...The only series that provide annual subnational data by two-, three-, and four digit level of SIC system. The series is useful for analyzing the

industrial structure of regions..." (County Business Patterns 1988, Michigan, p. 9).

In the case of the forest products sectors a problem of undercounting of employment has been noted in the number of establishments for most of the seven sectors that made up the forest products industry when compared with other sources of information (Michigan Directory of Forest Products Manufacturers, 1983 and Primary Wood Using Industries : Michigan Directory, 1987). This fact, of course, affects the number of employees counted in these activities. Therefore, one should be cautioned that the absolute numbers in this study are likely to be low. However, the rates of change (relative numbers) can still be useful. In light of these limitations, measures of diversification and instability were calculated for each region for year 1988 and compared with other diversification measures such as the Percent of Durable and Ogive index.

6.1 Diversification (DIV) and Instability (REI) Indexes

Results.

In the case of Kort's diversification index a higher value indicates greater relative diversification. When the Ogive index is considered it is thought that for a regional economy to be diversified an equal percentage of regional employment should be allocated in each industrial category :

the greater the index, the lower industrial diversity. In the case of the Percentage of Durable, the greater the reliance on export income, the less diversified the economy is considered.

Table 6.1 shows Kort's diversification indexes for year 1988 along with the other measures of diversification and instability that were calculated. Kort's index indicates that region 2 is the most diversified. Region 2, as was shown above includes most secondary activities such as food processing and forest products production, machinery and equipment, and most of the manufacturing industries. Regions 4 and 1 follow in the ranking of diversification. Region 4 represents another important group of industries(traditional or basic industries) while region 1

Table 6.1. Population, Diversification, and Instability
Measures by Region. 1988.

Region	1990 Population (thousands)	Kort's Index	Percent of Dur.	Ogive	REI Index*
Region 1	8284.6	2.2353	13.4066	1.0441	0.0661
Region 2	796.6	2.5285	23.5503	0.8963	0.0690
Region 3	44.4	1.4396	12.1223	1.1880	0.1023
Region 4	144.2	2.3143	18.7482	1.1551	0.1031
Region 5	19.7	0.5681	0	1.8334	0.1294
Region 6	5.8	0.3564	53.4837	1.8334	0.1683
Michigan	9295.3	2.3163	14.6613	1.0066	0.0665

*Based on a 1976-1989 employment time series.

includes most of the services. Region 3, where extractive activities are found, is next in importance. Finally, regions 5 and 6 that represent single county regions are the least diversified, as was expected.

The other measures of diversification (percentage of durable and ogive) showed a behavior quite similar to that observed by previous investigations (Kort, 1981; Brewer, 1985). Table 6.1 shows regional indexes of instability (REI) that were calculated based on a time series for the period 1976-1989. The indexes seems to be strongly related to diversification indexes. However, inversely related to Kort's index; positively related to percentage durable and ogive index. So, more diversified regions depict lower instability indexes. Less diversified regions show greater REI values in the case of the Kort indexes.

6.2 Results of Hypotheses Tests.

In chapter I a group of hypotheses were put forth as necessary to meet in order to corroborate the situation of the regional economic development of Michigan and its perspectives. Hypotheses related to change in regional industrial structure; relationship between regional diversification and instability; and between regional diversification and size of region. Several indicators have been used to test the different hypotheses formulated.

Results of the different tests will serve to assess our initial statements and to provide policy makers with additional tools for their decisions.

Hypotheses 1 : A significant change in the regional economic structure of State has occurred during the period of analysis.

Information for years 1982 and 1988 were utilized to test this hypotheses. Initially a matrix of covariances for each year was calculated, since the idea was to compare the economic structure of the State for those specific years. Because of the symmetry of each matrix (24 sectors by 24 sectors) only the values below the main diagonal were considered. After that a process of vectorization was carried out to obtain a unique vector for each year. This process permitted comparison of the two years. A Wilcoxon test for paired samples was performed to test for a significant change in economic structure. The test was considered appropriate since it requires only ranks (non-parametric test). The SYSTAT computer package was used to obtain the following results :

H_0 : Structure82 = Structure88

H_1 : Structure 82 = Structure88

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	Struct82	Struct88	Total
Struct82	0	96	
Struct88	204	0	
			300

Here, the numbers represent cases.

A level of significance of $\alpha = .05$ was considered appropriate, since it is the usual level used in this type of test. Meaning that there is only a 5% probability that one can make a mistake making the decision (Type I error). A two tailed test was selected since our hypotheses is nondirectional.

Here, because of the size of the sample the Wilcoxon statistic was standardized (Z values). The value obtained was $Z = 5.6$ which indicates the rejection of the null hypotheses which means that the economic structure of Michigan significantly changed over the period 1982 to 1988.

Hypotheses 2 : There exists a negative relationship between regional diversification and regional instability.

The first step in this second case was to run OLS regressions having REI as dependent variable and each diversification index as the independent variable in order to measure the existence of some kind of relationship

between them. From previous works (Kort,1981; Brewer,1985 etc.) OLS estimates seems to produce weak results due to the presence of heteroscedastic residuals and the recommendation given has been to apply WLS (Weighted Least Squares) which eliminates this problem. Following this path, several WLS regressions were estimated using as a weight the proportion of the population recommended by Brewer and Moomaw (1986). Ordinary Least Squares results did not show signs of a severe pattern of heteroscedasticity. Despite this fact, Weighted Least Squares was used. The use of WLS improved meaningfully the models and the adjusted R-Squared changed in some cases in a significant way. Table 6.2 depict our results.

Table 6.2. WLS and OLS Regression of REI and Alternatives Measures of Industrial Diversification.

Diver. Index	DIV. Coeffic.		Constant Term		Adjust. R-Squared		F	
	WLS	OLS	WLS	OLS	WLS	OLS	WLS	OLS
Kort's	-.039 (-3.70)**	-.037 (-4.13)	0.171 (14.49)	0.164 (10.27)	.986	.763	174.2	17.1
P. Dur.	0.001 (2.34)	0.001 (1.19)	0.107 (6.53)	0.084 (3.53)	.973	.517	91.9	1.4
Ogive	0.084 (3.44)**	0.087 (4.53)	0.001 (.026)	-.008 (-.32)	.984	.796	155.4	20.5

Note : Number in parentheses are t values.

** Significant at .05 level.

In order to evaluate the degree of normality of our variables (it is important to recall that we are working with a small number of observations and the assumption of normality can not be made) a Kolmogoroff-Smirnoff one sample test for normality was performed. At a level of significance of 0.05 our variables behave normally. Therefore, parametric tests can be carried out. Table 6.3 depicts our results.

Table 6.3. Kolmogoroff- Smirnoff One Sample Test Using Standard Normal Distribution.

Variable	N of Cases	Max Dif	Prob (2-Tail)
Kort Index	6	0.259	0.730
P. Durable	6	0.261	0.725
Ogive	6	0.299	0.561
REI	6	0.200	0.932
Population	6	0.423	0.173
DIV82	6	0.235	0.827

Also, the finding that our variables behave normally allowed one to perform a set of Pearsons' correlation tests. Given the level of significance (.05), a theoretical value of $r_p = .729$ was obtained from the Pearson's correlation test table. This value was used to decide if a

relationship was significant. Values below r_p means accepting of the null hypothesis. Values above r_p means rejection of the null hypothesis.

The first of this group of tests attempted to measure the direction of the relationship between Kort's index and REI. It is thought that the higher diversification is, the lower the instability index will be. Therefore in this case our hypotheses would be : $H_0 : r = 0$

$$H_1 : r < 0$$

A Pearson's correlation coefficient test at one tail was carried out. This type of test was used since in this case one was trying to prove a directional hypotheses (the existence of a negative relationship between REI and DIV indexes). A value of $r = -.83$ was obtained. This result indicates the existence of a significant negative relationship. Hence, the null hypothesis was rejected at $\alpha = .05$.

By the same token, hypothesis tests were performed for the other two indicators. In the case of the Ogive index, the hypotheses was that a positive relationship exists between this indicator and REI. So,

$$H_0 : r = 0$$

$$H_1 : r > 0$$

The null hypotheses was rejected for a value of $r = .915$. Therefore, in this case the positive relationship was corroborated as well.

For the percentage of durable the hypotheses was based on the existence of a positive relationship. The greater the percentage of durable the more specialized the economy will be. Here,

$$H_0 : r = 0$$

$$H_1 : r > 0$$

A value of $r = .511$ was obtained. The positive relationship is so weak that the null hypotheses can not be rejected.

Hypotheses 3 : There exists a positive relationship between regional diversification and the size of the region in terms of population.

It has been posed by Thompson (1965) and established by Kort (1981), that a positive relationship exists between diversification and population size. The 1988 Kort indexes of diversification were compared with the population in each region to confirm the above statement for the case of Michigan. The natural logarithm of the population was the

used instead of the absolute population in order to avoid scale problems when compared both sets of data. Thus,

$$H_0 : r = 0$$

$$H_1 : r > 0$$

A directional hypotheses was postulated at $\alpha = .05$, finding that $r = .788$. So, the null hypotheses was rejected. A significant relationship between diversification and population can be established for Michigan.

This chapter along with chapter 4 group the main findings of this research. Several behavioral hypotheses for Michigan in terms of economic structure, diversity, and degree of instability have been posed. These results will be the basis for our conclusions and recommendations.

Chapter VII

Conclusions and Recommendations

This work has hypothesized that to achieve a more stable economy Michigan needs to develop a more diversified economic structure. The automotive industry, although employing a large number of workers and providing an important source of income, is very sensitive to cyclical changes that occur mainly due to external shocks produced by the international economy.

In order to avoid these "swings" of the domestic economy, the promotion and development of economic sectors that generate stable employment and income seems to be a good policy. Several empirical studies have detected economic areas that offer potential possibilities for the State's economy.

The food processing, recreational and tourist, robotics, and forest products industries were selected as target industries during Governor Blanchard's administration. This study has emphasized the last area: The forest products industry.

Several important conclusions were obtained from the data analysis, indicators, and other types of information

that were used and calculated throughout the research. Some policy recommendations and ideas for future research are encouraged.

7.1 Conclusions.

7.1.1 Data Requirements.

Despite a large amount of information used to obtain results, these findings should be viewed in relative terms. County Business Pattern information, although provided at the level of disaggregation required in this research, lacks accuracy when information at three and four digit SIC level is used.

This fact restricted development of some results in absolute terms. Nevertheless, by using this information carefully important results were obtained. Most findings obtained were based on information at three and four digit levels. For that reason indicators were calculated in relative terms to prevent misleading conclusions.

7.1.2 The Need for Better Information.

Current economic information at county level do not offer the correct level of disaggregation necessary to attain good results in absolute terms. In order to achieve a more suitable set of conclusions it will be necessary

that information at county level be more disaggregated when economic industrial structure needs to be evaluated. Some economic variables that do not jeopardize the financial structure of specific enterprises could be published at more disaggregated levels than currently. Complementary surveys could be carried out periodically for those sectors that offer potential possibilities of stable growth.

7.1.3 Basic Activities.

The number of employees engaged in basic activities increased significantly between the two years that were analyzed (1982 and 1988) for most sectors. More specifically, for forest products sectors the increase was positive, except for the Wood Pallets and Skids sector which showed decline. Forest product employment as a whole (basic and non basic) showed a positive trend when years 1982 and 1988 were compared.

According to our figures it seems that in recent years governmental and private initiatives have been growing in such a way that some counties have improved their economic base structure. Forest products employment has benefited in part by this initiative. An example of this initiative is the target industry program initiated during Governor Blanchard's administration.

7.1.4 Michigan's Diversification.

Results for 1982 and 1988 based on Kort's diversification indexes indicate that the State economy was more diversified in 1988 compared with 1982. However, not all regions in the state increased in diversification. Regions 1,2 and 4 increased in diversification, while regions 3,5 and 6 decreased.

Table 7.1. Kort's Diversification Indexes : 1982 and 1988.

Region	DIV88	DIV82	DIFFERENCE (DIV88-DIV82)
Region 1	2.2353	1.9156	0.3197
Region 2	2.5285	2.1812	0.3473
Region 3	1.4396	1.8443	- 0.4047
Region 4	2.3143	1.9564	0.3579
Region 5	0.5681	1.4264	- 0.8583
Region 6	0.3564	1.5408	- 1.1844
Michigan	2.3163	1.9449	0.3714

Region 3, which includes oil and minerals industrials was less diversified in 1988 than 1982. Differences in diversification among those regions that showed positive change fluctuated between 0.32 and 0.36. From the table, one can infer that those regions with higher populations show positive differences in diversification while the less populated regions were less diversified. Worker migration could be playing a key role. People have not been encouraged to stay in the region because of the lack of employment opportunities.

