75-15,253

DILISIO, James Eugene, 1946-
STANDARDS-OF-LIVING AND SPATIAL-TEMPORAL TRENDS IN REGIONAL INEQUALITIES IN OKLAHOMA.

The University of Oklahoma, Ph.D., 1975
Geography

Xerox University Microfilms, Ann Arbor, Michigan 48106

THE UNIVERSITY OF OKLAHOMA

GRADUATE COLLEGE

STANDARDS-OF-LIVING AND SPATIAL-TEMPORAL TRENDS IN REGIONAL INEQUALITIES IN OKLAHOMA

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

in partial fulfillment of the requirements for the

degree of

DOCTOR OF PHILOSOPHY

by

JAMES EUGENE DILISIO

Norman, Oklahoma

1975

STANDARDS-OF-LIVING AND SPATIAL-TEMPORAL TRENDS

IN REGIONAL INEQUALITIES IN OKLAHOMA

A DISSERTATION

APPROVED FOR THE DEPARTMENT OF GEOGRAPHY

APPROVED BY

DISSERTATION COMMITTEE

ACKNOWLEDGEMENTS

I would like to express my sincere thanks to the members of my dissertation committee: Dr. Marvin W. Baker Jr., Dr. Alexander Kondonassis, Dr. Richard L. Nostrand, and Dr. Thomas J. Wilbanks for their suggestions, guidance, and constructive criticisms during the course of the dissertation. A special thanks to my committee chairman and dissertation director Dr. Gary L. Thompson for his enthusiastic and sincere interest, steady encouragement, and great patience during the preparation of the dissertation.

Thanks and appreciation are also extended to Mr. Paul Bieneman and Mr. Joseph Frasca for their suggestions and cartographic work, and Mrs. Nona Henderson for typing the manuscript. A very special thanks is due to two true friends Mike and Kelis Berry for their unselfish friendship, good humor, and support during a most stressful period. Last, but not least, a deep and affectionate thanks to Mom and Dad for their never faltering faith in their son.

TABLE OF CONTENTS

Page

LIST OF ILLUSTRATIONS

Figure		Page

LIST OF TABLES

Table		Page

CHAPTER I

INTRODUCTION AND BACKGROUND

Historical Perspectives

The classical economic view of many of the problems of lesser-developed areas is that phenomena such as inter-regional income inequalities, polarization of growth with resultant spread and backwash effects, and overall social and economic dualisms are merely temporary. Internal factor mobility has been viewed as the eventual solution to these inequities which characterize a state of disequilibrium (Olsen, 1965, p. 35).

The classical view is not completely shared by many contemporary regional scientists. The allocation of capital investments to economic sectors cannot be considered as separate from geographic location decisions. Economic development is never a uniform meliorative process. Regional growth differentials are to be expected. Some regions may be poor in resources, health, education, and productivity (Johnson, 1970, p. 162). Friedmann (1966, p. 35) has stated that:

> the concentration on national income accounts as a tool of development policy has blotted out the crucial significance of the regional element in national planning. . . and the newly evolving nations are beginning to appreciate the fact that national investment strategies require a subaggregation along regional lines.

Indeed, regional economic development is a very recent field of study. Only since World War II has there been a heightened interest in the systematic analysis of economic development processes in lesser-developed areas of the world. Economists have long recognized the existence and stubborn persistence of regional inequalities, but economic geographers, to a large degree, have only recently begun to address the problem (Gauthier, 1970, p.612; Keeble, 1967). The gap between general concepts (e.g. convergence, divergence, inequality, and standards-of living) and spatially specific empirical research has been a problem that has in the past inhibited contributions from economic geographers to explanations of regional development.

Traditionally, questions of economic development have been limited to the national-macro level or to the local-micro level of the firm (Stöhr, 1974, p. 1). For many years, both macroeconomics and microeconomics neglected to incorporate geographic space. Although location analysis and central place theory considered geographic space, the approaches were rather narrow. The first broad attempt to translate economic processes from functional space into geographic space was made by Perroux who formulated the concept of "growth poles " (1955).

Although much attention has been paid to problems of differential economic development and growth at the national-macro scale; similar problems exist internally among the regions of a country, among parts of a region, and among different cities. Much attention has been paid to the problems of development and growth in the Third World, but lesser-developed areas still exist in countries in an advanced stage of economic development. The existence of regional imbalances and dualisms has been referred to as the "North-South Problem." Economic stagnation in, for example, Brazil's Nordeste, Colombia's Oriente, Italy's Mezzogiorno, and the United States' South have all been well-documented (Williamson, 1965, pp. 99-101).

In the United States, the Public Works and Economic Development Act of 1965 which established the Economic Development Administration also established several multi-state development regions: New England, Appalachia, Upper Great Lakes, Coastal Plains, Ozarks, and Four-Corners. The creation of these districts signified a general awareness of the existence of socio-economic lag areas in an advanced economy.

The fact that regional inequalities are such a stubbornly persistent feature of a modern socio-economic landscape is not due to a lack of mobility of the factors of production and growth. The persistence of these lesser-developed areas is, in part, due to the fact that the slowness of the factor migrations prevents such areas from approaching or surpassing the levels of economic development in more highly-developed regions of the same country (Williamson, 1965, p. 101).

This research seeks to analyze changes through time in specific aspects of regional inequalities in the state of Oklahoma between 1940 and 1970. Its objectives are: (1) to selectively measure certain surrogate facets of the generalized notions of regional inequalities and standards-of-living; and (2) to determine how regional inequalities in the standard-of-living have changed in identifiable standard-of-living-regions since 1940.

A number of characteristics of a population critical to the description of that population's standard-of-living will be analyzed. The surrogate measures for standard-of-living fall into several general categories which include: income, health, education, and family environment.

Inequalities in variable(s) from these categories will be analyzed in both their spatial and temporal dimensions.

Implications of Regional Inequalities

Rationale for Investigating Regional Inequalities

The existence of severe regional inequalities has ramifications which reach from the more aggregate worldwide situations down to local household and individual human situations. The ultimate goal of scientific endeavors should be to reveal the world more clearly. Those who are interested in economic development and growth must initially come to grips with several very basic questions:

1. Under which conditions are economic development and growth desirable?

2. Do economic development and growth necessarily bring about betterment of the social welfare?

3. Are present policies and economic processes creating a more or a less equitable system?

4. Is the equalization of economic and social indicators a legitimate objective?

5. Are the methods and results of present policies in conflict with the underlying economic ideology of the political system?

Traditional welfare economics has never quite resolved the problem of how wealth should be distributed socially or geographically (Higgins, 1958, p. 363). Also, regional development has been simplistically regarded in economic terms, but the processes involved are much more complex than a simple rise in the GNP or an increase in regional output might indicate. Other factors such as self-respect of the individuals, standards-of-living, and the distribution of wealth must also be considered. A growth economy can result in an increased concentration of wealth in the hands of a few, greater unemployment, and greater urban-rural disparities. Development suggests the relief of poverty and the reduction of inequalities (Connell, 1973, p. 28). Under this philosophy, equality is considered as an objective in its own right.

Many economists feel that economic and spatial equality will hinder growth. Hirschman (1958, p. 66) has said that the task of development policy is to maintain tensions, disproportions and disequilibria in order to stimulate growth. This writer takes the opposite point of view--that the goals of American ideology can be realized only through a policy that seeks social and economic equality. Such an approach may not necessarily lead to a situation of optimal economic production, but the goal of development policy should be the betterment of social welfare as well as increased output. Connell (1973, p. 28) has stated that:

> Inequalities, especially increasing inequalities, are objectionable by any ethical standard; since race is usually highly correlated with income, economic inequality lies at the heart of racial tension. Our research efforts must be directed above all to understanding the causes of poverty and the mechanisms by which inequalities emerge as a basis for genuine development.

Hoover (1971, p. 273) touched upon another aspect of the "equality-maximum economic growth controversy" in his Place Prosperity position which advocates the allocation of economic assistance to a large number of small areas on the basis of need. Inducements to employers are suggested as the chief means of assistance. This approach assumes that people should be helped in situ, and that every region has some degree of development potential.

The People Prosperity position advocates assistance by improving the employability and mobility of the people, and facilitating their relocation. This position stresses the stimulation of development on the basis of growth potential and the development of human resources to facilitate the movement of people to growth centers.

The Place Prosperity and People Prosperity views are not incompatible. It should be possible to evolve strategies that would allow large portions of the population of a region to obtain better living conditions without moving to another location where growth is occurring. A presidential advisory commission in 1967 advocated a "national policy designed to give residents of rural America equal opportunity with all other citizens. This must include access to jobs, medical care, housing, education, welfare, and all other public services, without regard to race, religion, or place of residence " (President's National Advisory Commission on Rural Poverty, 1967, p. xi.). Such a position does not necessarily have as its goal the maximum efficiency in the allocation of economic resources. The goal advocated in this research is the betterment of social welfare. The nature of this research is basically diagnostic. Only after the spatial and temporal dimensions of regional inequalities have been thoroughly analyzed, can the prescription of policies be attempted in order to facilitate the treatment of regional inequalities. Policies associated with both the Place Prosperity and People Prosperity positions can make such a goal obtainable. A combination of the two policies could help a region to realize its growth potential by utilizing physical resources, while at the same time providing assistance to up-grade the human resources of the region.

Gunnar Olsson (1974, p. 16-21) has attempted to deal with the problem of extending descriptive social science into prescriptive social engineering. By using regional planning in Sweden as a reference, Olsson demonstrates what he believes to be a conflict between welfare ideology and the scientific methodology being used for the implementation of the ideology. The stated purpose of regional planning in Sweden has been to achieve equality, i.e. someone who lives in a valley of the undulating socio-economic surface should have the same opportunities as someone who lives on a peak. Olsson (1974, p. 16) states that:

> My only quarrel is that this laudable piece of welfare ideology has been put into practice by means of a scientific methodology which reflects just the opposite thinking. To be more specific, the planning has been based on a variant of the social gravity model, which has the same mathematical form as the Pareto function. In this sense, the descriptive social gravity model encapsulates exactly those relations of inequality that characterize both Pareto's optimality principle and his Machiavellian theory of the elites. I feel rather strongly that this mismatch of ideology and methodology has contributed to discontent and alienation which is becoming more and more visible.

One of Olssons' main points is that if the present methodological and manipulative path is pursued, there is a great risk of increasing those social, economic, and regional inequalities which the planning was designed to decrease.

One aspect of this study will be to determine whether or not the present planning attitudes in Oklahoma has increased or decreased the degree of inequalities both within and among standard-of-living regions of the state. Trends in regional inequalities resulting from planning or a lack of planning will be considered, but it is not the purpose of this study to evaluate the efficiency of the state's planning machinery. A very basic assumption of this research is that social welfare is strongly reflected by income. It is perhaps spurious to correlate wealth with social welfare and happiness, but increases in income may well increase the range of alternatives for the inhabitants of a region. Increased income creates many possibilities, such as making the populace more mobile, and having a cumulative multiplier effect on the region's growth.

This research is concerned with inequality characteristics such as education levels, health, retail trade, quality of housing, income, mobility, and family cohesion. It is felt that all of these characteristics are very closely related in the system of social, economic and spatial organization (Ornati, 1966). Figure 1 is a general scheme of the relationships that might exist between these various characteristics in a region. The circle can be entered at any point and movement made in either direction. Beginning with a low level of income, there are expectations of low levels of savings and investments, low levels of human capacities and ambitions (e.g. education, housing, entrepreneurial ability), low levels of resource utilization (physical and human), and once again low income levels.