7.1.5 Michigan Economic Structure.

The economic structure of Michigan has become more diversified during the period of analysis. One explanation could be that because of extreme dependence of the state economy on the automotive industry (which has been facing a recessionist period during recent years), many workers have searched for alternative employment in other sectors that are more stable or show positive growth.

A second cause could be that the economy per se is changing, incorporating new technologies or new activities that result in a more stable and profitable structure. Government incentive policies and programs, and private initiatives could be playing a key role in this case. For instance, the Governor's target industry program could have been an important influence.

7.1.6 Diversification and Instability.

Our findings have shown a significant negative relationship between diversification and instability, at $\alpha = .05$ when a Pearson's correlation test was carried out using the Kort indexes. This result is supported by our Weighted Least Squares results which showed significant increases in adjusted R-Squares.

The comparison between the Ogive diversification index and REI index verified the existence of a positive relationship. However, in the case of the durable goods index, the positive relationship could not be corroborated. Weighted Least Squares correlation coefficients were significant for both cases.

7.1.7 Diversification and Population.

A positive relationship between population and diversification was found, verifying Kort's and Thompson's premises. The higher population in the region, the more highly diversified the region will be. So, as population grows, the regional economy becomes more diversified in order to meet consumption requirements for the different segments of the local economy and for exporting to other regions.

7.2 Recommendations and Future Research.

It has been fruitful to work with the information on the structure of the Michigan economy. New avenues have been opened that facilitate planning of programs and projects with a lower level of uncertainty. It is recommended that results of this study be considered when economic policies and projects are planned.

Government and private initiatives should continue in order to reach a combination of stability and diversification appropriate for Michigan. Based on our results, planning sub-regions within our economic regions could be delimited. These planning regions could be made up of groups of counties that share some characteristics inherent to the type of policy to be performed. Planning regions could be part of a specific target program since this research has identified the distribution of activities by employment within each of the our economic regions.

Some counties that have initiated the development of stable activities in the field of forest products production should be supported in order to make their economies more stable. It is recommended that some forest product activities that have shown stable growth during the last years be supported. Low interest rates for capacity expansion, tax credit, some market facilities etc. are some of the potential incentives that government could apply. Sawmills and millwork activities should be supported.

In the future it would be appropriate to combine this type of study with an input-output study in order to develop an analytical framework that allows a more complete analysis of the Michigan economy. Regional employment multipliers that allow the measurement of indirect effects in the

delineated regions would be useful in decision making. Similarly, regional productivities could be measured for the economic

sectors engaged in the process of diversification (target sectors). Variables in addition to employment, such as income or value added could be useful.

Periodical evaluations of Michigan's economic structure should be completed. This could support evaluation of the performance of programs and projects in which the private sector, government, and other institutions are involved.

Research needed to improve the accuracy of the new diversification indexes should continue. By the same token, instability indexes need to be improved in the future. It will be necessary to assess current indicators and the information they require.

A future research study that analyzes the stability of the forest products industry market in Michigan and its growth perspectives would be the next step. For that research, it will be necessary to explore work force, salary structure, hours worked per week, availability of technology and resources. the research could be carried out at the level of county or MSAs.

APPENDIX A

List of Michigan Counties

APPENDIX A

List of Michigan Counties

- | | |
|--------------------|------------------|
| 1. Alcona | 48. Luce |
| 2. Alger | 49. Mackinac |
| 3. Allegan | 50. Macomb |
| 4. alpena | 51. Manistee |
| 5. Antrim | 52. Marquette |
| 6. Arenac | 53. Mason |
| 7. Baraga | 54. Mecosta |
| 8. Barry | 55. Menominee |
| 9. Bay | 56. Midland |
| 10. Benzie | 57. Missaukee |
| 11. Berrien | 58. Monroe |
| 12. Branch | 59. Montcalm |
| 13. Calhoun | 60. Montmorency |
| 14. Cass | 61. Muskegon |
| 15. Charlevoix | 62. Newaygo |
| 16. Cheboyan | 63. Oakland |
| 17. Chippewa | 64. Oceana |
| 18. Clare | 65. Ogemaw |
| 19. Clinton | 66. Ontonagon |
| 20. Crawford | 67. Osceola |
| 21. Delta | 68. Oscoda |
| 22. Dickinson | 69. Otsego |
| 23. Eaton | 70. Ottawa |
| 24. Emmet | 71. Presque Isle |
| 25. Genesee | 72. Roscommon |
| 26. Gladwin | 73. Saginaw |
| 27. Gogebic | 74. St. Clair |
| 28. Grand Traverse | 75. St. Joseph |
| 29. Gratiot | 76. Sanilac |
| 30. Hilldale | 77. Schoolcraft |
| 31. Houghton | 78. Shiawassee |
| 32. Huron | 79. Tuscola |
| 33. Ingham | 80. Van Buren |
| 34. Ionia | 81. Washtenaw |
| 35. Iosco | 82. Wayne |
| 36. Iron | 83. Wexford |
| 37. Isabella | |
| 38. Jackson | |
| 39. Kalamazoo | |
| 40. Kalkaska | |
| 41. Kent | |
| 42. Keweenaw | |
| 43. Lake | |
| 44. Lapeer | |
| 45. Leelanau | |
| 46. Lenawee | |
| 47. Livingston | |

APPENDIX C

Factor Analysis Results. 1982.

APPENDIX C

LATENT ROOTS (EIGENVALUES)

1	2	3	4	5
69.384	3.548	1.882	1.468	1.058
6	7	8	9	10
0.837	0.772	0.614	0.567	0.398
11	12	13	14	15
0.315	0.291	0.240	0.203	0.112
16	17	18	19	20
0.083	0.059	0.052	0.046	0.033
21	22	23	24	25
0.024	0.010	0.005	0.000	0.000
26	27	28	29	30
0.000	0.000	0.000	0.000	0.000
31	32	33	34	35
0.000	0.000	0.000	0.000	0.000
36	37	38	39	40
0.000	0.000	0.000	0.000	0.000
41	42	43	44	45
0.000	0.000	0.000	0.000	0.000
46	47	48	49	50
0.000	0.000	0.000	0.000	0.000
51	52	53	54	55
0.000	0.000	0.000	0.000	-0.000
56	57	58	59	60
-0.000	-0.000	-0.000	-0.000	-0.000

61	62	63	64	65
-0.000	-0.000	-0.000	-0.000	-0.000
66	67	68	69	70
-0.000	-0.000	-0.000	-0.000	-0.000
71	72	73	74	75
-0.000	-0.000	-0.000	-0.000	-0.000
76	77	78	79	80
-0.000	-0.000	-0.000	-0.000	-0.000
81	82			
-0.000	-0.000			

COMPONENT LOADINGS

	1	2	3	4	5
VAR(1)	0.929	0.136	-0.122	-0.003	-0.107
VAR(2)	0.738	-0.176	0.168	0.399	-0.222
VAR(3)	0.921	0.074	-0.059	0.060	0.091
VAR(4)	0.940	-0.267	0.082	0.041	-0.003
VAR(5)	0.843	-0.117	-0.334	-0.200	-0.165
VAR(6)	0.989	0.074	-0.022	0.017	-0.035
VAR(7)	0.889	0.038	-0.194	-0.062	-0.159
VAR(8)	0.892	-0.139	-0.248	-0.173	-0.035
VAR(9)	0.983	-0.153	-0.030	-0.021	-0.035
VAR(10)	0.930	-0.033	-0.076	-0.031	-0.032
VAR(11)	0.972	-0.207	-0.038	-0.038	-0.015
VAR(12)	0.850	0.331	-0.105	-0.044	0.182
VAR(13)	0.930	-0.322	-0.021	-0.021	-0.021
VAR(14)	0.977	-0.039	-0.049	-0.036	0.022
VAR(15)	0.927	-0.080	-0.032	-0.043	0.143
VAR(16)	0.933	0.208	0.038	0.138	-0.036
VAR(17)	0.581	0.211	0.260	-0.078	0.368
VAR(18)	0.994	-0.077	0.019	0.004	0.004
VAR(19)	0.968	0.023	0.018	-0.005	0.071
VAR(20)	0.954	0.199	0.026	0.126	-0.036
VAR(21)	0.913	0.022	-0.027	0.125	-0.170
VAR(22)	0.958	0.214	-0.004	0.017	0.062
VAR(23)	0.977	-0.171	-0.008	0.008	0.005
VAR(24)	0.555	0.536	-0.332	-0.212	-0.154
VAR(25)	0.994	-0.035	0.027	0.044	0.033
VAR(26)	0.995	-0.033	0.009	0.028	-0.010
VAR(27)	0.564	-0.097	0.048	0.103	-0.012
VAR(28)	0.987	-0.109	0.068	-0.003	0.016
VAR(29)	0.994	0.012	-0.055	-0.020	-0.008
VAR(30)	0.985	-0.013	-0.067	-0.052	-0.037
VAR(31)	0.928	-0.352	0.072	0.033	-0.005
VAR(32)	0.984	0.112	-0.023	0.002	0.081
VAR(33)	0.985	-0.061	0.039	0.034	0.020
VAR(34)	0.972	-0.159	-0.034	-0.043	0.018
VAR(35)	0.971	0.195	-0.011	0.043	0.028
VAR(36)	0.965	0.165	0.036	0.097	0.010
VAR(37)	0.966	-0.204	0.136	0.005	-0.034
VAR(38)	0.950	-0.277	0.020	-0.046	0.037
VAR(39)	0.978	-0.139	0.030	0.074	0.015
VAR(40)	0.778	0.287	0.426	-0.243	-0.117
VAR(41)	0.990	0.009	-0.023	0.019	0.045
VAR(42)	0.111	0.158	0.064	0.585	-0.552
VAR(43)	0.932	0.259	0.034	0.078	0.093
VAR(44)	0.993	0.076	-0.007	0.001	0.001
VAR(45)	0.923	-0.347	0.060	0.017	0.004
VAR(46)	0.950	-0.299	0.037	0.032	0.005
VAR(47)	0.994	-0.018	-0.058	-0.016	-0.013
VAR(48)	0.878	0.415	0.025	0.164	-0.023
VAR(49)	0.948	0.253	0.020	0.077	-0.004
VAR(50)	0.976	-0.138	-0.112	-0.066	-0.052
VAR(51)	0.915	0.109	0.036	0.154	0.049
VAR(52)	0.872	-0.292	0.328	-0.162	-0.126

VAR(53)	0.974	0.036	-0.059	0.011	0.089
VAR(54)	0.917	-0.387	0.063	0.016	-0.002
VAR(55)	0.956	-0.128	0.100	0.133	0.045
VAR(56)	0.797	-0.319	0.074	0.096	0.090
VAR(57)	0.927	0.340	-0.002	0.064	0.057
VAR(58)	0.951	-0.160	0.095	0.024	0.119
VAR(59)	0.757	0.021	-0.465	-0.277	-0.247
VAR(60)	0.790	0.583	0.023	0.093	0.082
VAR(61)	0.930	-0.300	-0.015	-0.069	0.014
VAR(62)	0.958	0.114	0.017	0.062	0.046
VAR(63)	0.984	-0.154	-0.009	0.000	-0.021
VAR(64)	0.960	0.130	0.036	0.041	0.128
VAR(65)	0.986	-0.084	0.016	0.003	0.002
VAR(66)	0.253	0.177	0.720	-0.521	-0.307
VAR(67)	0.743	0.068	-0.210	-0.324	-0.112
VAR(68)	0.899	0.347	-0.087	-0.001	0.049
VAR(69)	0.984	0.110	0.039	0.053	-0.008
VAR(70)	0.963	-0.127	-0.108	-0.049	0.015
VAR(71)	0.978	0.168	0.023	0.063	-0.003
VAR(72)	0.976	-0.093	0.027	-0.006	0.043
VAR(73)	0.988	-0.078	0.031	0.007	0.056
VAR(74)	0.958	0.127	-0.125	-0.053	0.041
VAR(75)	0.914	0.217	-0.134	-0.073	0.020
VAR(76)	0.827	0.404	0.249	0.048	-0.125
VAR(77)	0.967	-0.004	-0.090	-0.060	-0.062
VAR(78)	0.871	0.208	0.331	-0.232	-0.051
VAR(79)	0.968	0.052	-0.039	-0.050	0.112
VAR(80)	0.969	-0.197	0.025	0.009	0.002
VAR(81)	-0.116	0.010	0.010	0.007	0.045
VAR(82)	0.965	0.069	-0.022	-0.006	0.027