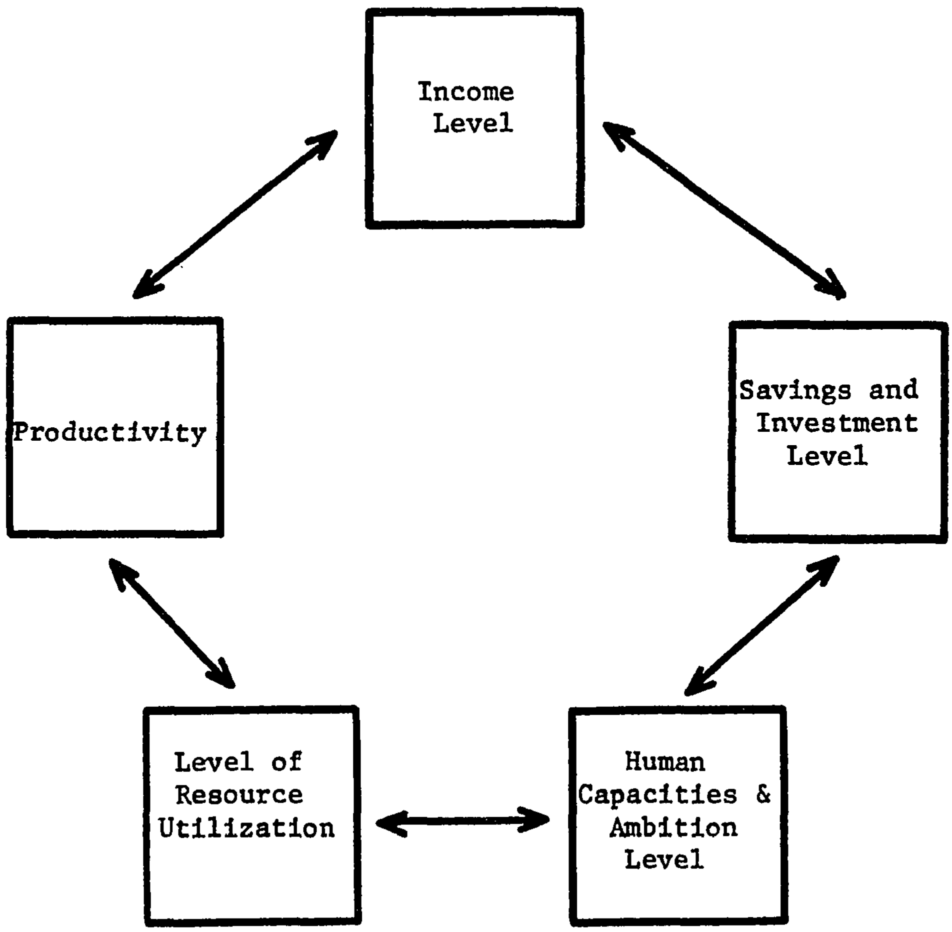
Hughes has stated that:

> Once income differences emerge they tend to become self-perpetuating, unless some exogeneous influences, e.g. government or chance, acts to offset market forces. These results flow from a process of circular causation-income differences causing differences in savings, investments, human capacities, ambitions, etc., and these in turn causing differences in income. (Hughes, 1961, p. 41)

The question of a circular effect has also been described at a more macro-scale by Liebenstein (1954),

FIGURE 1

The Self-Perpetuating and Cumulative
Reinforcement of Inequalities



Source: Based on Hughes (1961).

Does a vicious circle of self-perpetuating socio-economic inequalities really exist? If so, how can a region suffering from chronic problems of low growth break out of this circle with or without exogeneous help? This study addresses the first question, i.e. the diagnosis of the problem rather than the treatment of it. The uncovering of any systematic relationships among the characteristics in space and through time may prove to be helpful in social and economic planning policies for a region. While Oklahoma is the study area, other economically distressed areas of the United States could possibly benefit from an empirical analysis of regional inequalities.

Regional planning in the United States has been characterized by a laissez fair attitude. Such an attitude is permissible if the "vicious circle" does not exist and if regional differences are becoming less pronounced. If, on the other hand, the system is reinforcing, perpetuating, and increasing regional inequalities, planning policies may need revision. Questions such as those dealt with in this research must be answered if the misallocation of human, financial, and physical resources is to be prevented.

Smith (1973, p. 6) states that:

> Ideally, the objective of social policy is to identify the state of the social system and its subsystems; to compare this with some desired state that is both functional and conforms with accepted principles of social justice, and then to institute programs to correct the deficiency.

In this statement, Smith has touched on all of the broad aspects of the problem: diagnosis of the problem, a search for possible cures, and treatment. Human geographers such as Smith are beginning to realize that there is a dimension of the human situation called social welfare and that a society can be differentiated spatially within such a matrix.

Relation to Theory

The principal theoretical theme towards which this study is oriented is centered on the question: Is the regional growth process equilibrating or not? In other words, does the growth process in a regional system lead to the convergence of standards-of-living as a condition of human existence?

Some evidences of the convergence hypothesis in the United States have been presented by R. A. Easterlin (1960), F. Hanna (1959), G. H. Borts and J. L. Stein (1964), and J. T. Romans (1965).[1] All of these investigators found evidence of convergence of per capita incomes, though the process was found to be neither steady nor continuous.
It cannot be assumed that factor flows in an economy will automatically lead to convergence. In a dynamic economy, there are also disequilibrating factor movements that may outweigh equilibrating factor movements. Although dynamic forces do not inevitably work in favor of divergence, at the same time they contain no inherent bias in the direction of convergence (Easterlin, 1958, p. 4).

Gunnar Myrdal (1957) has been recognized as a chief critic of the convergence hypothesis. Myrdal sees growth in a region as a force leading to greater inequalities, i.e. divergence. In his center-periphery model,

---

[1]For a detailed analysis of regional equilibrium theory, see Harry Richardson. Regional Economics. New York: Praeger, 1969.

Myrdal sees additional growth as being concentrated in a few centers of growth. The periphery suffers from negative backwash effects as the factors of production flow into the growth centers to create a growing-spiralling effect. The center and the area immediately around it benefit from spread effects, which further enhance the center's attractive powers for growth.[1] The movement of labor, capital, goods, and services to the centers from the periphery are regarded as being disequilibrating forces.

In a singular economic system, the patterns of trade of the poorer regions can become distorted to benefit the wealthier regions. Richardson (1969, p. 349) has stated that:

> Perhaps even more important, economic backwardness results in non-economic influences harmful to growth--low levels of education, lack of aspiration and other social attitudes incompatible with high rates of economic development and deterioration in the social capital of such regions.

Overall, Myrdal neglects the possibility that factor movements can be equilibrating, as well as other forces that tend to promote convergence. Strong disequilibrating forces as opposed to the equilibrating forces will occur in the early stages of economic development and growth of a region (Williamson, 1965, p. 108). One unresolved question is whether or not the processes change in advanced stages of growth, with the equilibrating forces prevailing and convergence resulting?

---

[1]Attractive powers are enhanced by the development of factors such as infrastructure, external economies, internal economies, and economies of scale. Spread effects are taken here to mean the beneficial effects on poorer areas of the interaction with rich areas. Backwash effects are the detrimental effects suffered by poorer areas as a result of interaction with the rich (Olsen, 1965, p. 109).

The dynamics of equilibrating and disequilibrating forces through time at different levels of growth have not been fully explored, but it is clear that social, demographic, or technological changes may give rise to factor movements of either type.

It is obvious that the complex question of regional convergence is laden with many theoretical implications. Detailed empirical evidence of the process of convergence are scanty. Richardson (1969) points out that generally, the trends in the United States since 1880 have been towards regional per capita income equalization, but the process is far from completed. Due to the contributing disequilibrating factors, it is understandable that such a process will almost certainly remain incomplete, particularly in the absence of equilization policies by the government.

Research Area

General Setting

The study area selected for this analysis of regional inequalities is the state of Oklahoma (Figure 2). An earlier study suggested that Oklahoma possesses several characteristics which make it an appropriate laboratory for the study of differential economic development (DiLisio, 1973). The state is far from being a homogeneous geographical area, and displays a wide variety of living conditions, economic activities, physical and human resources.

An axis of highest economic development exists in central Oklahoma and stretches to the northeast. This area includes the Oklahoma City and Tulsa Standard Metropolitan Statistical Areas; these two metropolitan areas are the premier manufacturing centers of the state. The economy

STUDY AREA
Oklahoma 1970

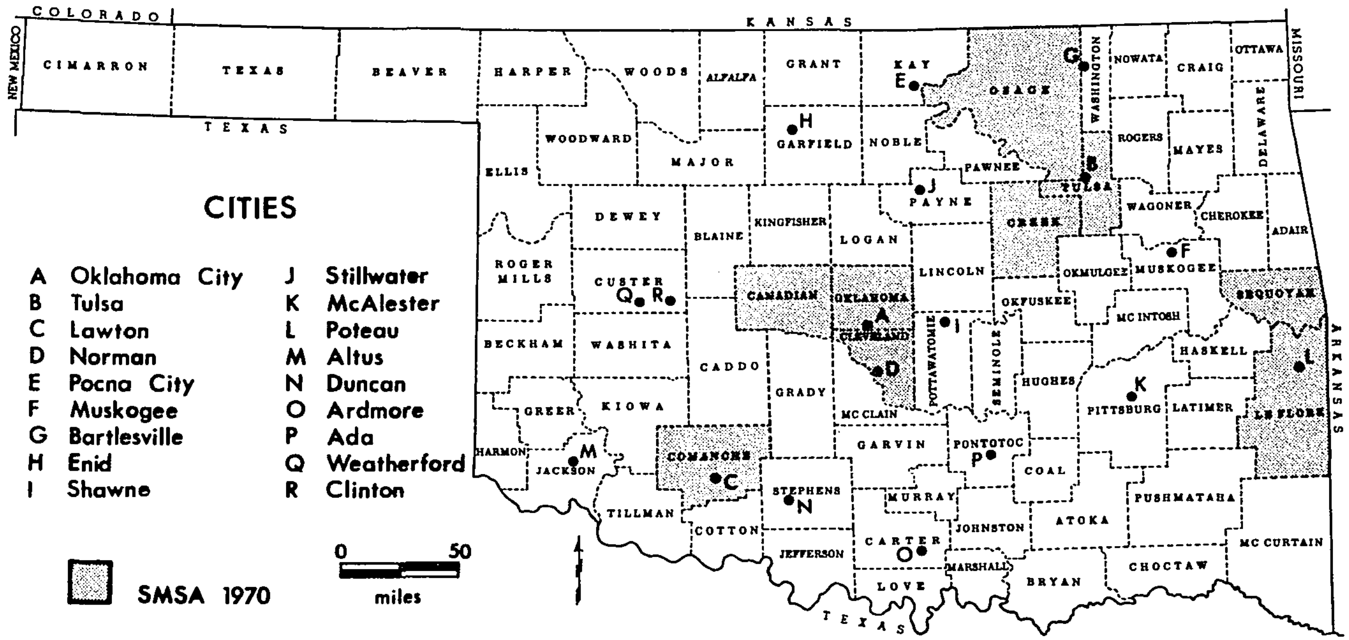


Figure 2

of Oklahoma City is largely underpinned by government employment. The area to the northwest of the core is one of moderate development. This area includes the wheat and cattle producing counties of the northwest and the "Panhandle." Stretching southwest from the core is an area of moderate to low development. The area centers on the Lawton S.M.S.A. in Comanche County. The hill areas to the east and southeast of the core are generally areas of low development. A more complete description of standard-of-living-regions of Oklahoma will be the objective of Chapter III.

The Question of Scale

Many of the studies that have been done on regional inequalities have been conducted at the international and national scales. The notable study by Williamson (1965) on regional inequalities and national development was done at two different scales: an international cross-section analysis, and a United States cross-section analysis. Easterlin (1960) directed his attention to the national scale. Hanna (1959) analyzed state income differentials in a national setting. Romans (1965) dealt with major regions of the United States. Stöhr (1973) states that:

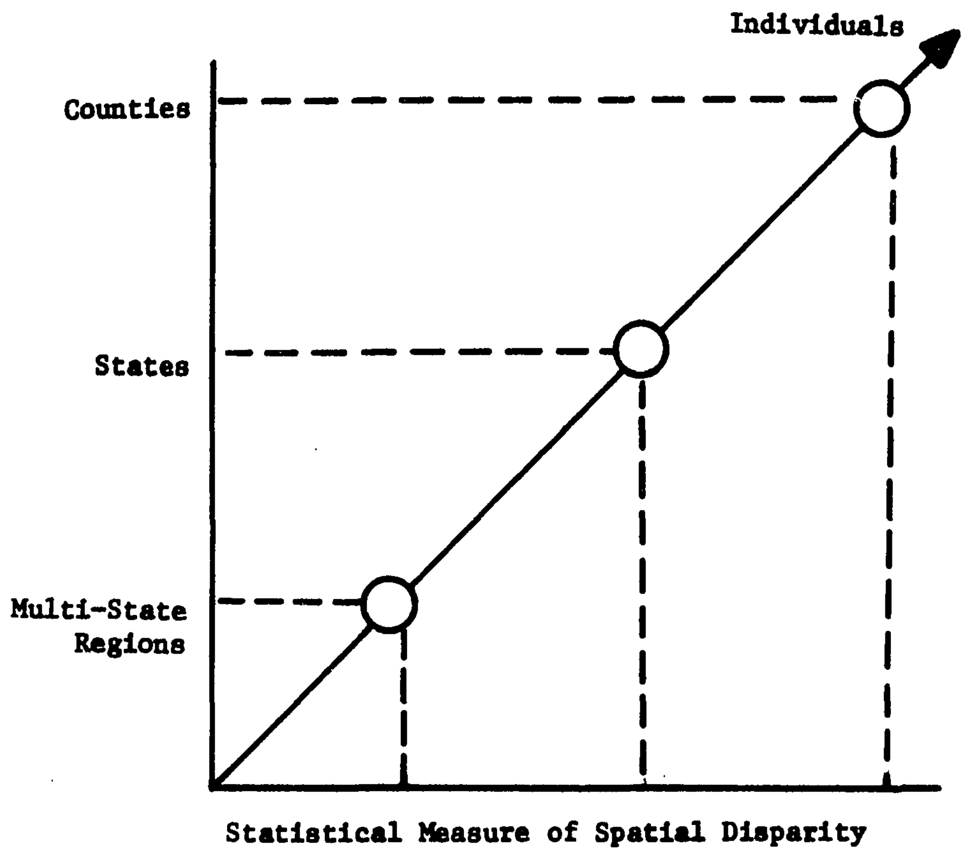
> Spatial disparities may exist at different levels and between different types of areal units, for instance between countries (international disparities), between different parts of a region (e.g. center-hinterland disparities), or between different cities (interurban disparities).

By focusing in on the much larger scale of an individual state, this research will be able to more clearly describe the magnitude and nature of inequalities. The observational units will be each of the seventy seven counties of the state. The smaller the geographic units into which data are broken down, the greater will be the inequalities that appear statistically (Stohr, 1974). Inequality measures of major regions of the United States are for this reason quite small. If the scale were changed to an analysis of the nation by state, the inequality measure would become larger. The changing of scale by disaggregating to the county and metropolitan levels should yield larger inequality measures respectively (Figure 3). The inequality measures would be at a maximum if individuals were considered as the observational units. Smaller scale analyses utilize data that are more averaged. The more averaged data contain less variance, i.e. disparities. The larger scale analyses get closer to the individual, and indicate more clearly the true degree of disparities inherent in a finely meshed surface.

The question of the existence of convergence or divergence in a regional system is both complex and controversial. Prominent scholars of economic development have presented points of view that support both convergence and divergence. Since growth models differ greatly in their prediction of the likelihood of convergence, it is highly probable that the question can only be settled empirically (Richardson, 1969, p. 55). This study will essentially be an empirical diagnosis of regional inequalities in both their spatial and temporal dimensions. The discussion presented in this chapter should make it possible to clearly understand the objectives and methodology of the study which are described in the next chapter.

FIGURE 3

Relationship Between Level of Spatial Disaggregation Of Data and Measure of Spatial Disparity



Source: Stohr, 1974, p.3.

CHAPTER II

RESEARCH OBJECTIVES AND METHODOLOGY

Research Objectives

Problem

This research will be an examination by the writer of the degrees and directions of the changes in regional inequalities in Oklahoma between 1940 and 1970, and the relationship of these inequalities to standard-of-living. The patterns and relationships will be measured at ten year intervals between 1940 and 1970 in order to analyze temporal changes. This maximizes data availability and will make possible the exploration of the relationships over both time and space. Regional inequalities of the following characteristics will be considered: (1) education levels, (2) health, (3) retail trade, (4) quality of housing, (5) income, (6) mobility, and (7) family cohesion.

The specific research problems to be considered are: (1) how are regional standards-of-living related to regional inequalities at selected points in time? (2) How has the magnitude of inequalities for specific socio-economic characteristics changed within the present standard-of-living regions since 1940? To answer these questions, it will be necessary to identify the standard-of-living regions in the state.

Premises

The general proposition under consideration has been stated by Williamson (1965) with regard to income. He suggests a systematic connection between the level of economic development and the intensity of regional income inequality. According to Williamson, the early stages of economic development generate increasingly large income differentials, i.e. there is a process of divergence.[1] As development of the physical and social infrastructure proceeds, divergence continues up to a certain point of development. When this turning point is reached, further growth produces a process of convergence in the advanced stages of development.[2] Thus an index of regional income inequality should form an inverted-U (Figure 4) when plotted against the spectrum of levels of economic development.

This research will test Williamson's general proposition, but with several key differences. The Williamson hypothesis will be expanded by considering not only the degree of income inequality, but also the degree of inequality in education levels, health, retail trade, quality of housing, mobility, and family cohesion. Instead of the general concept of level of economic development, this research will be concerned with the more precisely defined concept of standard-of-living.[3]

At this point, a distinction should be made between economic development and economic growth. The concepts are quite different.

---

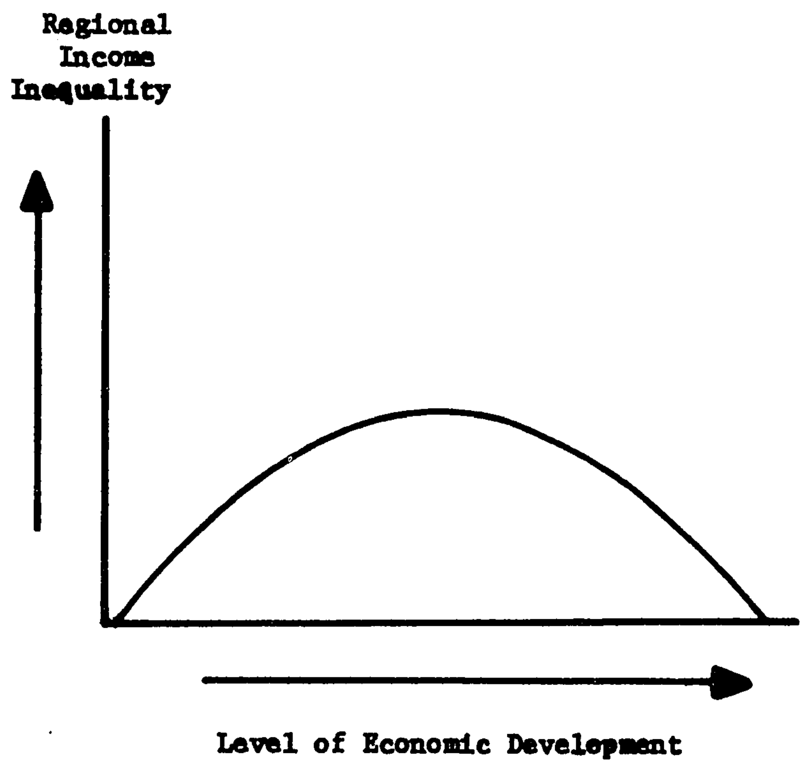
[1]Divergence is taken here to mean an increasing trend in the magnitude of regional disparities. Convergence refers to a process indicated by decreasing regional disparities.

[2]Implications of the Williamson hypothesis for regional planning are many. If the hypothesized process does occur, then a laissez faire attitude towards regional planning is permissible, but serious questions exist about the movement to a state of equality without some form of active planning and action on the part of the government.

[3]The concept of standard-of-living will be defined and operationalized in Chapter III.

FIGURE 4

THE DEVELOPMENT PROCESS



Source: Based on Williamson (1965).

Kindleberger (1958, p. 3) has stated that:

> Economic growth means more output, and economic development implies more output and changes in the technical and institutional arrangements by which it is produced.

Development is, therefore, a term that is more applicable to sustained increases of productivity in a lesser-developed country or region of the world. For this to occur improvements in the basic social, economic, and physical infrastructures are required. Growth is a term that is more applicable to sustained increases of productivity in an economy that is already advanced and has well established infrastructures. The focus of this study will be on economic growth as opposed to economic development. Economic growth levels for regions of Oklahoma will be identified by the use of the concept of standard-of-living.[1]

An initial basic assumption of this study is that the present level of standard-of-living of the various regions of Oklahoma is systematically related to levels of education, income, retail trade, health, family cohesion, mobility, and housing quality.

The central hypothesis of this study is that the state of Oklahoma has been experiencing an overall convergence in the degree of regional inequalities since 1940; i.e. the regions of Oklahoma are becoming more alike in the degree of inequality.[2] In order to fully explore the dynamics of regional disparities in Oklahoma, several supportive premises are necessary. It is felt that regions of lower

---

[1]In this research, standard-of-living will be used as a concept measured in terms of the results of growth. It will be more of an output consumption oriented yardstick than an input-production oriented yardstick.

[2]Inequality means the degree of variation or disparity of a given socio-economic characteristics both within and among defined region(s).

standard-of-living will exhibit greater internal inequalities than regions of higher standards-of-living for each of the time points in the study. The changing degree of inequalities within each region should vary. Regions of lower standards-of-living should experience greater inequalities in each of the characteristics over time; regions of higher standard-of-living should experience a diminishing degree of inequalities over time.

Methodology

General Research Design

This research is essentially descriptive in the sense that it seeks to identify changes rather than to suggest causal processes. It will seek to describe the changing associations among the several aforementioned socio-economic characteristics in both the spatial and temporal dimensions.

Kerlinger (1964, p. 379) has called this type of research ex-post facto, and has described it:

> as systematic empirical inquiry in which the scientist does not have direct control of independent variables because their manifestations have already occurred or because they are inherently not manipulable. Inferences about relations among variables are made, without direct intervention from concomitant variation of independent and dependent variables.

It is felt that this type of research approach is most appropriate to achieve the desired objectives. Connell (1973, p. 32) has strongly stated that although identification and description may not be the ultimate aim, they do constitute a first order of geographic business, and they are certainly an order of business most relevant to lesser-developed areas.

Standard-of-Living-Regions

The objective of Chapter III will be the regionalization of Oklahoma into standard-of-living regions. This research will be executed in a stepwise fashion through the various levels of analysis shown by Figures 5 and 6. Level I of the research will begin at the aggregated state level. Data for a number of standard-of-living surrogate variables will include: health, crime, income-savings, education, retail trade, employment, demographic, and miscellaneous.[1]

Standard-of-living regions for Oklahoma will be formed by using the aforementioned data. The basic approach to be followed in the construction of the regions can be described as "factorial ecology." This approach makes possible the parsimonious description and analysis of characteristics of the human population. Its use here will be taxonomic in nature. The term "factorial ecology" was first coined by Sweetser (1960, p. 372-386). This inductive method is used to specify the spatial distribution of interrelated social characteristics. Rees (1971, p. 209) says that factorial ecology seeks to explain interrelated characteristics among human populations and their socio-economic environments by first characterizing areal differences, then explaining why such differences occur.

In order to simultaneously consider all of the surrogate variables and to collapse the data matrix (77 counties x n variables) into a

---

[1]For an exact list of the variables used see Appendix A.