VAR(1)	-0.012	-0.169	0.078	0.062	
VAR(2)	0.017	-0.121	-0.367	-0.182	
VAR(3)	0.192	0.175	-0.147	0.098	
VAR(4)	0.025	-0.058	0.053	0.024	
VAR(5)	0.018	0.032	-0.146	0.245	
VAR(6)	0.057	0.015	0.036	0.047	
VAR(7)	-0.069	-0.248	0.064	0.092	
VAR(8)	-0.055	-0.108	0.033	-0.044	
VAR(9)	-0.026	-0.045	0.001	0.017	
VAR(10)	0.073	-0.038	0.115	-0.031	
VAR(11)	-0.031	0.004	-0.015	-0.051	
VAR(12)	-0.036	0.261	-0.164	0.091	
VAR(13)	0.004	0.006	0.008	-0.038	
VAR(14)	-0.052	0.059	0.026	-0.079	
VAR(15)	-0.127	0.056	-0.010	0.011	
VAR(16)	0.099	-0.109	-0.112	-0.130	
VAR(17)	-0.538	-0.216	-0.184	0.078	
VAR(18)	0.010	0.023	0.024	-0.001	
VAR(19)	-0.069	0.046	0.049	-0.085	
VAR(20)	-0.002	0.005	0.089	0.013	
VAR(21)	0.077	-0.194	-0.232	-0.146	
VAR(22)	-0.071	-0.088	0.079	-0.037	
VAR(23)	0.006	0.031	0.020	0.004	

VAR(24)	-0.107	-0.288	0.129	-0.088
VAR(25)	0.032	0.021	0.016	0.042
VAR(26)	0.028	-0.012	0.052	-0.002
VAR(27)	0.050	-0.016	0.124	-0.005
VAR(28)	-0.001	0.012	0.036	-0.007
VAR(29)	0.018	0.017	-0.002	0.036
VAR(30)	0.035	0.073	0.004	-0.024
VAR(31)	-0.021	-0.015	0.050	0.000
VAR(32)	-0.000	0.043	0.006	0.028
VAR(33)	0.012	-0.029	0.047	0.022
VAR(34)	-0.036	0.093	0.002	-0.090
VAR(35)	0.053	-0.010	0.030	0.073
VAR(36)	0.049	-0.030	0.097	-0.008
VAR(37)	0.027	0.007	0.054	0.007
VAR(38)	-0.090	0.030	-0.032	-0.004
VAR(39)	0.079	-0.015	-0.081	-0.025
VAR(40)	0.022	-0.053	-0.075	0.079
VAR(41)	0.054	0.041	0.008	0.051
VAR(42)	-0.432	0.299	0.090	0.129
VAR(43)	0.035	0.024	-0.008	0.101
VAR(44)	0.035	0.067	0.009	-0.000
VAR(45)	0.001	0.001	0.052	0.023
VAR(46)	0.020	0.018	0.031	-0.003
VAR(47)	0.031	0.044	-0.018	0.031
VAR(48)	0.048	0.003	0.096	0.009
VAR(49)	0.049	-0.046	0.110	-0.033
VAR(50)	-0.002	0.007	-0.031	0.065
VAR(51)	0.186	-0.073	-0.099	0.040
VAR(52)	0.008	0.014	0.031	0.042
VAR(53)	0.045	0.078	-0.009	0.102
VAR(54)	-0.020	0.001	0.036	0.006
VAR(55)	-0.039	-0.046	-0.083	-0.094
VAR(56)	0.142	-0.049	0.129	0.078
VAR(57)	0.033	-0.058	0.062	0.041
VAR(58)	-0.137	-0.095	-0.052	0.055
VAR(59)	0.006	-0.010	-0.169	0.158
VAR(60)	0.028	-0.051	0.053	0.003
VAR(61)	-0.143	-0.070	-0.021	-0.032
VAR(62)	0.049	0.028	0.061	-0.029
VAR(63)	0.004	-0.028	0.046	0.010
VAR(64)	-0.070	0.068	0.027	-0.033
VAR(65)	0.022	0.061	-0.031	0.089
VAR(66)	0.039	0.072	-0.013	0.086
VAR(67)	-0.117	0.232	0.028	-0.417
VAR(68)	-0.096	0.081	-0.050	0.052
VAR(69)	0.042	-0.040	0.089	0.015
VAR(70)	0.012	0.051	-0.005	0.025
VAR(71)	0.065	0.011	0.055	0.015
VAR(72)	-0.073	0.006	0.059	-0.091
VAR(73)	-0.027	0.004	-0.098	0.020
VAR(74)	0.005	0.113	-0.166	-0.032
VAR(75)	0.070	0.220	-0.072	-0.050
VAR(76)	0.193	-0.074	-0.102	-0.086
VAR(77)	-0.093	-0.146	-0.050	0.035
VAR(78)	-0.044	0.095	0.032	-0.071
VAR(79)	-0.092	0.068	0.019	-0.089

VAR(80)	-0.001	-0.043	0.056	0.011
VAR(81)	-0.026	-0.019	0.008	0.046
VAR(82)	-0.029	0.090	0.034	-0.119

VARIANCE EXPLAINED BY COMPONENTS

1	2	3	4	5
69.384	3.548	1.882	1.468	1.058
6	7	8	9	
0.837	0.772	0.614	0.567	

PERCENT OF TOTAL VARIANCE EXPLAINED

1	2	3	4	5
84.614	4.326	2.296	1.790	1.290
6	7	8	9	
1.020	0.942	0.749	0.691	

ROTATED LOADINGS

	1	2	3	4	5
VAR(6)	0.987	0.147	0.013	-0.019	-0.001
VAR(20)	0.987	0.144	0.014	-0.022	0.041
VAR(57)	0.986	0.144	0.015	-0.023	0.055
VAR(2)	0.985	0.149	0.011	-0.015	-0.062
VAR(68)	0.985	0.149	0.011	-0.015	-0.062
VAR(43)	0.985	0.149	0.011	-0.015	-0.062
VAR(7)	0.985	0.149	0.011	-0.015	-0.062
VAR(1)	0.985	0.149	0.011	-0.015	-0.062
VAR(14)	0.984	0.142	0.016	-0.025	0.089
VAR(83)	0.983	0.168	0.015	-0.013	0.039
VAR(27)	0.982	0.140	0.017	-0.026	0.110
VAR(21)	0.981	0.134	0.017	-0.020	0.131
VAR(29)	0.981	0.162	0.011	0.030	0.093
VAR(69)	0.980	0.124	0.142	-0.021	0.055
VAR(18)	0.978	0.138	0.018	-0.028	0.143
VAR(60)	0.976	0.120	0.008	0.035	-0.065
VAR(45)	0.970	0.114	0.008	0.044	-0.065
VAR(24)	0.967	0.239	0.006	0.081	0.017
VAR(46)	0.964	0.239	0.010	0.069	0.093
VAR(59)	0.957	0.233	0.004	0.126	0.078
VAR(54)	0.954	0.263	0.023	0.037	0.117
VAR(31)	0.953	0.141	0.021	0.013	0.246
VAR(17)	0.952	0.211	0.004	0.168	0.125
VAR(78)	0.949	0.226	0.005	0.160	0.143
VAR(37)	0.948	0.199	0.201	0.088	0.106
VAR(81)	0.942	0.288	0.001	0.163	0.047
VAR(65)	0.926	0.081	0.018	0.041	0.253
VAR(8)	0.925	0.318	-0.004	0.146	0.102
VAR(4)	0.922	0.163	0.174	0.036	0.255
VAR(39)	0.911	0.350	-0.003	0.205	0.069
VAR(63)	0.908	0.318	0.002	0.213	0.169
VAR(36)	0.908	0.114	0.026	-0.044	0.397
VAR(58)	0.900	0.355	-0.006	0.241	0.062
VAR(82)	0.887	0.405	-0.003	0.185	0.110
VAR(33)	0.887	0.385	0.004	0.210	0.140
VAR(25)	0.886	0.392	-0.006	0.234	0.070
VAR(9)	0.882	0.427	-0.005	0.176	0.068
VAR(79)	0.880	0.399	-0.001	0.121	0.144
VAR(61)	0.874	0.356	-0.013	0.320	0.054
VAR(52)	0.862	0.330	0.373	0.058	0.047
VAR(74)	0.861	0.426	0.003	0.246	0.108
VAR(35)	0.859	0.065	0.241	-0.029	0.438
VAR(38)	0.855	0.471	-0.008	0.192	0.081
VAR(11)	0.848	0.490	-0.016	0.173	0.094
VAR(16)	0.843	0.400	-0.005	0.279	0.103
VAR(55)	0.836	0.396	0.008	0.074	0.295
VAR(53)	0.829	0.480	-0.004	0.040	0.248
VAR(73)	0.827	0.496	-0.011	0.241	0.082
VAR(5)	0.821	0.558	-0.014	0.028	0.032
VAR(50)	0.813	0.456	-0.018	0.352	0.055
VAR(30)	0.801	0.554	0.031	0.140	0.033
VAR(41)	0.792	0.519	-0.014	0.306	0.078

VAR(53)	0.702	0.634	0.057	0.231	-0.003
VAR(54)	0.941	0.264	0.092	0.124	0.027
VAR(55)	0.795	0.487	0.068	0.063	0.048
VAR(56)	0.833	0.311	0.029	0.013	-0.055
VAR(57)	0.483	0.835	0.099	0.173	0.028
VAR(58)	0.816	0.437	0.097	0.136	0.005
VAR(59)	0.466	0.375	0.016	0.773	-0.018
VAR(60)	0.226	0.938	0.106	0.109	0.041
VAR(61)	0.875	0.294	0.075	0.233	-0.002
VAR(62)	0.652	0.689	0.091	0.123	0.028
VAR(63)	0.834	0.476	0.095	0.212	0.023
VAR(64)	0.642	0.685	0.085	0.103	0.040
VAR(65)	0.785	0.530	0.131	0.226	0.041
VAR(66)	0.079	0.122	0.984	-0.007	-0.016
VAR(67)	0.462	0.406	0.125	0.312	-0.027
VAR(68)	0.433	0.779	0.080	0.279	0.088
VAR(69)	0.676	0.691	0.129	0.148	0.043
VAR(70)	0.786	0.481	0.046	0.285	-0.011
VAR(71)	0.630	0.735	0.127	0.165	0.055
VAR(72)	0.793	0.511	0.095	0.133	0.024
VAR(73)	0.776	0.526	0.108	0.200	0.001
VAR(74)	0.596	0.649	0.062	0.318	-0.016
VAR(75)	0.515	0.707	0.087	0.285	0.001
VAR(76)	0.351	0.795	0.353	0.073	0.020
VAR(77)	0.700	0.530	0.094	0.368	0.021
VAR(78)	0.521	0.607	0.510	0.078	0.011
VAR(79)	0.684	0.610	0.068	0.177	-0.009
VAR(80)	0.857	0.440	0.097	0.172	0.012
VAR(81)	0.813	0.508	0.090	0.198	0.011
VAR(82)	0.673	0.629	0.093	0.160	0.038
	6	7	8	9	
VAR(1)	0.080	-0.174	0.074	0.021	
VAR(2)	0.061	0.038	0.663	0.000	
VAR(3)	-0.014	0.297	0.116	0.037	
VAR(4)	0.063	-0.029	0.102	0.011	
VAR(5)	0.010	0.134	0.021	0.036	
VAR(6)	0.037	0.013	0.068	0.067	
VAR(7)	0.108	-0.237	0.072	0.005	
VAR(8)	0.026	-0.162	0.075	0.203	
VAR(9)	0.102	-0.021	0.102	0.087	
VAR(10)	-0.012	-0.085	0.037	0.116	
VAR(11)	0.094	0.010	0.015	0.164	
VAR(12)	0.203	0.337	-0.015	0.181	
VAR(13)	0.043	0.013	0.105	0.128	
VAR(14)	0.112	0.016	0.057	0.224	
VAR(15)	0.237	0.084	-0.001	0.157	
VAR(16)	0.068	-0.044	0.329	0.088	
VAR(17)	0.824	-0.011	0.039	0.013	
VAR(18)	0.080	0.024	0.081	0.107	
VAR(19)	0.157	0.003	0.048	0.204	
VAR(20)	0.073	-0.044	0.073	0.065	
VAR(21)	0.051	-0.077	0.471	0.078	
VAR(22)	0.197	-0.109	0.053	0.118	
VAR(23)	0.067	0.038	0.076	0.105	