FIGURE 5

THE GENERAL RESEARCH PROCEDURE

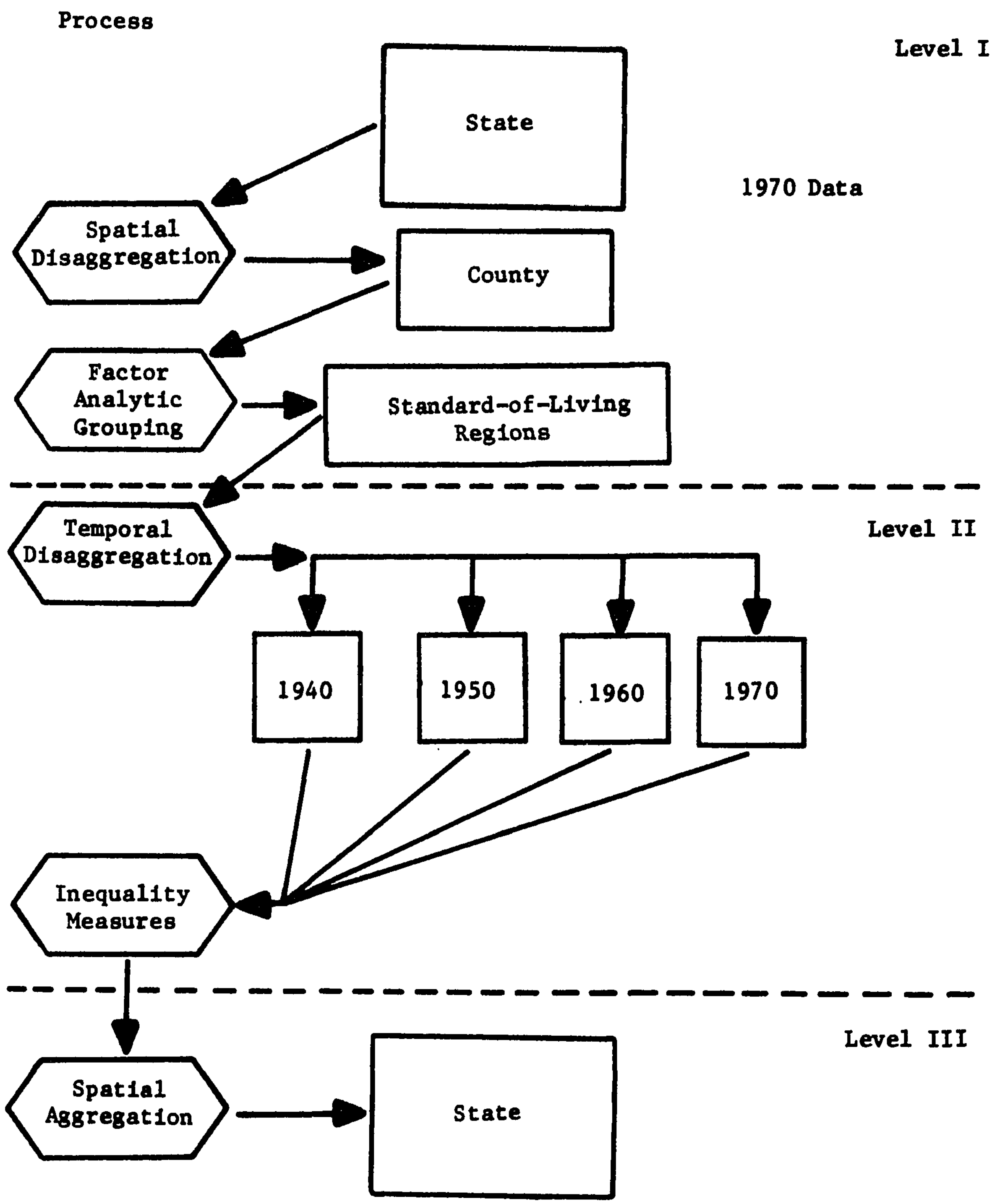
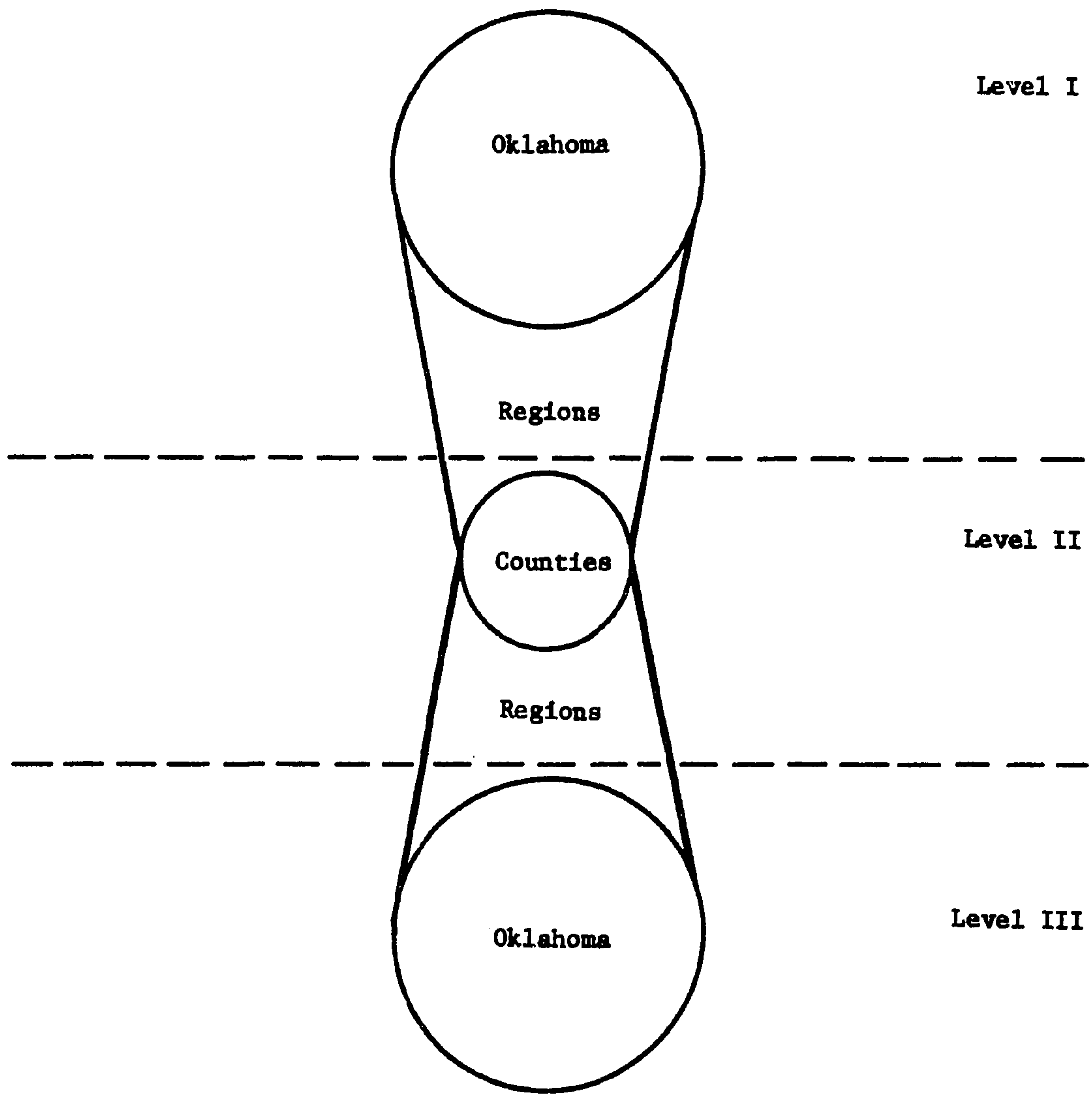


FIGURE 6

Changing Levels of Resolution



few basic patterns, a principle components, R-mode factor analysis will be performed on the raw data matrix. In order to more clearly define the clusters of relationships among the variables, an orthogonal rotation of the matrix of factor loadings will be performed. The purposes of this analysis are to identify standard-of-living dimensions and to generate factor scores to be used as a basis for the regional clustering of counties.

Some of the uses of factorial ecology are somewhat controversial.[1] Berry (1971, p. 218) claims that comparative factorial ecologies have limits to generality due to differences in the degree of planning, freedom, and culture of different areas. How can such comparisons produce general laws or theories? An argument can be made for culturally confined studies. This whole question of cross-cultural comparative factorial ecologies is part of the larger question of the application of Western development theory and methodology to culturally different regions. Other questions about factorial ecologies center on the ecological-individual fallacy, i.e. areal units are used as ecological observations; but are correlations among ecological units the same as those based on individuals within units (Berry, 1971, p. 215)? Johnston (1971, p. 317) questions the independence of the dimensions extracted by factor analysis and states that correlation and independence are not necessarily synonomous.

---

[1]For a full discussion of comparative factorial ecology, see Economic Geography, Vol. 47, No. 2 (supplement), June 1971, which was guest edited by Brian J. L. Berry.

The use of the factorial ecology method in this research will be for taxonomic purposes. The method will not be used to test hypotheses nor will there be any attempt at cross-cultural comparisons. In view of the intended uses of factorial ecology, it is felt that many of the major questionable limitations of the method will not greatly affect this study. Although there exists some cultural differences and differences in degree of planning in Oklahoma, these dissimilarities are not so great as to invalidate any comparisons among counties.

The final objective of Level I of the research is to regionalize Oklahoma into standard-of-living-regions; to accomplish this, a standard-of-living index will be calculated for each county. Factor scores from the factor analysis will be weighted by the percentage of common variance explained by each dimension. The signs of the factor scores will be altered for consistency, i.e. a positive score will indicate a higher standard-of-living dimension than a negative score. The weighted factor scores will be summed across all of the dimensions for each of the 77 counties to produce a standard-of-living index score. This procedure is formulated as:[1]

$$S_j = a_1 z_1 + a_2 z_2 + \ldots a_n z_n$$

S_j = Index for jth county

a_1 = Factor score on Dimension I

z_1 = Percentage of common variance explained by Dimension I

The resultant standard-of-living index scores will then be used in a clustering approach to produce the desired regions. The guiding

[1]The general approach is based on Margaret Hagood, N. Danilevsky, and C. Beum, "An Examination of the Use of Factor Analysis in the Problem of Subregional Delineation," Rural Sociology, Vol. VI (Sept., 1941).

principle to be used in the regionalization process will be that suggested by Grigg (1962). Grigg said that the general all-purpose classification should be discouraged and that a classificatory scheme should be devised to meet the needs and objectives of the specific research at hand.

The regionalization in Level I of the research (Figure 5) will be accomplished in a two-stage procedure. First, a multidimensional typology of the county units will be completed, i.e. a factorial ecology. Then, by analyzing the distribution of types, regions will be delimited. The counties will be clustered by using a procedure based on the principle of minimum average distance squared. There will be no geographic contiguity constraint in the clustering process. This approach is basically an agglomerative classification approach, i.e. the single units are grouped by type. The agglomerative approach seems to be much more popular and useful in geographic research than the divisive approach.

It will be these standard-of-living regions, based on 1970 data, that will later be used as data cells for the examination of inequalities between 1940 and 1970. The objective is to examine the changes in the degree of inequalities in the evolution of the present day standard-of-living-regions. This approach is very similar to that used by Semple and Griffin (1971) in their information analysis of inequalities in urban centers of Canada between 1911 and 1966.

Measures of Inequality

Chapter IV will analyze regional inequalities within and among the derived standard-of-living regions of Oklahoma. This process will constitute Level II (Figure 5) of the research.

There have been several approaches to the analysis of regional inequalities. One approach uses information statistics (Theil, 1967; Semple and Griffin, 1971; Semple and Gauthier, 1972). The information-theoretic approach to the analysis of regional inequalities is based on a definition of the entropic state as a condition of complete regional equality (Wilbanks, 1973, p. 4). The classical economic view mentioned earlier (p. 1) would view the entropic state as a condition towards which an economic system evolves without external interference.[1] An entropic surface would be flat (Leopold and Langbein, 1962). The degree of inequality between locational points on the surface is indicated by the slope between these points.

Another approach to the analysis of regional inequalities is to use variance indices (Williamson, 1965). The approach to be used in this research will be essentially a variance index approach. Several techniques will be utilized to measure the degree of inequalities within and among the specified standard-of-living-regions at the given time points: analysis of variance (ANOVA), the coefficient of variation, Williamson's Inequality Index, and Lorenz Curve analysis (Figure 7).