VAR(24)	0.119	-0.398	-0.011	0.199
VAR(25)	0.085	0.050	0.078	0.054
VAR(26)	0.062	-0.019	0.085	0.086
VAR(27)	0.015	-0.052	0.068	0.045
VAR(28)	0.098	0.013	0.077	0.100
VAR(29)	0.080	0.035	0.070	0.100
VAR(30)	0.030	0.049	0.070	0.178
VAR(31)	0.075	-0.007	0.089	0.059
VAR(32)	0.135	0.065	0.040	0.109
VAR(33)	0.096	-0.013	0.079	0.053
VAR(34)	0.087	0.058	0.074	0.235
VAR(35)	0.088	0.017	0.058	0.029
VAR(36)	0.060	-0.058	0.077	0.058
VAR(37)	0.051	0.001	0.091	0.060
VAR(38)	0.166	0.061	0.078	0.136
VAR(39)	0.057	0.066	0.209	0.060
VAR(40)	0.181	-0.004	0.123	0.008
VAR(41)	0.069	0.074	0.058	0.068
VAR(42)	-0.012	0.001	0.067	-0.009
VAR(43)	0.142	0.085	0.053	0.001
VAR(44)	0.068	0.061	0.070	0.132
VAR(45)	0.059	0.014	0.067	0.049
VAR(46)	0.046	0.031	0.093	0.076
VAR(47)	0.061	0.064	0.081	0.110
VAR(48)	0.048	-0.052	0.074	0.044
VAR(49)	0.058	-0.094	0.074	0.083
VAR(50)	0.067	0.042	0.072	0.096
VAR(51)	0.028	0.067	0.238	-0.066
VAR(52)	0.064	0.004	0.078	0.046
VAR(53)	0.091	0.132	0.015	0.053
VAR(54)	0.071	0.016	0.084	0.065
VAR(55)	0.168	0.018	0.245	0.095
VAR(56)	-0.032	-0.003	0.022	-0.093
VAR(57)	0.125	-0.046	0.052	0.031
VAR(58)	0.300	0.013	0.109	0.015
VAR(59)	-0.018	0.052	0.051	0.139
VAR(60)	0.149	-0.056	0.055	0.047
VAR(61)	0.209	-0.039	0.098	0.140
VAR(62)	0.063	0.008	0.069	0.108
VAR(63)	0.069	-0.026	0.079	0.082
VAR(64)	0.197	0.057	0.034	0.158
VAR(65)	0.084	0.109	0.072	0.049
VAR(66)	0.045	0.003	-0.010	0.031
VAR(67)	0.012	-0.029	0.019	0.683
VAR(68)	0.208	0.090	0.026	0.148
VAR(69)	0.064	-0.067	0.082	0.074
VAR(70)	0.061	0.068	0.042	0.132
VAR(71)	0.049	-0.002	0.079	0.068
VAR(72)	0.146	-0.034	0.068	0.189
VAR(73)	0.175	0.092	0.146	0.083
VAR(74)	0.126	0.175	0.140	0.217
VAR(75)	0.015	0.193	0.047	0.271
VAR(76)	0.002	-0.030	0.317	0.035
VAR(77)	0.191	-0.089	0.134	0.077
VAR(78)	0.161	0.012	0.030	0.225
VAR(79)	0.193	0.037	0.025	0.247

VAR(80)	0.083	-0.033	0.077	0.062
VAR(81)	0.140	0.024	0.069	0.058
VAR(82)	0.094	0.023	0.069	0.252

VARIANCE EXPLAINED BY ROTATED COMPONENTS

1	2	3	4	5
39.679	26.706	2.604	4.565	1.135
6	7	8	9	
1.668	0.754	1.444	1.574	

PERCENT OF TOTAL VARIANCE EXPLAINED

1	2	3	4	5
48.389	32.569	3.175	5.567	1.384
6	7	8	9	
2.035	0.919	1.761	1.920	

APPENDIX B

Factor Analysis Results. 1988.

APPENDIX B

LATENT ROOTS (EIGENVALUES)

1	2	3	4	5
62.176	9.803	3.868	2.931	1.782
6	7	8	9	10
1.078	0.651	0.245	0.190	0.098
11	12	13	14	15
0.065	0.042	0.030	0.019	0.009
16	17	18	19	20
0.007	0.003	0.002	0.001	0.000
21	22	23	24	25
0.000	0.000	0.000	0.000	0.000
26	27	28	29	30
0.000	0.000	0.000	0.000	0.000
31	32	33	34	35
0.000	0.000	0.000	0.000	0.000
36	37	38	39	40
0.000	0.000	0.000	0.000	0.000
41	42	43	44	45
0.000	0.000	0.000	0.000	0.000
46	47	48	49	50
0.000	0.000	0.000	0.000	0.000
51	52	53	54	55
0.000	0.000	0.000	0.000	-0.000
56	57	58	59	60
-0.000	-0.000	-0.000	-0.000	-0.000

61	62	63	64	65
-0.000	-0.000	-0.000	-0.000	-0.000
66	67	68	69	70
-0.000	-0.000	-0.000	-0.000	-0.000
71	72	73	74	75
-0.000	-0.000	-0.000	-0.000	-0.000
76	77	78	79	80
-0.000	-0.000	-0.000	-0.000	-0.000
81	82	83		
-0.000	-0.000	-0.000		

COMPONENT LOADINGS

	1	2	3	4	5
VAR(82)	0.998	-0.025	0.024	-0.009	-0.005
VAR(33)	0.997	-0.017	0.007	-0.040	-0.036
VAR(39)	0.996	0.017	0.024	-0.060	0.033
VAR(9)	0.995	-0.043	0.030	-0.000	0.033
VAR(38)	0.994	-0.096	0.022	0.000	0.016
VAR(25)	0.994	-0.039	0.017	-0.065	0.026
VAR(74)	0.994	-0.078	-0.002	-0.056	-0.010
VAR(58)	0.992	-0.007	0.017	-0.094	0.032
VAR(11)	0.992	-0.103	0.021	0.029	-0.000
VAR(63)	0.992	0.046	0.006	-0.080	-0.070
VAR(8)	0.991	0.075	0.038	-0.027	0.005
VAR(81)	0.990	0.096	0.035	-0.064	0.056
VAR(73)	0.986	-0.148	0.010	-0.022	0.011
VAR(79)	0.986	0.006	0.031	-0.031	-0.033
VAR(78)	0.981	0.156	0.027	-0.072	-0.036
VAR(46)	0.980	0.188	0.049	-0.004	0.019
VAR(61)	0.980	-0.054	0.002	-0.158	0.031
VAR(54)	0.979	0.183	0.038	0.029	-0.004
VAR(59)	0.979	0.164	0.049	-0.030	0.039
VAR(17)	0.977	0.163	0.033	-0.075	-0.011
VAR(24)	0.977	0.178	0.054	-0.030	0.088
VAR(41)	0.974	-0.209	-0.006	-0.065	0.007
VAR(16)	0.972	-0.082	-0.011	-0.152	-0.033
VAR(50)	0.971	-0.173	-0.010	-0.139	0.024
VAR(53)	0.971	-0.037	0.027	0.115	-0.150
VAR(30)	0.967	-0.158	0.002	0.115	0.081
VAR(5)	0.966	-0.110	0.055	0.131	0.049
VAR(37)	0.960	0.236	-0.144	-0.007	0.022
VAR(29)	0.958	0.273	0.061	-0.006	0.021
VAR(55)	0.957	0.021	0.000	0.037	-0.196
VAR(28)	0.956	-0.268	-0.060	0.022	0.059
VAR(83)	0.951	0.284	0.076	0.037	0.082
VAR(3)	0.947	-0.284	0.029	0.073	0.088
VAR(21)	0.945	0.319	0.064	0.026	-0.012
VAR(14)	0.944	0.314	0.074	0.040	0.033
VAR(56)	0.944	-0.189	-0.028	-0.253	0.062
VAR(27)	0.944	0.317	0.072	0.043	0.013
VAR(57)	0.944	0.310	0.078	0.035	0.067
VAR(20)	0.943	0.308	0.080	0.033	0.080
VAR(18)	0.942	0.320	0.068	0.048	-0.019
VAR(31)	0.941	0.297	0.026	-0.027	-0.142
VAR(6)	0.941	0.302	0.084	0.027	0.121
VAR(69)	0.934	0.342	-0.049	0.037	0.077
VAR(2)	0.934	0.293	0.090	0.018	0.179
VAR(68)	0.934	0.293	0.090	0.018	0.179
VAR(43)	0.934	0.293	0.090	0.018	0.179
VAR(7)	0.934	0.293	0.090	0.018	0.179
VAR(1)	0.934	0.293	0.090	0.018	0.179
VAR(23)	0.933	-0.071	-0.034	0.020	-0.332
VAR(4)	0.932	0.281	-0.136	-0.021	-0.143
VAR(32)	0.930	-0.051	-0.012	0.029	-0.313
VAR(52)	0.929	0.133	-0.303	0.123	0.104

VAR(60)	0.925	0.289	0.057	-0.114	0.152
VAR(45)	0.920	0.287	0.051	-0.136	0.147
VAR(12)	0.903	-0.261	0.033	0.134	0.035
VAR(26)	0.903	-0.263	-0.004	-0.012	-0.007
VAR(65)	0.901	0.320	0.002	-0.136	-0.175
VAR(36)	0.894	0.335	0.035	0.084	-0.273
VAR(15)	0.889	-0.165	-0.044	-0.380	0.126
VAR(70)	0.859	-0.478	-0.011	-0.003	0.082
VAR(35)	0.845	0.383	-0.195	0.055	-0.308
VAR(76)	0.835	-0.418	-0.139	0.235	-0.201
VAR(13)	0.815	-0.476	0.027	0.218	0.044
VAR(51)	0.813	-0.416	-0.022	0.360	-0.028
VAR(44)	0.812	-0.516	-0.049	-0.058	-0.143
VAR(75)	0.803	-0.512	0.009	0.157	0.092
VAR(19)	0.752	-0.611	-0.074	-0.167	-0.015
VAR(34)	0.694	-0.659	-0.011	0.133	-0.010
VAR(49)	0.687	0.404	-0.576	-0.013	0.028
VAR(10)	0.683	-0.580	0.023	0.276	0.053
VAR(22)	0.546	-0.554	-0.151	-0.592	-0.030
VAR(80)	0.534	-0.774	-0.000	0.230	0.037
VAR(64)	0.259	-0.841	0.012	0.395	0.019
VAR(62)	0.368	-0.797	0.016	0.404	-0.015
VAR(67)	0.438	-0.752	-0.061	0.239	0.081
VAR(42)	0.108	-0.740	-0.169	-0.569	0.004
VAR(47)	0.364	-0.698	-0.154	-0.537	0.007
VAR(66)	-0.076	0.237	-0.919	0.213	0.213
VAR(40)	-0.076	0.237	-0.919	0.213	0.213
VAR(77)	0.256	0.360	-0.855	0.250	-0.050
VAR(71)	0.036	-0.363	-0.824	-0.215	-0.095
VAR(48)	0.016	0.002	-0.152	-0.629	-0.117
VAR(72)	0.399	0.241	-0.070	0.147	-0.859

6

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VAR(82)	0.044	-0.011			
VAR(33)	0.044	-0.013			
VAR(39)	0.048	0.006			
VAR(9)	0.031	0.023			
VAR(38)	0.001	-0.005			
VAR(25)	0.049	0.029			
VAR(74)	0.033	-0.018			
VAR(58)	0.048	0.042			
VAR(11)	0.009	0.059			
VAR(63)	0.044	0.021			
VAR(8)	0.032	-0.008			
VAR(81)	0.032	0.033			
VAR(73)	0.024	-0.001			
VAR(79)	-0.018	-0.111			
VAR(78)	0.067	0.030			
VAR(46)	0.021	0.026			
VAR(61)	0.073	0.067			
VAR(54)	-0.015	0.008			
VAR(59)	0.087	-0.004			
VAR(17)	0.093	-0.014			
VAR(24)	-0.002	0.037			
VAR(41)	0.033	-0.001			

VAR(16)	-0.068	0.040
VAR(50)	0.052	0.030
VAR(53)	-0.106	-0.052
VAR(30)	0.024	-0.070
VAR(5)	-0.133	0.103
VAR(37)	0.008	0.025
VAR(29)	0.027	0.036
VAR(55)	-0.134	-0.143
VAR(28)	-0.016	-0.021
VAR(83)	0.027	0.009
VAR(3)	0.008	-0.062
VAR(21)	0.013	0.001
VAR(14)	0.033	0.004
VAR(56)	0.026	0.035
VAR(27)	0.035	0.002
VAR(57)	0.029	0.007
VAR(20)	0.028	0.008
VAR(18)	0.038	-0.001
VAR(31)	-0.067	-0.005
VAR(6)	0.023	0.012
VAR(69)	0.001	0.005
VAR(2)	0.017	0.017
VAR(68)	0.017	0.017
VAR(43)	0.017	0.017
VAR(7)	0.017	0.017
VAR(1)	0.017	0.017
VAR(23)	0.042	0.012
VAR(4)	-0.107	-0.006
VAR(32)	0.080	0.099
VAR(52)	-0.005	-0.005
VAR(60)	-0.141	0.022
VAR(45)	-0.167	0.023
VAR(12)	0.044	-0.271
VAR(26)	-0.046	-0.107
VAR(65)	-0.190	-0.003
VAR(36)	0.063	-0.023
VAR(15)	-0.044	0.115
VAR(70)	0.010	-0.130
VAR(35)	-0.023	-0.029
VAR(76)	-0.015	0.079
VAR(13)	-0.046	-0.047
VAR(51)	-0.068	0.150
VAR(44)	0.099	0.158
VAR(75)	0.001	-0.194
VAR(19)	-0.087	-0.100
VAR(34)	0.044	0.150
VAR(49)	-0.173	-0.006
VAR(10)	-0.166	-0.172
VAR(22)	0.076	-0.041
VAR(80)	-0.046	0.210
VAR(64)	-0.130	0.202
VAR(62)	-0.122	0.199
VAR(67)	-0.140	-0.365
VAR(42)	0.258	-0.065
VAR(47)	0.233	-0.042
VAR(66)	0.033	-0.015