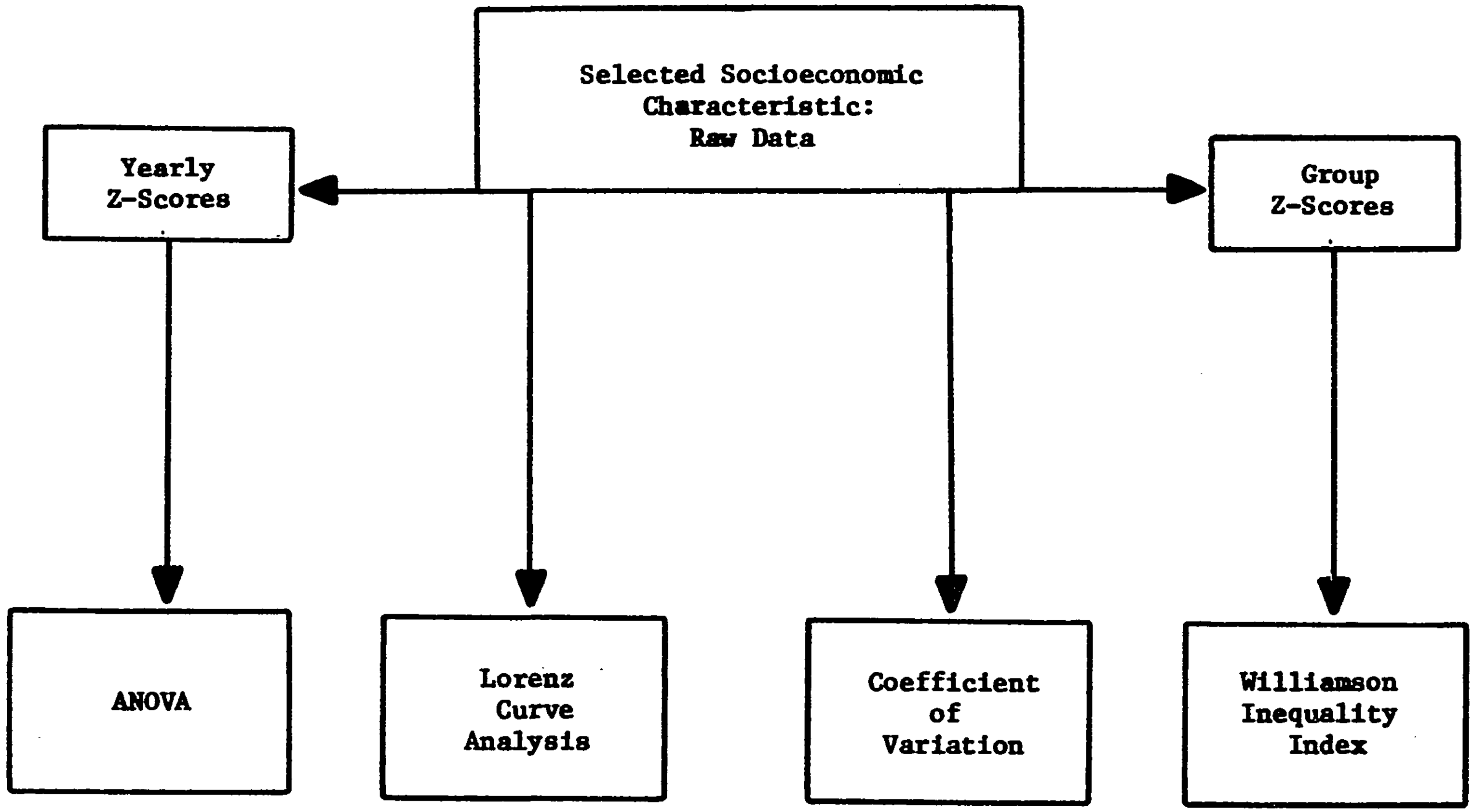
A one-way analysis of variance will be calculated on the selected variables for each of the time points. The raw data will be initially standardized to z-scores; the z-scores will be based on the mean and standard deviation of the data for an entire year. Groups for this

---

[1]For a discussion of the calculation of entropy and inequality values in an information statistics approach see Semple, R.K. and Griffin, J.M., "An Information Analysis of Trends in Urban Growth Inequality in Canada." Ohio State University, Department of Geography Discussion Paper No. 19, 1971. See Appendix B for a sample application of information statistics to sales tax data in Oklahoma.

FIGURE 7

Measures of Inequality



analysis will be the regions that were established in Level I of the research. ANOVA will produce several useful results: an F-score for each year, variance within the set of regions (V_w), and variance among regions (V_b).[1] The trend in the change of F-scores between 1940 and 1970 will indicate the degree of convergence or divergence taking place.[2] An analysis of V_b and V_w will make possible a clearer understanding of the changes in the F-score. The V_b and V_w values are pooled variances and do not allow for an analysis of V_b and V_w individual regions. This will be compensated for by one of the other approaches. Although analysis of variance is a commonly used technique to measure variations in income levels and growth, it has limitations. Analysis of variance involves the squaring of differentials which may make it highly sensitive to the few extreme deviations so common in development problems (Semple and Gauthier, 1972, p. 170). For this reason, other inequality measures will be used to check against and complement the analysis of variance.

A coefficient of variation has been used by Warner (1973) to indicate the degree of convergence or divergence in income for the State of Oklahoma. A coefficient of variation (standard deviation ÷ mean) will be calculated for each variable for each study year. The changing nature of the coefficient will indicate a convergence of divergence process and will be used as a check against the F-score trends from the ANOVA.

---

[1]F-score = $\dfrac{V_b}{V_w}$

[2]ANOVA makes possible the testing of the hypothesis that there is no difference between regional means (Ho: $X_1 = X_2 = \ldots X_n$). The Williamson index has been criticized because it does not allow for such a test. For a discussion of this matter see: Metwally, M. and Jensen, R.C., "A Note on the Measurement of Regional Income Dispersion," Economic Development and Cultural Change, Vol. 22, No. 1 (October 1973).

A revised version of the Williamson inequality index will be calculated for each variable for each study year. Initially, z-scores will be calculated for each region for each study year. The regional z-scores will be utilized in the calculation of the index. The revised index to be used is a combination location quotient-variance index:

$$V_{ij} = \frac{\sqrt{\sum (Y_i - \bar{Y})^2 \frac{f_i}{n}}}{\bar{Y}}$$

V_{ij} = inequality index for the ith county on the jth year

Y_i = county data for the ith county

$\bar{Y}$ = regional data value

f_i = county population for the ith county

n = regional population

This approach results in an inequality index for each region for each of the study years. The regional inequality index is comprised of county data that is weighted by the population of each county. These inequality indices make possible an analysis of the degree of inequalities within each individual standard-of-living region as well as changes in internal disparities over time.

A Lorenz Curve analysis will be performed on each of the variables except the mobility variable.[1] A Lorenz Curve is obtained by plotting the cumulative percentage of population by regions on the abscissa against the cumulative percentage of the total of a given variable on

---

[1]Mobility will be indicated by net migration figures. Since the Lorenz Curve is a plot of cumulative percent population against cumulative percent of a variable (in this case net migration) the use of the approach is inappropriate.

the ordinate (Figure 8). The forty-five degree diagonal line on the graph (Line A) represents a total equality distribution of a given characteristic. A curve will be calculated and drawn for each year (Curve C). If the curves move towards the diagonal over time, the overall distribution is becoming more equal and vice-versa.

A Lorenz Curve makes possible an analysis of the concentration of a given variable throughout the population. An index of concentration will be calculated in the following manner:

$$L = \frac{A}{A + B}$$

L = index of concentration

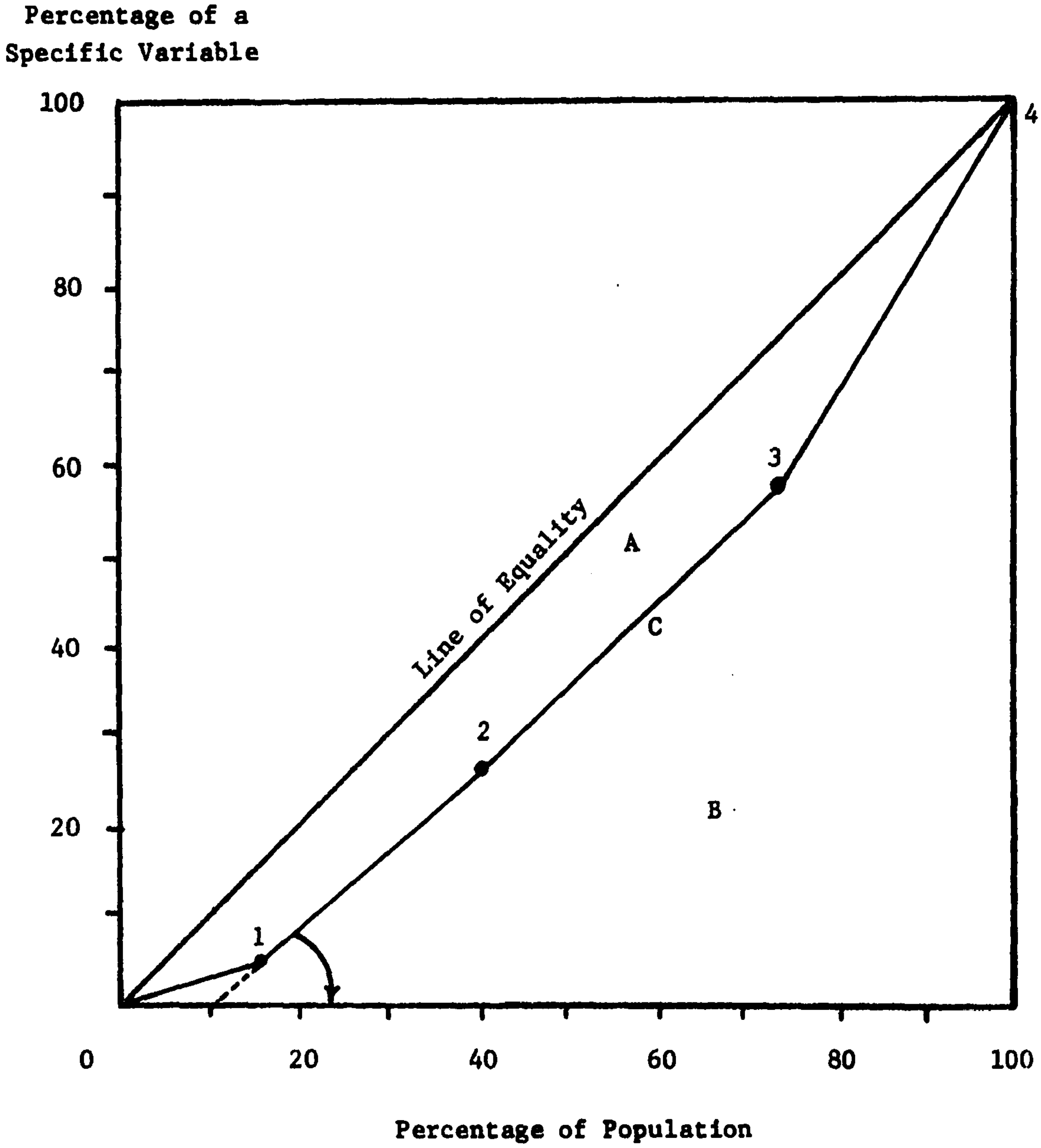
A = area between the diagonal and the curve

A + B = area under the diagonal

For each region, it will also be possible to calculate a variance index. If a line is drawn between every two points (each point representing a region) and the angle measured between this line and the abscissa, a variance from the equality line can be determined. Any angle greater than forty-five degrees will have a positive index, i.e. this region has a greater share of particular variable than it does of the state population. Any angle less than forty-five degrees will have a negative index, i.e. this region has a smaller share of the variable than it does of the state population. An angle of forty-five degrees indicates that a region has exactly the same share of a variable as it does of the state population. An example of the measurement of a variance index is shown on Figure 8. A line is drawn connecting region 2 to region 1. The line is extended to the abscissa. The angle formed by the line and the abscissa is 43°. Since cumulative percentage data are

FIGURE 8

LORENZ CURVE



utilized, the variance index of -2, i.e. 43°-45°, applies to region 2. The variance index for region 1 is found by connecting region 1 to the origin, measuring the angle, etc.

With regards to Lorenz Curves, a changing trend toward the diagonal would represent the movement of the state towards a more equal distribution of standard-of-living.[1] These trends must be compared with the results of the ANOVA, coefficient of variation, and Williamson inequality index to determine changes of living standards within individual regions.

This combination of research procedures allows for the grouping of the counties of Oklahoma into standard-of-living regions, and for the analysis of regional inequalities both within and among the derived regions for the study years. The next chapter will be concerned with the regionalizing process.

---

[1]For a description of the calculation of Lorenz Curves, see: Yeates, M., Quantitative Methods in Economic Geography, New York: McGraw-Hill, 1968.

CHAPTER III

STANDARD-OF-LIVING REGIONS IN OKLAHOMA

Standard-of-Living

Definition

Standard-of-living is a very commonly used term. The term will be defined in this research as the degree of capability of the people of an area to produce, obtain, and consume the social and economic goods and services of the market economy. The standard-of-living varies with the capability of the people to truly participate in the economy, a capability which will be measured by a number of surrogate variables. Ornati (1966, p. 50) believes that the poverty of the affluent society is the poverty of those clearly out of the mainstream of American life. The underprivileged are in, but not of, the market society. These people sit outside of the economy and are discriminated against socially and economically. They are not part of the prevailing economic structure.