VAR(40)	0.033	-0.015
VAR(77)	0.069	-0.035
VAR(71)	0.045	0.123
VAR(48)	-0.751	0.027
VAR(72)	0.105	-0.076

VARIANCE EXPLAINED BY COMPONENTS

1	2	3	4	5
62.176	9.803	3.868	2.931	1.782
6	7			
1.078	0.651			

PERCENT OF TOTAL VARIANCE EXPLAINED

1	2	3	4	5
74.911	11.811	4.660	3.531	2.147
6	7			
1.299	0.784			

ROTATED LOADINGS

	1	2	3	4	5
VAR(6)	0.987	0.147	0.013	-0.019	-0.001
VAR(20)	0.987	0.144	0.014	-0.022	0.041
VAR(57)	0.986	0.144	0.015	-0.023	0.055
VAR(2)	0.985	0.149	0.011	-0.015	-0.062
VAR(68)	0.985	0.149	0.011	-0.015	-0.062
VAR(43)	0.985	0.149	0.011	-0.015	-0.062
VAR(7)	0.985	0.149	0.011	-0.015	-0.062
VAR(1)	0.985	0.142	0.011	-0.015	-0.062
VAR(14)	0.984	0.142	0.016	-0.025	0.089
VAR(83)	0.983	0.168	0.015	-0.013	0.039
VAR(27)	0.982	0.140	0.017	-0.026	0.110
VAR(21)	0.981	0.134	0.017	-0.020	0.131
VAR(29)	0.981	0.162	0.011	0.030	0.093
VAR(69)	0.980	0.124	0.011	-0.021	0.055
VAR(18)	0.978	0.138	0.018	-0.028	0.143
VAR(60)	0.976	0.120	0.008	0.035	-0.065
VAR(45)	0.970	0.114	0.008	0.044	-0.065
VAR(24)	0.967	0.239	0.006	0.081	0.017
VAR(46)	0.964	0.239	0.010	0.069	0.093
VAR(59)	0.957	0.233	0.004	0.126	0.078
VAR(34)	0.954	0.263	0.023	0.037	0.117
VAR(31)	0.953	0.141	0.021	0.013	0.246
VAR(17)	0.952	0.211	0.004	0.168	0.125
VAR(78)	0.949	0.226	0.005	0.160	0.143
VAR(37)	0.948	0.199	0.201	0.088	0.106
VAR(81)	0.942	0.288	0.001	0.163	0.047
VAR(65)	0.926	0.081	0.018	0.041	0.253
VAR(8)	0.925	0.318	-0.004	0.146	0.102
VAR(4)	0.922	0.163	0.174	0.036	0.255
VAR(39)	0.911	0.350	-0.003	0.205	0.069
VAR(63)	0.908	0.318	0.002	0.213	0.169
VAR(36)	0.908	0.114	0.026	-0.044	0.397
VAR(58)	0.900	0.355	-0.006	0.241	0.062
VAR(82)	0.887	0.405	-0.003	0.185	0.110
VAR(33)	0.887	0.385	0.004	0.210	0.140
VAR(25)	0.886	0.392	-0.005	0.234	0.070
VAR(9)	0.882	0.427	-0.005	0.176	0.068
VAR(79)	0.880	0.399	-0.001	0.121	0.144
VAR(61)	0.874	0.356	-0.013	0.320	0.054
VAR(52)	0.862	0.330	0.373	0.058	0.047
VAR(74)	0.861	0.426	0.003	0.246	0.108
VAR(35)	0.859	0.065	0.241	-0.029	0.438
VAR(38)	0.855	0.471	-0.008	0.192	0.081
VAR(11)	0.848	0.490	-0.006	0.173	0.094
VAR(16)	0.843	0.400	-0.015	0.279	0.103
VAR(55)	0.836	0.396	0.008	0.074	0.295
VAR(53)	0.829	0.480	-0.004	0.040	0.248
VAR(73)	0.827	0.496	-0.011	0.241	0.082
VAR(5)	0.821	0.558	-0.014	0.028	0.032
VAR(50)	0.813	0.456	-0.018	0.352	0.055
VAR(30)	0.801	0.554	0.031	0.140	0.033
VAR(41)	0.792	0.519	-0.014	0.306	0.078

VAR(56)	0.792	0.414	-0.023	0.436	0.001
VAR(32)	0.780	0.412	-0.006	0.182	0.402
VAR(15)	0.767	0.335	-0.024	0.486	-0.092
VAR(23)	0.767	0.427	0.007	0.194	0.424
VAR(28)	0.745	0.606	0.051	0.255	0.032
VAR(3)	0.737	0.629	-0.022	0.211	0.006
VAR(49)	0.730	-0.002	0.631	0.010	0.106
VAR(26)	0.697	0.564	-0.018	0.252	0.087
VAR(12)	0.693	0.601	-0.016	0.172	0.083
VAR(70)	0.578	0.710	-0.033	0.353	-0.010
VAR(51)	0.529	0.828	0.044	0.002	0.103
VAR(76)	0.536	0.772	0.110	0.158	0.282
VAR(13)	0.524	0.800	-0.030	0.142	0.030
VAR(44)	0.506	0.694	-0.044	0.438	0.183
VAR(75)	0.503	0.781	-0.024	0.230	-0.007
VAR(62)	-0.026	0.980	-0.054	0.031	0.007
VAR(64)	-0.138	0.969	-0.057	0.036	-0.042
VAR(80)	0.151	0.940	-0.058	0.210	-0.034
VAR(67)	0.056	0.877	0.010	0.186	-0.037
VAR(10)	0.353	0.868	-0.034	0.084	0.005
VAR(34)	0.344	0.852	-0.050	0.301	0.042
VAR(19)	0.421	0.718	-0.043	0.499	0.040
VAR(66)	-0.047	-0.103	0.986	-0.060	-0.087
VAR(40)	-0.047	-0.103	0.986	-0.060	-0.087
VAR(77)	0.277	-0.063	0.928	-0.081	0.216
VAR(71)	-0.176	0.180	0.656	0.607	0.106
VAR(42)	-0.179	0.330	-0.064	0.912	-0.056
VAR(47)	0.068	0.418	-0.059	0.895	-0.032
VAR(22)	0.287	0.382	-0.053	0.845	0.010
VAR(72)	0.346	0.003	0.037	-0.068	0.934
VAR(48)	0.018	-0.133	-0.009	0.239	-0.019

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VAR(6)	0.041	0.021			
VAR(20)	0.042	0.021			
VAR(57)	0.042	0.021			
VAR(2)	0.040	0.021			
VAR(68)	0.040	0.021			
VAR(43)	0.040	0.021			
VAR(7)	0.040	0.021			
VAR(1)	0.040	0.021			
VAR(14)	0.042	0.020			
VAR(83)	0.042	0.020			
VAR(27)	0.042	0.020			
VAR(21)	0.011	0.020			
VAR(29)	0.013	-0.013			
VAR(69)	0.004	0.022			
VAR(18)	0.043	0.020			
VAR(60)	-0.162	0.021			
VAR(45)	-0.195	0.021			
VAR(24)	-0.015	-0.004			
VAR(46)	0.007	-0.001			
VAR(59)	0.060	0.024			
VAR(54)	-0.016	0.019			
VAR(31)	-0.103	0.019			

VAR(17)	0.040	0.028
VAR(78)	0.011	-0.016
VAR(37)	-0.028	-0.004
VAR(81)	-0.005	-0.006
VAR(65)	-0.263	0.018
VAR(8)	0.005	0.032
VAR(4)	-0.156	0.019
VAR(39)	0.008	0.019
VAR(63)	-0.020	-0.006
VAR(36)	0.044	0.017
VAR(58)	-0.009	-0.018
VAR(82)	0.020	0.035
VAR(33)	0.001	0.033
VAR(25)	0.004	-0.004
VAR(9)	0.015	0.007
VAR(79)	-0.018	0.137
VAR(61)	-0.014	-0.047
VAR(52)	0.006	0.039
VAR(74)	-0.012	0.041
VAR(35)	-0.076	0.019
VAR(38)	-0.013	0.036
VAR(11)	0.001	-0.029
VAR(16)	-0.148	-0.014
VAR(55)	-0.143	0.162
VAR(53)	-0.082	0.079
VAR(73)	-0.004	0.029
VAR(5)	-0.078	-0.053
VAR(50)	-0.026	-0.008
VAR(30)	0.063	0.107
VAR(41)	-0.015	0.026
VAR(56)	-0.093	-0.011
VAR(32)	0.019	-0.105
VAR(15)	-0.202	-0.086
VAR(23)	-0.020	-0.017
VAR(28)	-0.023	0.057
VAR(3)	0.035	0.102
VAR(49)	-0.235	0.023
VAR(26)	-0.060	0.137
VAR(12)	0.096	0.302
VAR(70)	0.005	0.166
VAR(51)	0.051	-0.106
VAR(76)	0.016	-0.061
VAR(13)	0.039	0.092
VAR(44)	0.017	-0.149
VAR(75)	0.068	0.235
VAR(62)	0.031	-0.152
VAR(64)	0.026	-0.155
VAR(80)	0.032	-0.167
VAR(67)	-0.023	0.410
VAR(10)	-0.037	0.226
VAR(34)	0.067	-0.119
VAR(19)	-0.167	0.129
VAR(66)	0.037	0.013
VAR(40)	0.037	0.013
VAR(77)	0.052	0.017
VAR(71)	-0.202	-0.154

VAR(42)	-0.016	0.037
VAR(47)	-0.029	0.024
VAR(22)	-0.199	0.033
VAR(72)	0.028	0.003
VAR(48)	-0.960	-0.001

VARIANCE EXPLAINED BY ROTATED COMPONENTS

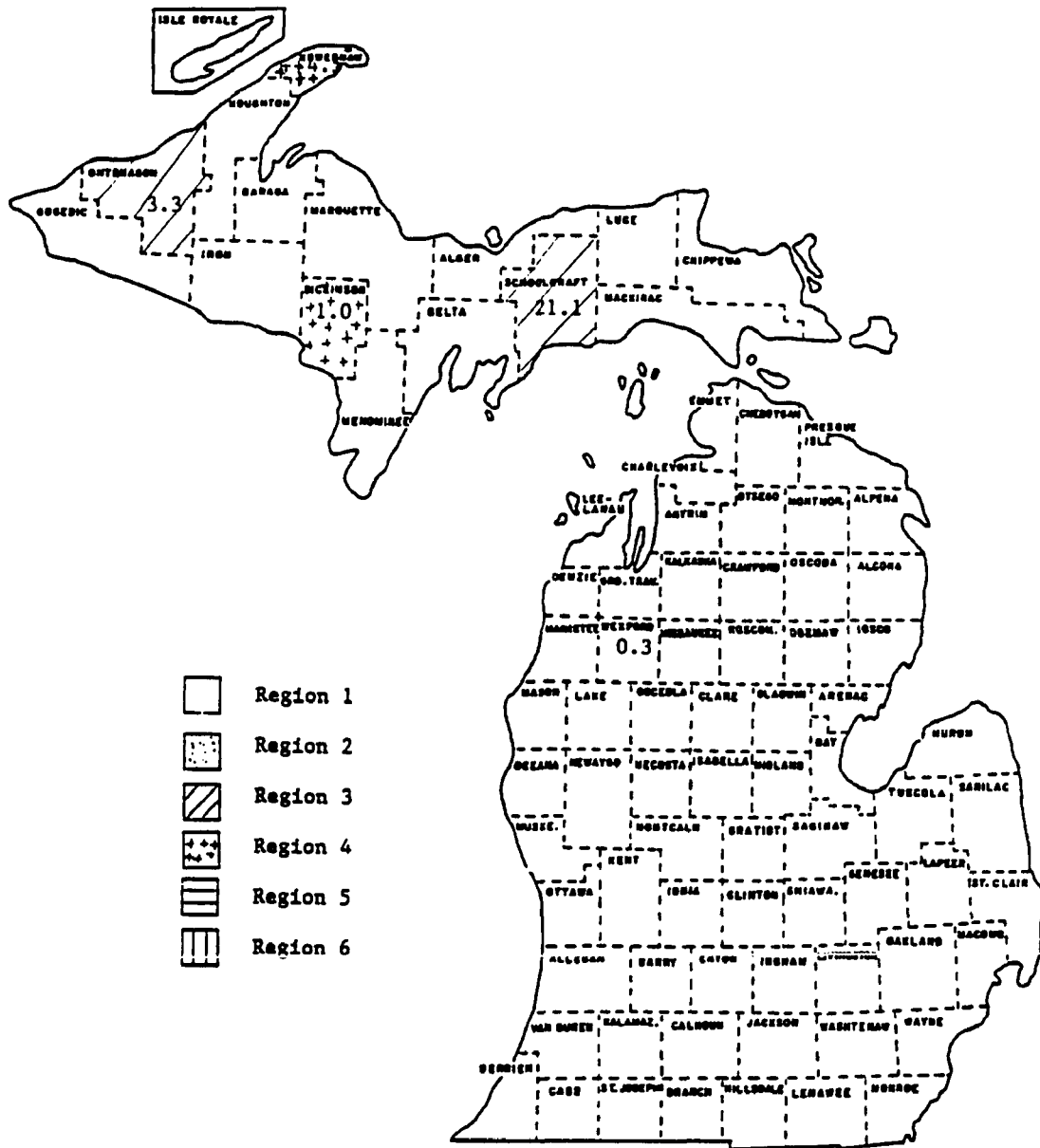
1	2	3	4	5
51.680	16.548	3.979	5.426	2.498
6	7			
1.443	0.715			