The selection of the surrogate variables was done with the goal of making the concept of standard-of-living a measure of production and consumption. Hence, sales tax revenues are included as a variable rather than the number of retail establishments; the number of years of school completed by a segment of the population rather than the amount of dollars spent on education.

It should be kept in mind that standard-of-living is not a statistic; it is a human condition and an experience of daily life. To leap from statistics to human conditions requires a "mental jump." It is, therefore, very important to briefly justify the surrogate variables used to identify and measure the standard-of-living as one aspect of the human situation.

A Justification of Surrogate Variables

A number of standard-of-living surrogate variables were selected from several broad categories: health, crime, income-savings, retail trade, employment, demographic, and miscellaneous (See Appendix A).

The level of a region's overall economic health is related to not only its economic progress, but also to its public health policies, its level of education, and housing (Ornati, 1966, p. 72). Ornati has found that definite differences remain between upper and lower income levels. The poor are prone to certain diseases, especially those associated with poor housing or sanitation. Superior health, in the aggregate, is purchasable. Better health among higher income groups is associated with better knowledge about hygiene and immunization. Ornati states that whatever the reason, there is a demonstrable statistical connection between low income and poor health. Pulmonary diseases are clearly related to poor housing conditions. Lower rates of immunization among the lower standard-of-living segments of the population appear to explain the heavier impact on these people of poliomyelitis, diptheria, whooping cough, and other diseases. The poor suffer more from arthritis, syphilis, diseases of the female genital organs, and heart disease. People in higher income brackets appear to suffer more from diabetes mellitis (Ornati, 1966, p. 74). Other evidence of the connection between health and standard-of-living have been uncovered.[1]

Several types of crime rates were used in this study as indicators of social disorganization, i.e. these variables measure social pathologies related to personal deviance, instability, or a behavioral response to a disorganized or stressful social environment (Smith, 1973, p. 81). The variables used in this category include the number of juvenile arrests, drug arrests, alcohol related arrests, and index crimes.

Index crimes are those reported by the Federal Bureau of Investigation. They were selected on the basis of their seriousness, frequency, and the reliability of their reporting to the police (Harries, 1971, p. 204). Index crimes can be subdivided into the two categories of those against persons and those against property. The index crimes against persons include categories such as: rape, robbery, aggravated assault, and murder and nonnegligent manslaughter. The index crimes gainst property include categories such as: burglary, larceny (over fifty dollars), and auto theft. This study uses the total number of index crimes as reported by the Oklahoma Bureau of Investigation. Although specific types of index crimes have been investigated (Harries, 1974; Hackney, 1968; Lottier, 1938; Schuessler, 1961), that was not done here. The purpose for the use of crime data in this study is to

---

[1]For example, see: Characteristics of Recipients of Aid to the Permanently and Totally Disabled, Public Assistance Report No. 22, U.S. Department of Health, Education, and Welfare, 1953. Laughton, Buck, and Holb, "Socioeconomic Status and Illness," Millbank Memorial Fund Quarterly, January 1958, pp. 46-54.

add a social disorganization component to the definition of standard-of-living. A more complete analysis of the spatial patterns of specific crime types has already been done by Harries (1974). Harries found high murder rates in the southern part of the United States. (Harries, 1971, p. 205). This region is generally the lowest standard-of-living region in the United States. (Smith, 1972) Lottier (1938) and Shannon (1954) found a similar pattern. The classic explanatory theories of this high occurrence of violence focuses on factors such as: lower status occupations, ruralism, poverty, and modernization. Harries (1969) found crime to be related to the level of urbanization and population density. Schuessler (1961) found crime rates to be related to occupational status, minority group size and status, age composition, and economic status.

Smith (1973, p. 69) claims that in an area with a high degree of social well-being, people will have incomes adequate for their basic needs, be socially and economically mobile, have a good quality education and health services, live in decent houses, have access to recreational facilities, and have a low degree of social disorganization. In his determination of some of the basic components of social well-being, Smith (1972, p. 20) found social disorganization to be a major component. Under the social disorganization heading, high narcotics addiction, venereal disease and violence are quite closely related, being associated with urbanized states with large deprived minority populations. High alcoholism, which is most closely correlated with high incomes and good housing, is more characteristic of richer areas as are crimes against property.

Generally, it is felt that people with a higher standard-of-living have a greater chance of living in an environment characterized by less social disorganization than people with a lower standard-of-living. The inclusion of surrogates of social disorganization is an important component of a definition of the social well-being of a population.

Variables referred to as income-savings include such items as median family income, bank deposits, and percentage of families below the poverty level.[1] The importance of income and wealth to a high standard-of-living is beyond dispute. In an exchange economy, money is necessary for access to the basic necessities and for such services as health and education. Money provides access to goods and services that fulfill needs, bring satisfaction, and bring personal status in a society that places a high value on economic achievement and self-reliance. The linkages between income and other characteristics have been well-established. It is a simple statistical fact that low educational attainment is highly associated with low income (Ornati, 1966, p. 62).

The financial advantage of higher education is marked. Available figures reveal that every school year completed brings measurable dollar dividends (Miller, 1960). The link between low income and bad housing is also very strong. Low income is part of the syndrome of bad education, bad housing, bad nutrition, limited knowledge of hygiene, and late identification of disease (Ornati, 1966, p. 68). The income

---

[1]For a detailed explanation of the poverty definition, see U.S. Bureau of the Census, Current Population Reports, Series P-23, No. 28, Revision in Poverty Statistics, 1959 to 1968.

and savings of an area also affects the amount of capital available for investment. Investment is necessary to increase productivity and the utilization of physical and human resources. Financial capital can, however, flow into an area from the outside since it is a very fluid factor of production. These outside financial resources can come in the form of private or public investment funds.

The retail trade and employment categories are also closely associated with each other. The rationale for the inclusion of these categories in the definition of standard-of-living can be found in the hypothesis that tertiary employment increases relative to total employment during the course of development. Hurst (1972, p. 15-16) describes this process:

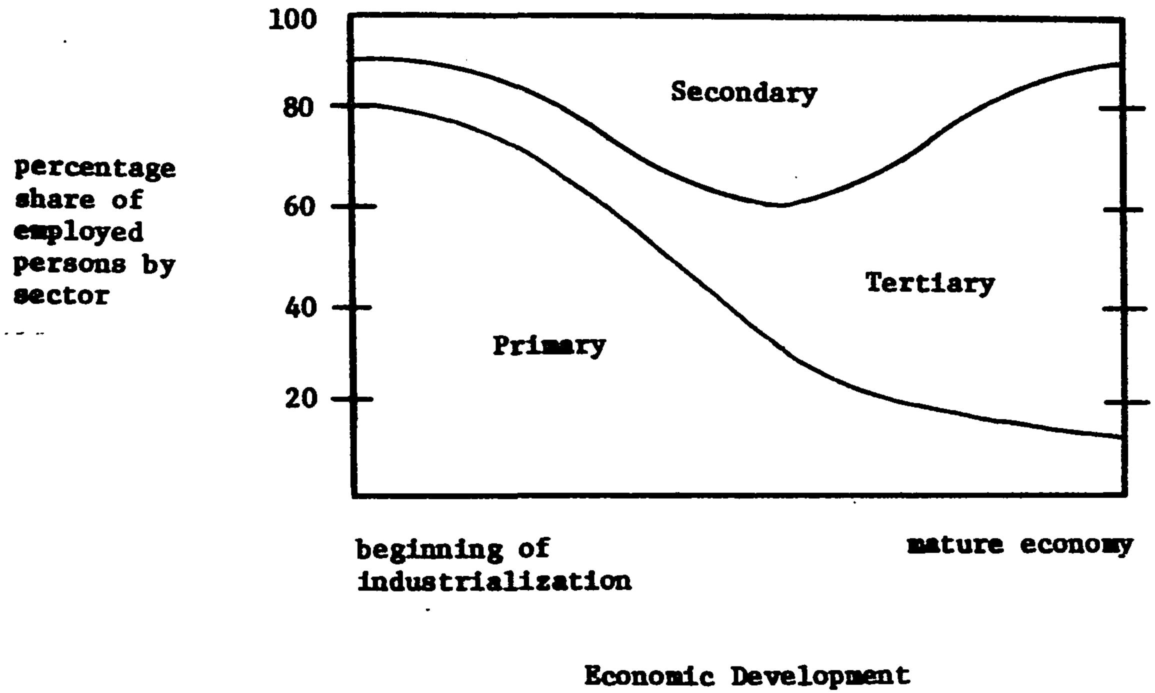
> (1) Growth occurs through specialization in primary activities. There are transportation improvements. Industry and services remain at a small scale.
> (2) Secondary industries are introduced. Economic infrastructure develops. Returns from primary activities decrease.
> (3) Secondary industries diversify and there are complex internal industrial linkages. Real income rises.
> (4) Specialization occurs in certain tertiary activities.

This general model is known as the Clark-Fisher Thesis. Figure 9 represents an analysis of this process for the country of France between c. 1800 and c. 2100 (projected).

Ornati (1966) has found that demographic characteristics such as the size of the rural population, the percentage of non-white population, median age, and percent of families with female heads are all closely associated in standard-of-living levels. In contemporary America, one's statistical chance of being poor is considerably

FIGURE 9

DEVELOPMENT OF PRIMARY, SECONDARY AND TERTIARY ACTIVITIES



Source: Jean Fourastie, <u>La Productivitie</u>, Paris, 1964.

above average if one is, for example, over 65, a female head of a household, non-white, or a rural farm resident. U.S. poverty increasingly involves individuals and families almost exclusively with these poverty-linked characteristics.

All of the human characteristics in the above mentioned categories are closely interrelated. These linked characteristics converge on that aspect of the human condition which is referred to as the standard-of-living.

Standard-of-Living Factorial Ecology

Factor Analysis Results

An initial factor analysis was performed for the seventy seven counties of Oklahoma using thirty seven socio-economic variables. The matrix of factor loadings from the R-mode analysis was orthogonally rotated with a critical eigenvalue of 1.0. At this point, the intercorrelations of the 37 variables were analyzed by the construction of a tree diagram of linkages, and it was found that a number of variables were highly intercorrelated with other variables, e.g. median family income correlates very highly with percent of families under the poverty level, and median number of years of school completed; it also correlates strongly with a retail-location quotient, unemployment rate, and percentage of the population that is rural. All of the intercorrelation linkages down to $\pm$ .60 were analyzed.[1] The number of variables was finally reduced to 20 in order to avoid redundancy of information.

---

[1]See Appendix A for the intercorrelation matrix.

The final factor analysis was performed on the 20 variables indicated in Table 1.[1] The results of the factor analysis of the intercorrelation matrix is shown in Table 2. In order to more clearly define the patterns of clusters of variables, an orthogonal rotation was performed with the results shown in Table 3.

The rotated matrix indicates a five dimensional description of the data. These five dimensions account for 70.21 percent of the total variance in the original twenty x twenty matrix of variables. Table 4 shows the highest factor loadings and a description of the variables involved. Only those loadings with an absolute value greater than ± .60 are shown on Table 4.

The first dimension is a <u>general wealth</u> dimension. The loadings of the variables on this dimension are not surprising. The positive loadings for median family income and number of telephones per capita; and the negative loadings for unemployment rates, and assistance payments all are in strong agreement with the findings of Ornati (1966, p. 51). One would expect that an area with a relatively high standard-of-living would have a higher median family income and number of telephones; and a lower percentage of non-white population, unemployment level, households female-headed, and public assistance payments.

The second dimension is an <u>employment</u> dimension. The results shown in Table 4 are in agreement with the Clark-Fisher hypothesis (Figure 9). It is expected that areas with higher agricultural employment will have

---

[1]Variable numbers in the following tables will refer back to the variables as numbered in Table 1.