PERCENT OF TOTAL VARIANCE EXPLAINED

1	2	3	4	5
62.265	19.937	4.795	6.537	3.010
6	7			
1.738	0.861			

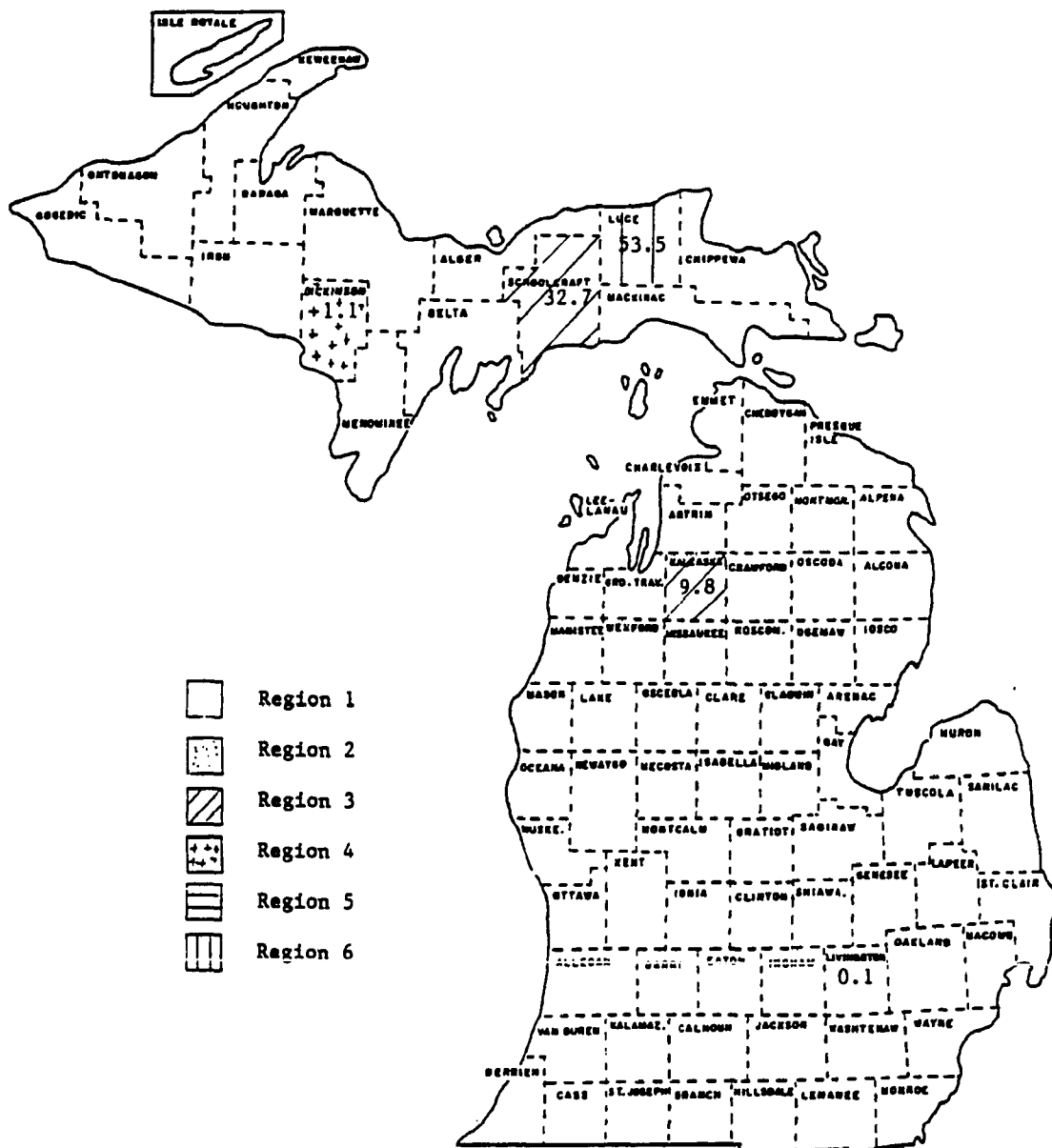
APPENDIX D

Forest Products Basic Industries by County. 1982 and 1988.



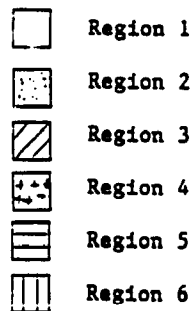
Note : Figures represent percentages of non agricultural
and non governmental employment.

Figure 1D. Sector 6: Logging contractors. Basic industry
county share. 1982.



Note : Figures represent percentages of non agricultural and non governmental employment.

Figure 2D. Sector 6: Logging contractors. Basic industry county share. 1988.



Note : Figures represent percentages of non agricultural and non governmental employment.

Figure 3D. . Sector 7: Sawmills and planning mills. Basic industry county share. 1982.

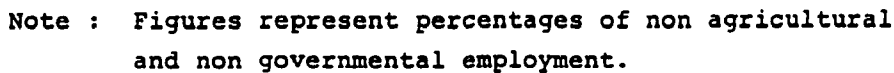
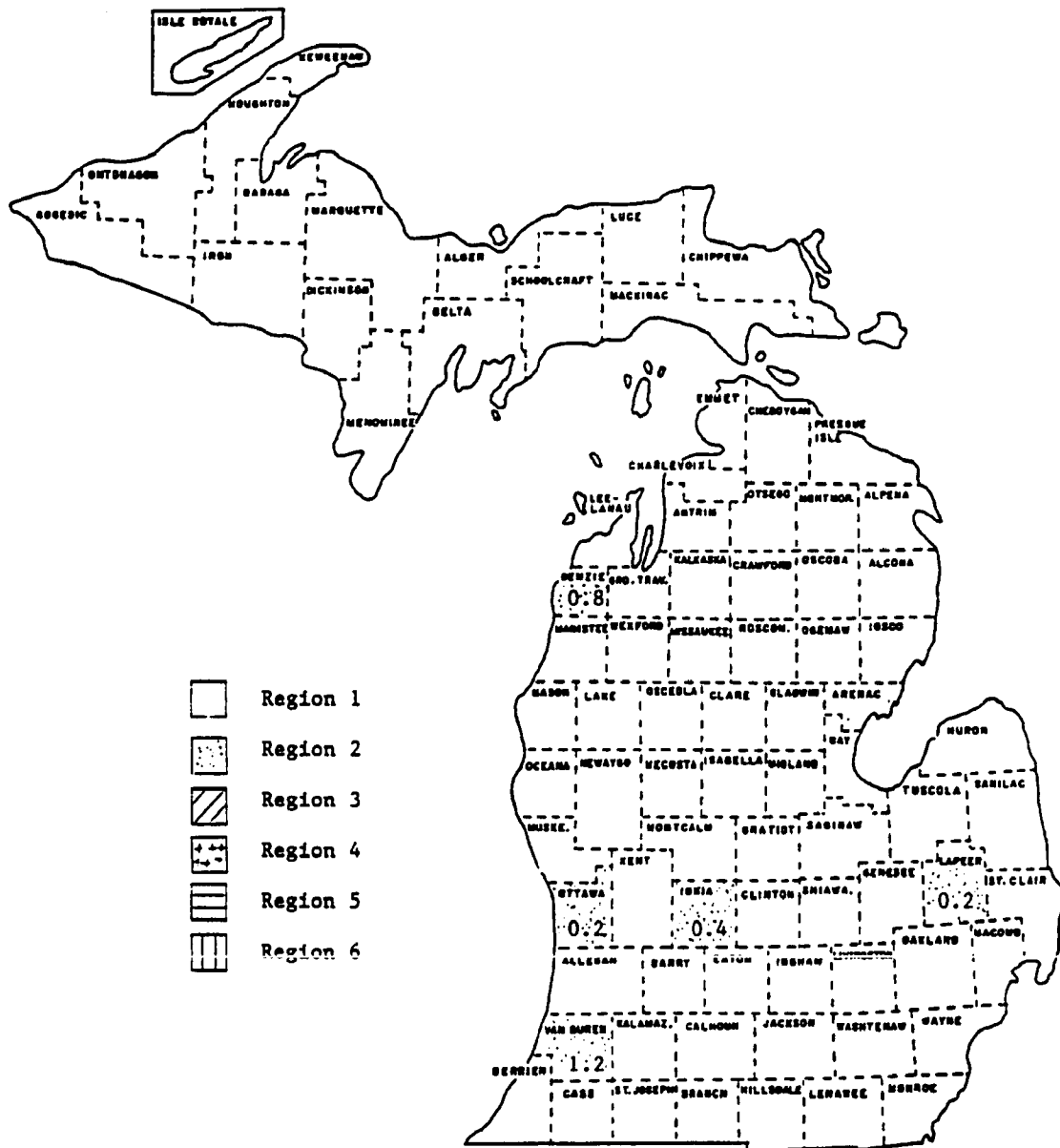
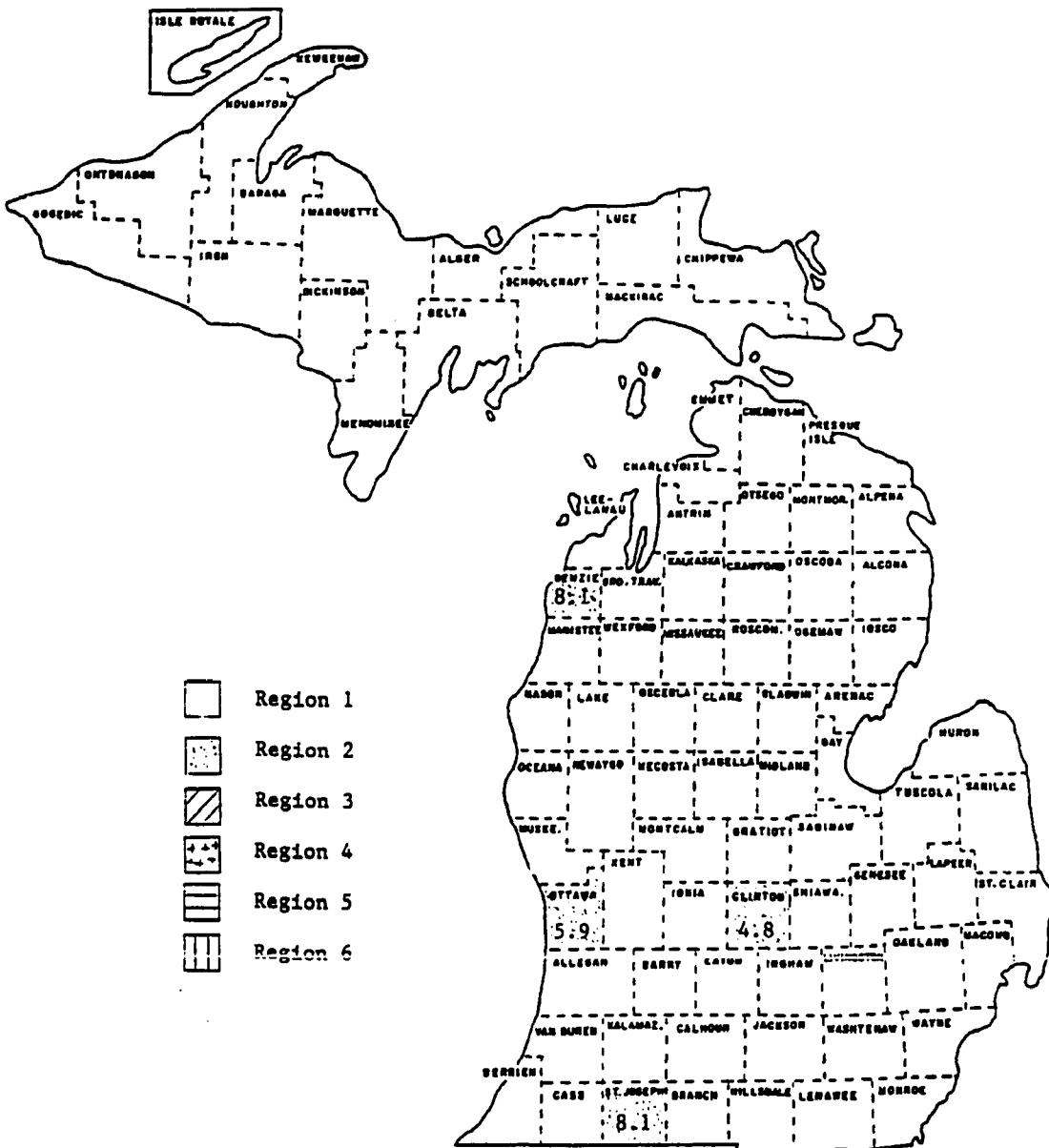


Figure 4D. Sector 7: Sawmills and Planning mills. Basic industry county share. 1988.



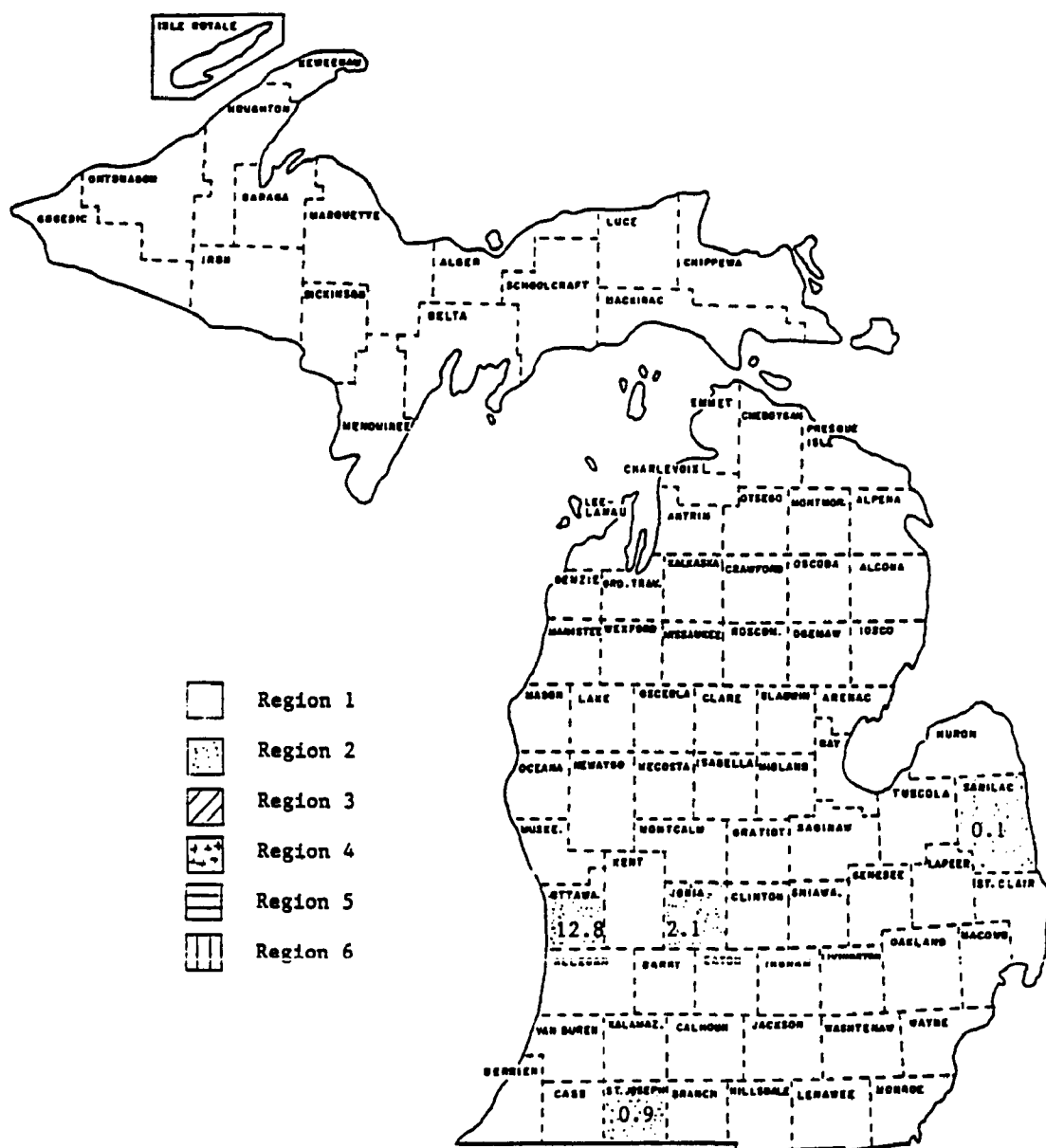
Note : Figures represent percentages of non agricultural and non governmental employment.

Figure 5D. Sector 8: Millwork, flooring, structural members. Basic industry county share. 1982.



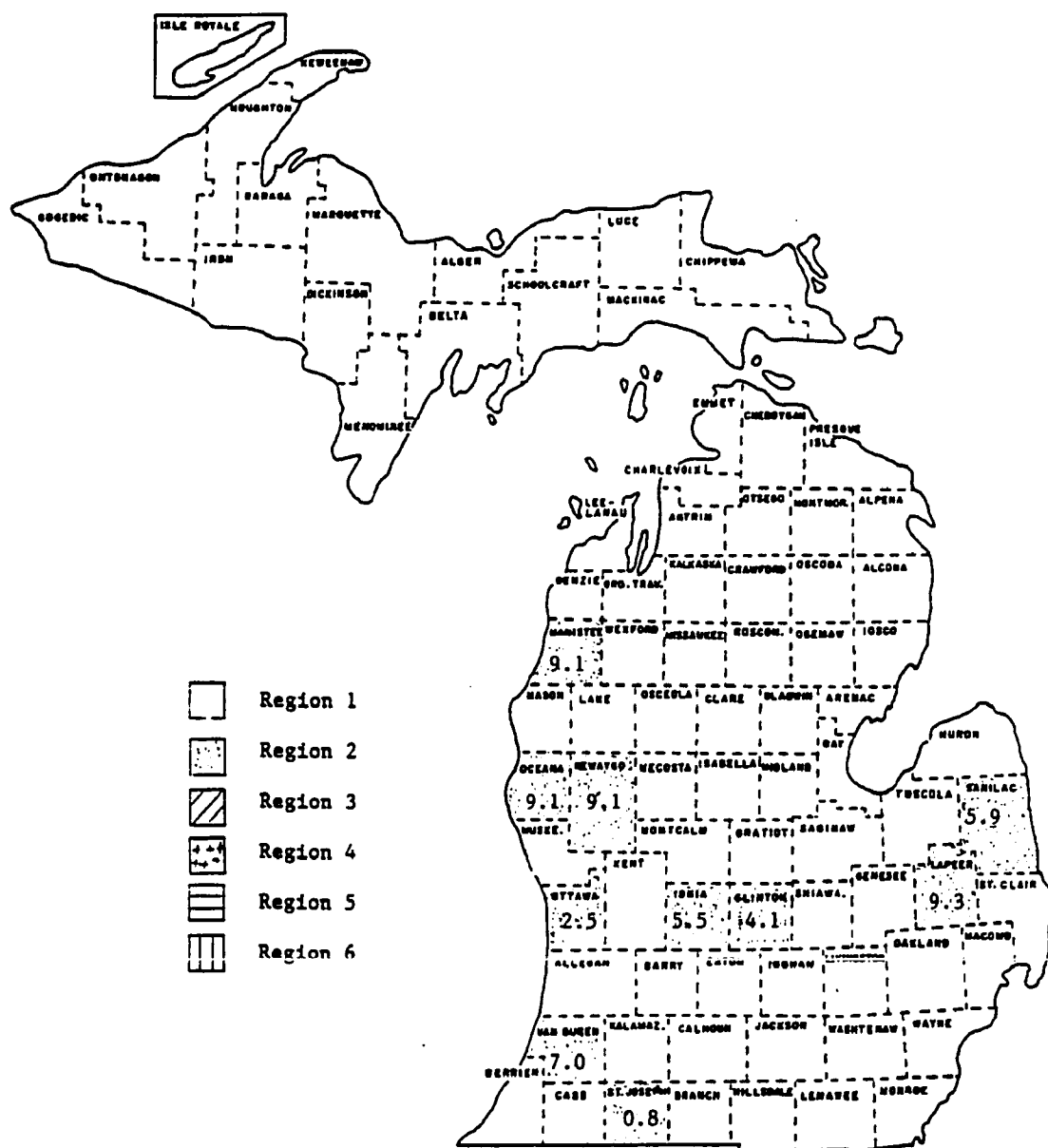
Note : Figures represent percentages of non agricultural and non governmental employment.

Figure 6D. . Sector 8: Millwork, flooring, structural members.
Basic industry county share. 1988.



Note : Figures represent percentages of non agricultural and non governmental employment.

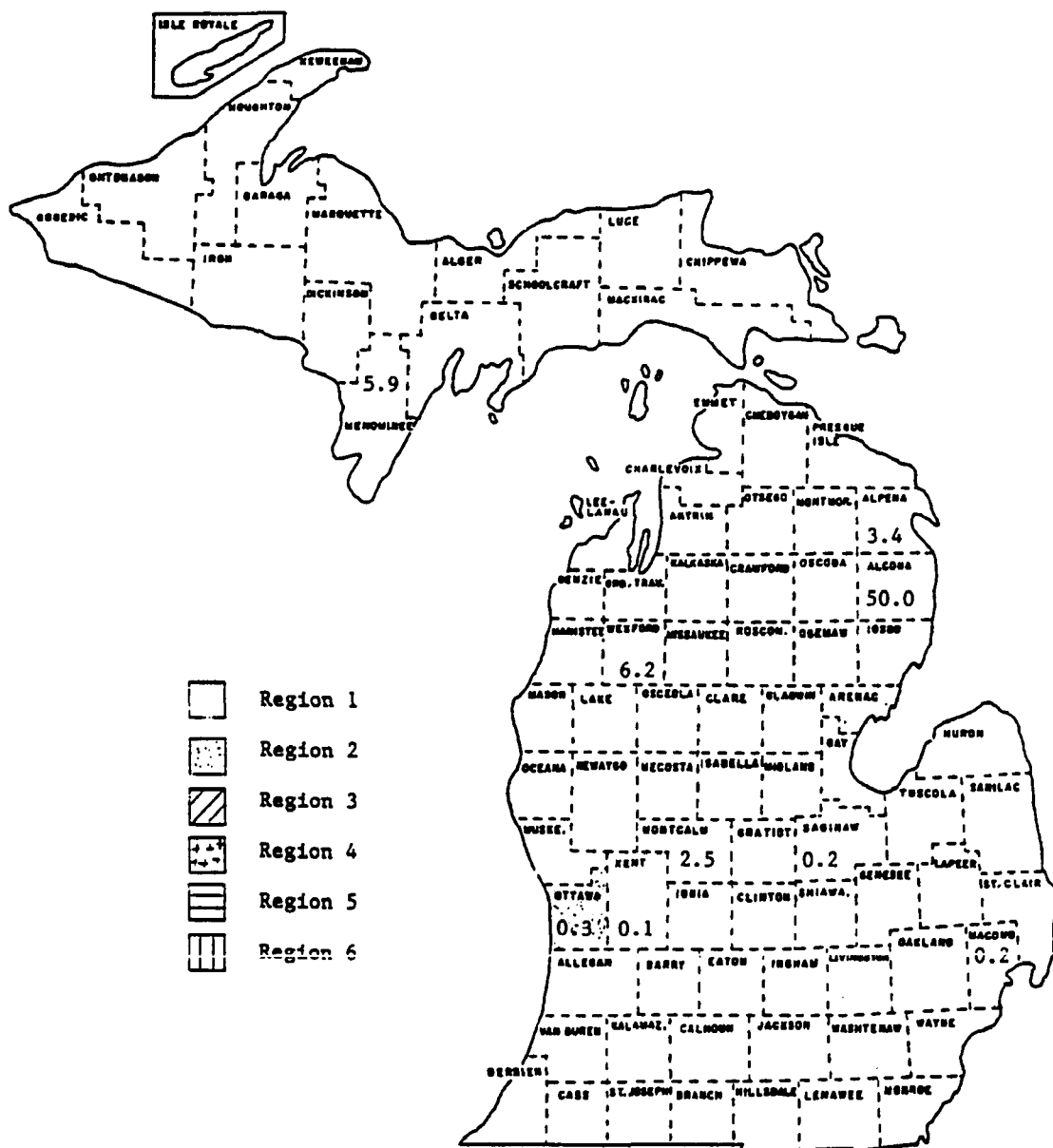
Figure 7D. Sector 9: Wood furniture and fixtures. Basic industry county share. 1982.