TABLE 1

Socioeconomic Variables

Variable Category	Variable Number	Variable Name
Health	1	Births per 1000 pop.
	2	Deaths per 1000 pop.
	3	Deaths under 1 year per 1000 population
	4	Diabetes Mellitus per 100,000 population
	5	Number of Doctors per 1000 population
Crime	6	Number of juvenile arrests per M
	7	Drug arrests per M
	8	Percent alcohol related arrests
	9	Total arrests per M
Income-Savings	10	Median family income
Education	11	Pupil-teacher ratio
Retail Trade-Employment	12	Retail location quotient*
	13	Unemployment rate
	14	Percent employed in agriculture
	15	Percent employed in wholesale-retail
	16	Other employment
Demographic	17	Percent of population non-white
	18	Percent households female-headed
Other	19	Telephones per capita
	20	Public assistance per 1000 population in thousands of dollars

$$\text{*Retail location quotient} = \frac{\text{Percent of state's retail sales}}{\text{Percent of state's population}}$$

Source: See Appendix A for a complete list of the original thirty-seven variables and their data sources.

TABLE 2

Factor Matrix Before Rotation*

Variable	Factor I	II	III	IV	V
1	.303	(.733)	.088	-.138	-.038
2	-.544	-.370	-.406	.423	.145
3	-.039	-.114	-.455	.363	-.428
4	-.146	-.405	-.314	.266	.170
5	(.618)	.063	-.365	.296	.043
6	-.232	.060	(.726)	.403	-.032
7	.020	-.075	(.828)	.323	-.034
8	-.374	.068	-.056	-.099	(.749)
9	-.436	.336	.393	.445	.104
10	(.912)	-.067	.116	-.087	.057
11	.425	(.754)	.042	.024	-.120
12	(.677)	.189	-.200	.384	-.027
13	(-.603)	.509	-.023	-.159	-.030
14	-.509	(-.692)	.199	-.095	-.143
15	(.606)	.178	.030	.291	.345
16	.547	.502	-.051	-.060	.131
17	-.478	(.665)	-.131	.171	-.075
18	-.325	(.750)	-.191	.260	-.051
19	.545	(-.660)	-.018	.309	.035
20	(-.807)	.298	-.264	.124	.044

*Loadings with an absolute value greater than ± .60 are shown in parentheses.

Source: Author's computations

TABLE 3

Factor Matrix After Rotation*

Variable	Factor I	II	III	IV	V
1	-.292	-.402	-.020	(.640)	.023
2	-.236	.160	-.037	(-.846)	-.013
3	-.129	-.094	-.171	-.367	(-.601)
4	.088	.004	-.103	(-.605)	.015
5	.215	(-.685)	-.214	-.082	-.201
6	-.084	.118	(.852)	.037	.013
7	.209	.072	(.854)	.138	.008
8	-.249	.036	-.047	-.250	(.768)
9	-.491	-.004	(.639)	-.70	.112
10	(.671)	-.520	-.074	.364	-.034
11	-.270	-.559	.016	(.603)	-.126
12	.196	(-.772)	-.035	.051	-.269
13	(-.723)	.264	-.013	.166	.133
14	.228	(.762)	.154	-.387	-.035
15	.234	(-.712)	.115	.068	.157
16	-.009	(-.601)	-.131	.449	.082
17	(-.842)	-.053	.070	.070	-.037
18	(-.833)	-.255	.053	.088	-.070
19	(.767)	-.256	.064	-.371	-.184
20	(-.806)	.271	-.032	-.308	.089
% total variance	26.2 +	23.4 +	8.4 +	7.2 +	5.0 = 70.2
% common variance	37.3 +	33.3 +	11.9 +	10.2 +	7.1 = 100.0

*Loadings with an absolute value greater than ± .60 are shown in parentheses.

Source: Author's computations

TABLE 4

Highest Factor Loadings

Factor I	Factor II	Factor III	Factor IV	Factor V
median family income .67	# of doctors -.68	juvenile arrests .85	birth rate .64	infant mort. -.60
unemployment -.72	retail loc. quotient -.77	drug arrests .85	death rate -.84	alcohol related arrests .76
non-white population -.84	agricultural employment .76	total arrests .63	Diabetes -.60	
Female-headed households -.83	Wholesale-retail employment -.71		Pupil-teacher ratio .60	
Telephones .76	Other employment -.60			
Aid cases -.80				

Source: Author's Computations

lower employment in the wholesale-retail category. The retail location quotient is based on sales tax data, and it is an indication of activity in the tertiary sector. The "other" category includes miscellaneous secondary and tertiary sector jobs. It is expected that areas with high secondary-tertiary indicators experience a relatively higher standard-of-living than areas that show-up low on these indicators. The fact that the number of doctors per 1000 population correlates highly with the secondary-tertiary indicators is not surprising. Rural areas frequently suffer in terms of a lack of physician services and represent one of the most intractable problems of the delivery of health care (Shannon and Dever, 1974, p. 38). The distribution of physicians in the United States is very uneven. Terris and Monk (1956) have noted that physicians are leaving not only rural areas but also low socio-economic areas of the cities. The dual migration: rural to urban, and inner city to suburbia has been typical of selective segments of the population and likewise typical of physicians (Shannon and Dever, 1974).

The third dimension is a crime rate dimension. High and positive loadings were obtained for juvenile arrests, drug arrests, and total arrests. Areas of low standard-of-living would experience a higher incidence of these indicators of social disorganization and vice versa.

The fourth dimension is a health dimension. Birth rate and pupil-teacher ratio loaded positive while the death rate and incidence of diabetes loaded negative. High birth rates as well as high pupil-teacher ratios can reasonably be expected in areas with lower standards-of-living. As Ornati (1966) has pointed out, areas of higher income experience a greater incidence of diabetes mellitus than areas of lower income.

The fifth dimension is rather difficult to interpret. Infant mortality rates loaded negatively while alcohol related arrests loaded positively. Any statement about the relationship of these two variables would be spurious.

Standard-of-Living Index

In order to group the counties of Oklahoma into standard-of-living types, a standard-of-living index was developed. The calculation of the index has already been described in Chapter II.

Briefly, the factor scores (see Appendix B) for each county on each dimension were weighted by the percentage of common variance explained by that factor. The signs of the weighted scores were altered for consistency so that a positive score would indicate a higher standard-of-living than a negative score. The scores were then added across each factor for each county to produce a final standard-of-living index. The results of this process are shown in Table 5.

Using the derived index numbers, a standard-of-living surface was mapped (Figure 10).[1] The SYMVU is viewed from the southeast at an azimuth of 45 degrees. The undulating socio-economic landscape of Oklahome is displayed well in Figure 10. The peaks represent areas of higher standard-of-living than the lower "terrain."

The four outstanding high peaks represent the centers of the five counties of Oklahoma with the highest standards-of-living. These peaks include locations at: (A) Oklahoma and Cleveland Counties,

---

[1]Figure 10 is a SYMVU. SYMVU is a computer graphics program used for the purpose of generating a three-dimensional line-drawing display of data. For a detailed description see: SYMVU Manual, Version 1.0, Harvard University, Cambridge, Mass., October, 1971.

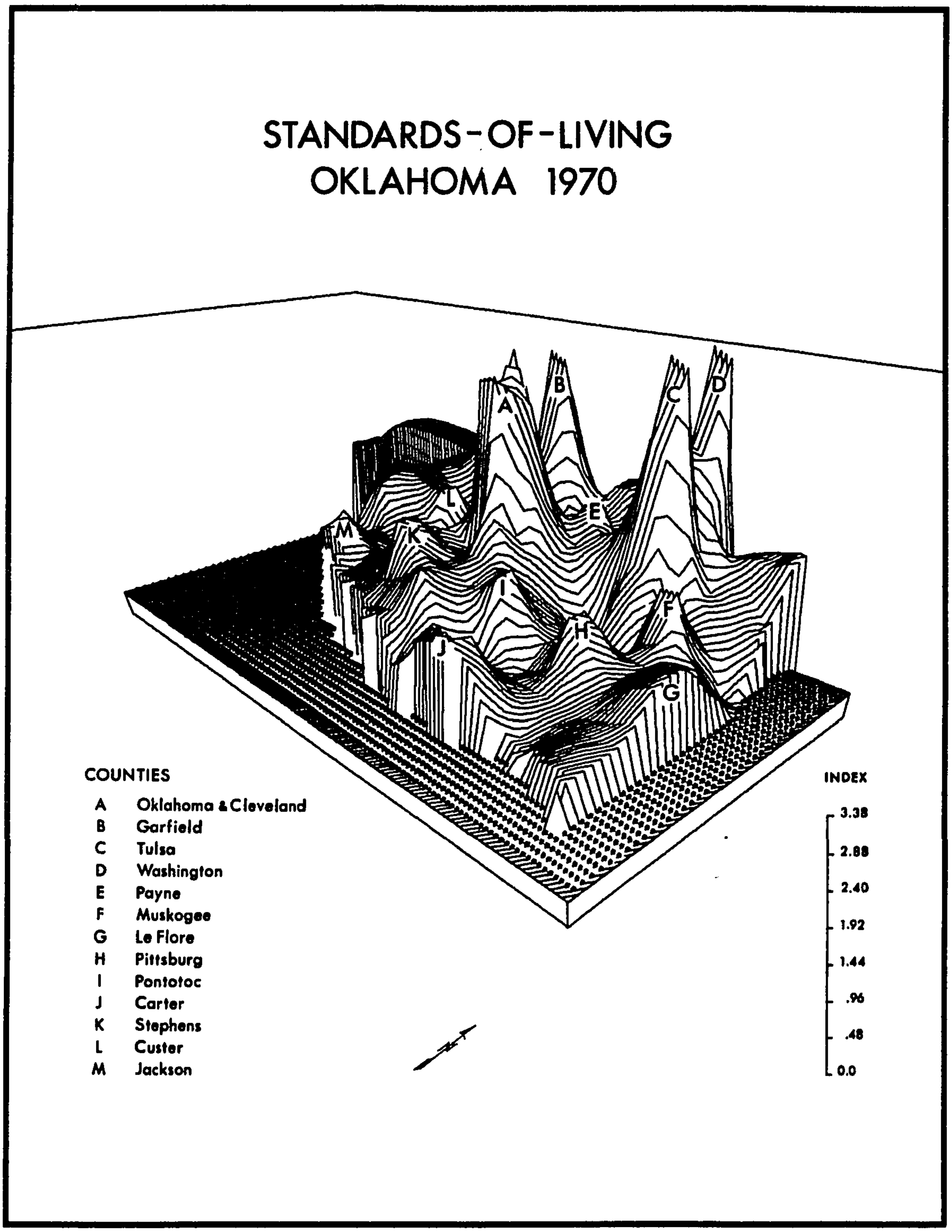

STANDARDS-OF-LIVING
OKLAHOMA 1970
A
B
C
D
E
F
G
H
I
J
K
L
M
COUNTIES
A Oklahoma & Cleveland
B Garfield
C Tulsa
D Washington
E Payne
F Muskogee
G Le Flore
H Pittsburg
I Pontotoc
J Carter
K Stephens
L Custer
M Jackson
INDEX
3.38
2.88
2.40
1.92
1.44
.96
.48
0.0

Figure 10

TABLE 5

Standard-of-Living Index

County	Index	County	Index
1. Adair	-1.249	39. Latimer	.560
2. Alfalfa	.256	40. LeFlore	-.213
3. Atoka	-.739	41. Lincoln	.154
4. Beaver	.571	42. Logan	.023
5. Beckham	.479	43. Love	-.591
6. Blaine	-.021	44. McClain	.041
7. Bryan	-.016	45. McCurtain	-.701
8. Caddo	-.258	46. McIntosh	-.788
9. Canadian	.592	47. Major	.350
10. Carter	.312	48. Marshall	-.129
11. Cherokee	-.732	49. Mayes	-.285
12. Choctaw	-1.007	50. Murray	-.009
13. Cimarron	.080	51. Muskogee	.149
14. Cleveland	.967	52. Noble	.037
15. Coal	-.742	53. Nowata	-.033
16. Comanche	.099	54. Okfuskee	-.907
17. Cotton	-.232	55. Oklahoma	1.150
18. Craig	.101	56. Okmulgee	-.178
19. Creek	.322	57. Osage	.195
20. Custer	.447	58. Ottawa	.196
21. Delaware	-.535	59. Pawnee	-.008
22. Dewey	-.028	60. Payne	.515
23. Ellis	.445	61. Pittsburg	-.023
24. Garfield	.910	62. Pontotoc	.252
25. Garvin	.163	63. Pottawatomie	.289
26. Grady	.358	64. Pushmataha	-.780
27. Grant	-.330	65. Roger Mills	-.320
28. Greer	-.128	66. Rogers	
29. Harmon	-.304	67. Seminole	-.284
30. Harper	.400	68. Sequoyah	-.726
31. Haskell	-.546	69. Stephens	.641
32. Hughes	-.560	70. Texas	.588
33. Jackson	.326	71. Tillman	-.256
34. Jefferson	-.232	72. Tulsa	1.144
35. Johnston	-.870	73. Wagoner	-.461
36. Kay	.507	74. Washington	1.148
37. Kingfisher	.387	75. Washita	.015
38. Kiowa	-.228	76. Woods	.656
		77. Woodward	.698

Source: Author's Computations

(B) Garfield County, (C) Tulsa County, and (D) Washington County. Smaller peaks of medium standards-of-living include locations at: (E) Payne County, (F) Muskogee County, (G) LeFlore County, (H) Pittsburn County, (I) Pontotoc County, (J) Carter County, (K) Stephens County (L) Custer County, and (M) Jackson County. In each of these counties indicated by peaks on the SYMVU, an urban growth center can be easily identified (Table 6).