Note : Figures represent percentages of non agricultural and non governmental employment.

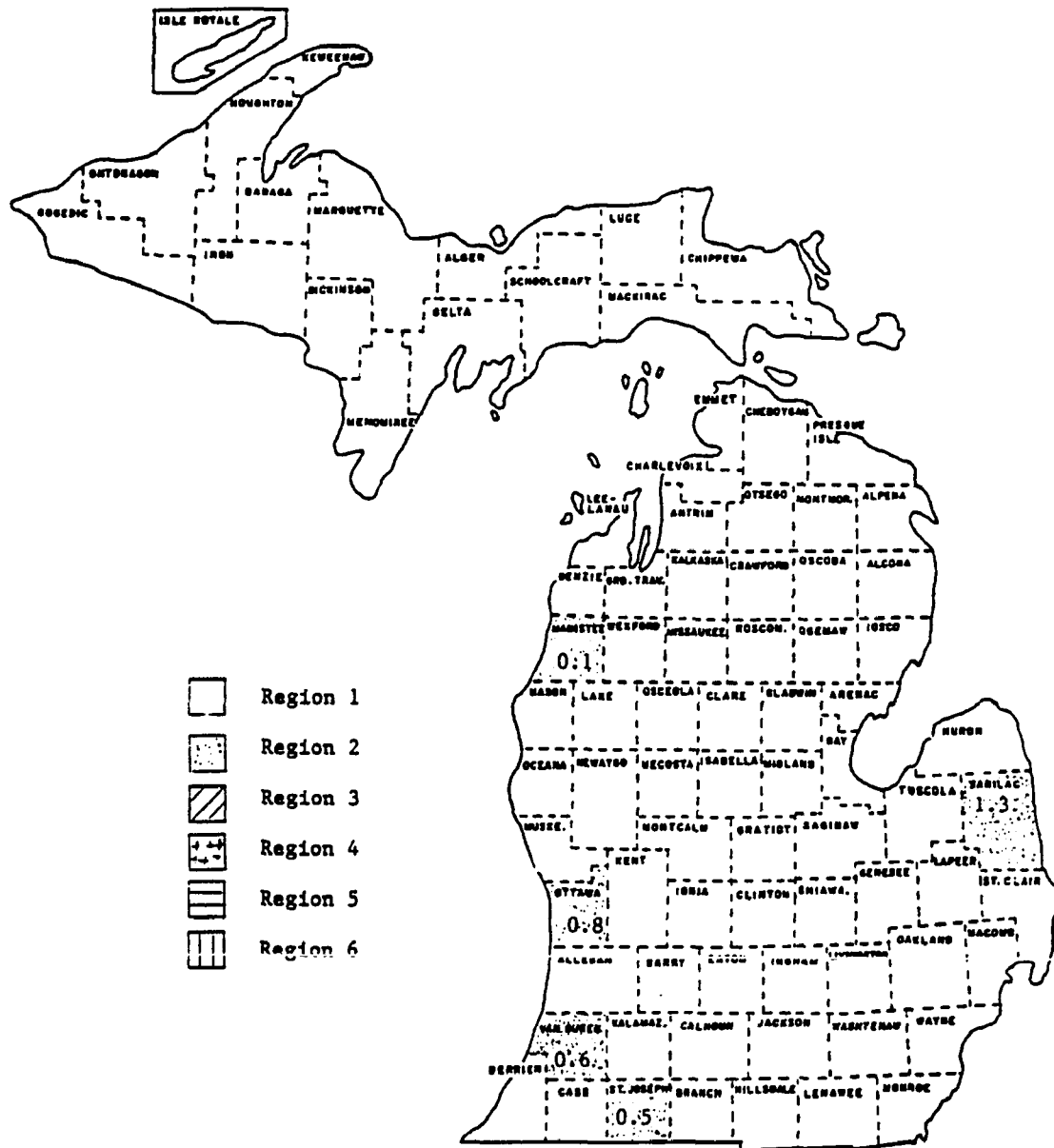
Figure 8D. Sector 9: Wood furniture and fixtures. Basic industry county share. 1988.

Figure 9D. Sector 10: Wood pallets and skids. Basic industry county share. 1982.



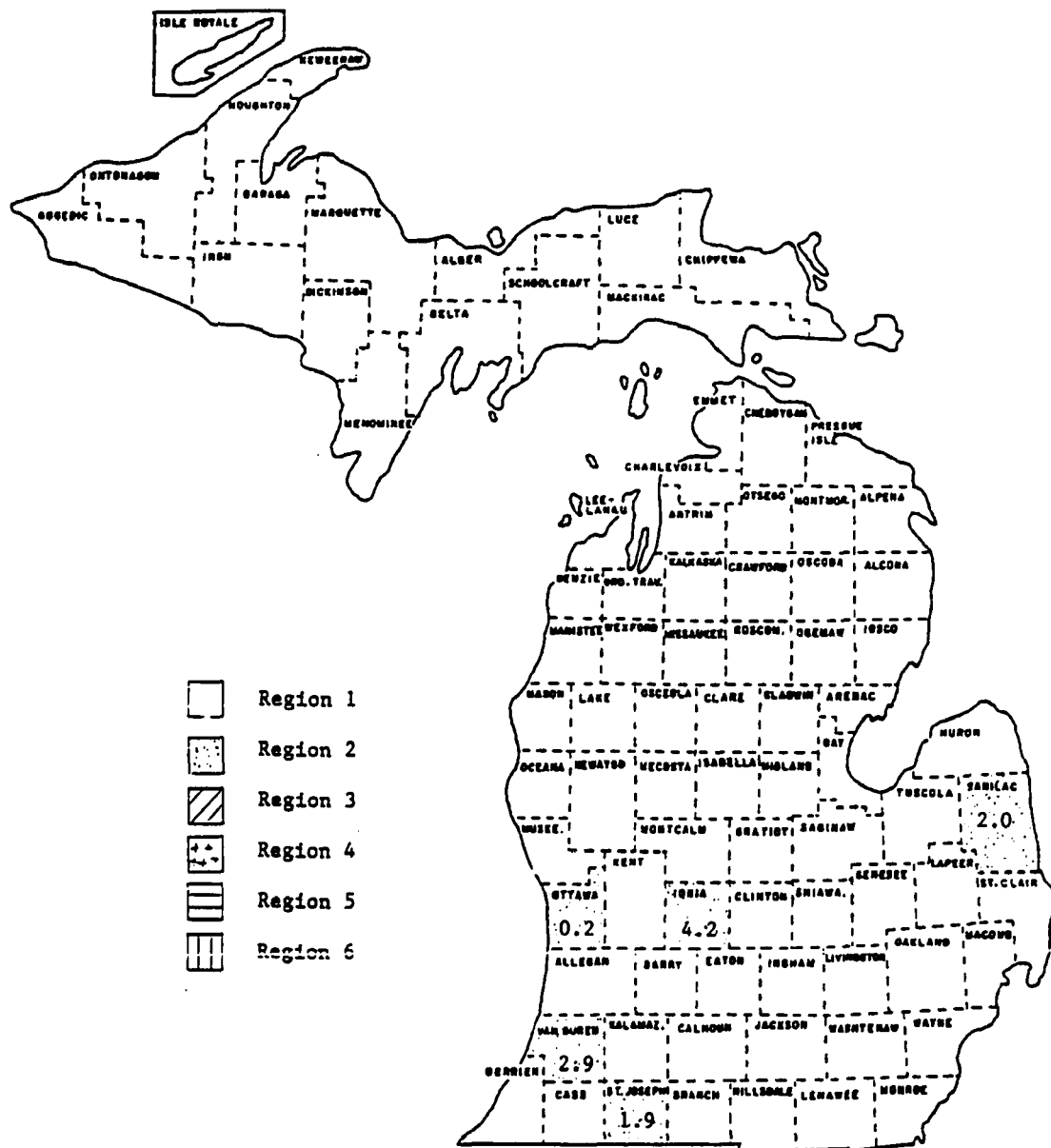
Note : Figures represent percentages of non agricultural and non governmental employment.

Figure 10D.. Sector 10: Wood pallets and skids. Basic industry county share. 1988.



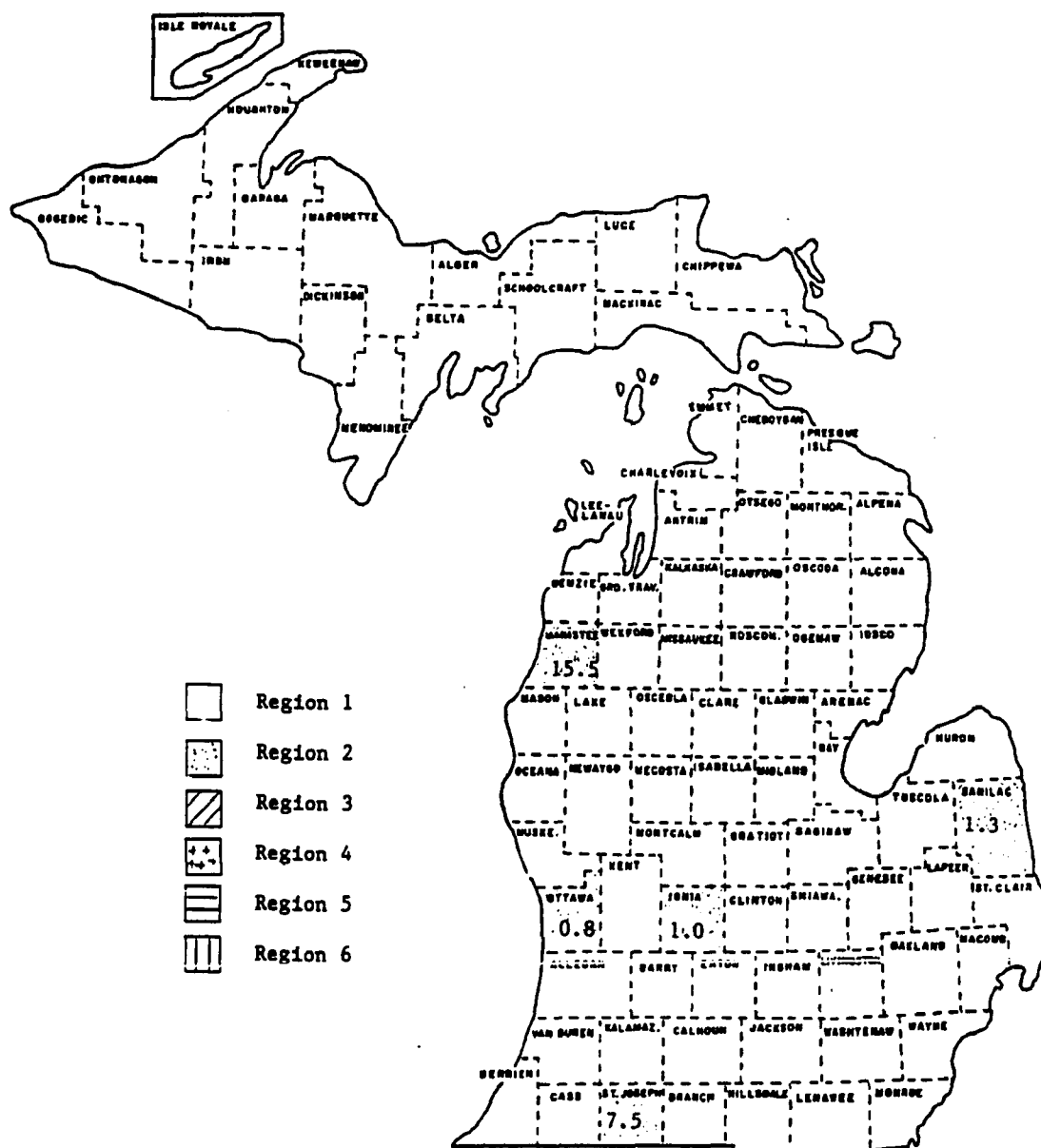
Note : Figures represent percentages of non agricultural and non governmental employment.

Figure 11D.- Sector 11: Venner and plywood, other lumber and wood products. Basic industry county share. 1982.



Note : Figures represent percentages of non agricultural and non governmental employment.

Figure 12D.. Sector 11: Venner and plywood, other lumber and wood products. Basic industry county share. 1988.



Note : Figures represent percentages of non agricultural and non governmental employment.

Figure 13D. . Sector 12: Paper and allied products. Basic industry county share. 1982.

Figure 14D. . Sector 12: Paper and allied products. Basic industry county share. 1988.

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