A number of valleys, i.e. areas of low standard-of-living, also appear on Figure 10. The Eastern-Southeastern depression is very noticeable. This depression includes the counties of: McCurtain, Choctaw, Pushmataha, Atoka, Cherokee, Wagoner, and Delaware.

Regional Clustering Process

The standard-of-living index scores were used as the basis for a regional clustering process.[1] The principle of the clustering process was that of minumum average distance squared. There was no geographical contiguity constraint used in the clustering process. A grouping with a contiguity constraint would not have produced the most homogeneous regional types. Metwally and Jensen (1973) have pointed out that the Williamson Index is a suitable indication of regional dispersion only if regions are designed so that they are internally homogeneous. Johnston (1970, p. 295) has argued that regionalization with contiguity constraints over-simplifies and operates against

[1]The clustering program used was the "Congrila Program" from: Krause, Paul (ed.), Department of Geography Program Library, Department of Geography, University of Oklahoma, Norman, Oklahoma, Technical Paper No. 1, January, 1974.

TABLE 6

Growth Centers

County	Growth Center	County Standard-of-Living Index
Oklahoma	Oklahoma City	1.150
Cleveland	Norman, Moore	.967
Tulsa	Tulsa	1.144
Garfield	Enid	.910-
Washington	Bartlesville	1.148
Muskogee	Muskogee	.140
Pittsburg	McAlester	-.023
Pontotoc	Ada	.252
Stephens	Duncan	.641
Custer	Weatherford, Clinton	.447
Jackson	Altus	.326
Carter	Ardmore	.312
Payne	Stillwater	.515
LeFlore	Poteau	-.213

Source: Author's Computations

efficient hypothesis testing. He feels that there is no basis in geographic theory for the adjacency requirement. Czyz (1968, p. 115) believes that if a region is defined as a compact unit and a group is produced which has two or more areally separated clusters, then we have two or more regions of the same type. Bunge (1966) also addressed the issue when he asked whether or not regions could be discontiguous. His conclusion was that they certainly could be, but that they tend not to be. Bunge believes that we sould not prevent regions from being discontiguous when they are.

The clustering process was carried out to step seventy-two, at which point four regions were identified. Table 7 and Figure 11 indicate the regions and the counties comprising each of the regions. The four standard-of-living regions were designated as: I. High, II. Medium-High, III. Medium-Low, and IV. Low. Region I is comprised of five counties; Region II, twenty-one counties; Region III, thirty-four counties, and Region IV, seventeen counties. The primary reason for the regionalization process was to group the counties of Oklahoma into homogeneous regional types. The lack of a geographical contiguity constraint has resulted in regions of a special nature. What the counties of each region have in common is the level of standard-of-living. Due to the purpose of the regionalization, the counties of each region do not necessarily share a common economic base, physical features, or other characteristics of the more traditional type of geographical regions. Grigg (1965) supports regionalization tailored for specific research rather than the more general-purpose approach. Due to the non-contiguous character of the standard-of-living regions,

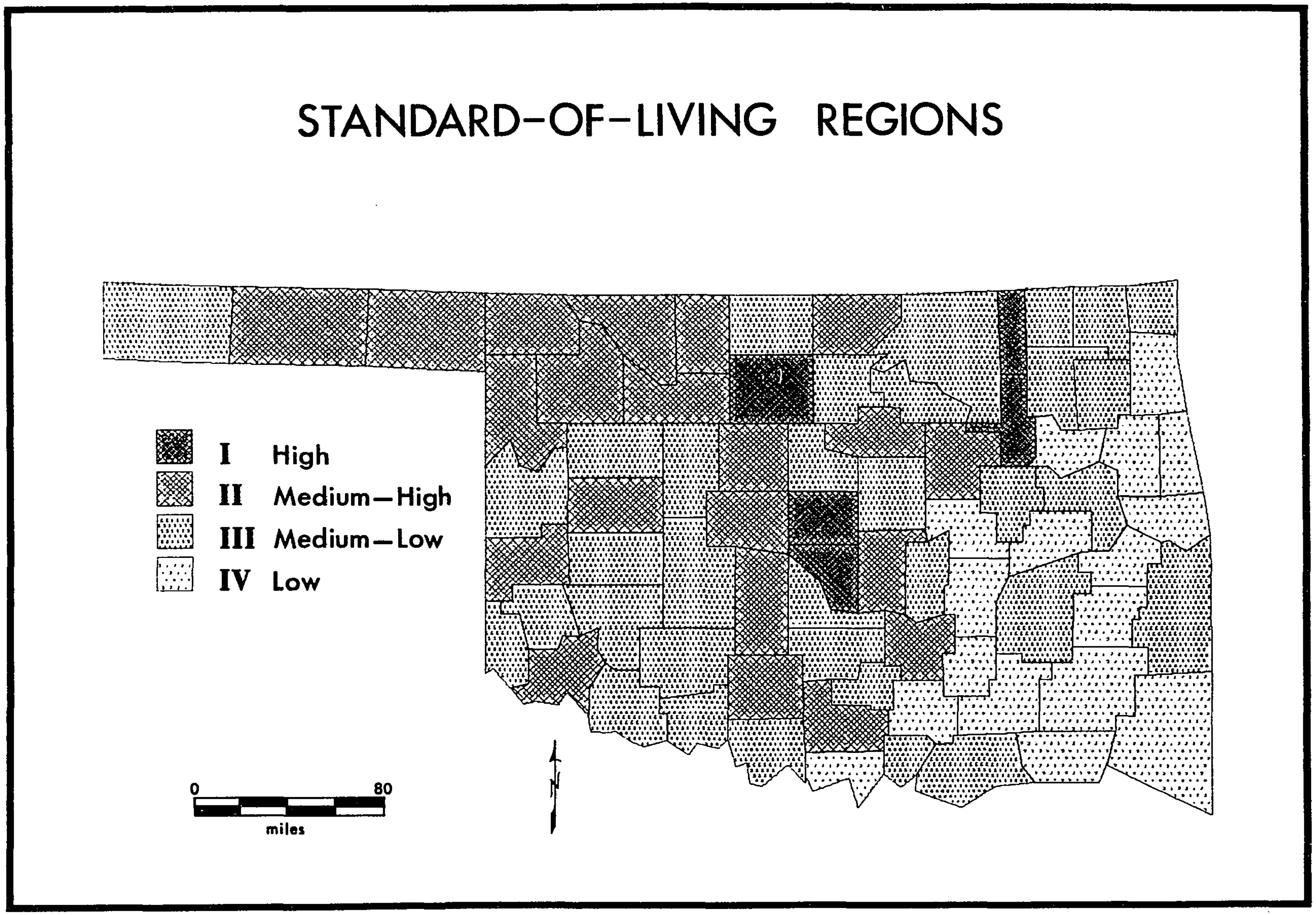

STANDARD-OF-LIVING REGIONS
I High
II Medium—High
III Medium—Low
IV Low
0
80
miles

Figure 11

TABLE 7

Standard-of-Living-Regions

Region	County	Region	County
I. High	1. Cleveland	II. Medium-High	1. Alfalfa
	2. Garfield		2. Beaver
	3. Oklahoma		3. Beckham
	4. Tulsa		4. Canadian
	5. Washington		5. Carter
			6. Creek
III. Medium-Low	1. Blaine		7. Custer
	2. Bryan		8. Ellis
	3. Caddo		9. Grady
	4. Cimarron		10. Harper
	5. Comanche		11. Jackson
	6. Cotton		12. Kay
	7. Craig		13. Kingfisher
	8. Dewey		14. Major
	9. Garvin		15. Payne
	10. Grant		16. Pontotoc
	11. Greer		17. Pottawatomie
	12. Harmon		18. Stephens
	13. Jefferson		19. Texas
	14. Kiowa		20. Woods
	15. LeFlore		21. Woodward
	16. Lincoln		
	17. Logan	IV. Low	1. Adair
	18. McClain		2. Atoka
	19. Marshall		3. Cherokee
	20. Mayes		4. Choctaw
	21. Murray		5. Coal
	22. Muskogee		6. Delaware
	23. Noble		7. Haskell
	24. Nowata		8. Hughes
	25. Okmulgee		9. Johnston
	26. Osage		10. Latimer
	27. Ottawa		11. Love
	28. Pawnee		12. McCurtain
	29. Pittsburg		13. McIntosh
	30. Roger Mills		14. Okfuskee
	31. Rogers		15. Pushmataha
	32. Seminole		16. Sequoyah
	33. Tillman		17. Wagoner
	34. Washita		

it is difficult to describe them in general terms. A few statements about the characteristics of the regi ns are possible (Table 8).

Region I contains the bulk of Oklahoma's population, manufacturing, financial resources, and general growth. The two major foci of this region are the Oklahoma City and Tulsa metropolitan areas. Other smaller foci include Bartlesville, Enid, and Norman. That Region I is the highest standard-of-living region in the state can be supported by the fact that Region I, with forty-three percent of the state's population, generated fifty-nine percent of Oklahoma's sales tax revenues in 1970 and accounted for fifty-one percent of the state's total personal income.[1]

Oklahoma City is the state's capital and largest city. Employment in government is very substantial in Oklahoma City. This metropolitan area is a major regional wholesaling center and a diversified manufacturing center. Of special note are food processing, metal fabrication, and transportation equipment. Oklahoma City is also a well-situated transportation center. Tulsa is a major manufacturing center and has been recognized as an administrative center for the petroleum industry. This city is also well-situated with regards to major transportation routes. In Garfield County, Enid is a center for the collection, storage, and shipment of wheat. In 1969, Garfield County produced more wheat than any other county in Oklahoma (Hagle, et. al., 1972, p. 228). In Washington County, Bartlesville is a petroleum administrative center.

Region II is comprised of a number of counties in the northwest and Panhandle, a few counties west of Oklahoma and Cleveland counties,

---

[1]Sales tax data were obtained from Oklahoma Sales Tax and Use Tax, 1970, Oklahoma Tax Commission, June 1970. The calculations of per capita income and total personal income will be discussed in Chapter IV.

TABLE 8

Selected Regional Characteristics: 1970

Region	Percentage of State Population	Percentage of State Total Income	Percentage of Sales Tax Revenues
I	43	51	59
II	20	18	17
III	28	23	19
IV	9	8	5

Sources: U.S. Bureau of the Census, <u>General Social and Economic Characteristics, Oklahoma, 1970</u>, PC-(1)-C-28.

Oklahoma Tax Commission, <u>Oklahoma Sales Tax, 1970</u>.

a few counties southeast of Cleveland County, and two counties between Oklahoma City and Tulsa. This region accounts for twenty percent of the state's population, eighteen percent of the total personal income, and generates seventeen percent of the state's sales tax revenues.

The northwest and Panhandle counties of Region II are important wheat producing and cattle raising counties. Wheat is Oklahoma's number one cash crop. All of the counties in this region produced well over one million bushels in 1969. Texas County had more cattle on farms than any other county of the state in 1969 (Hagle, et. al., 1973, p. 232).

A number of counties in Region II are located west of Oklahoma and Cleveland counties. Canadian County is part of the Oklahoma City SMSA (Figure 2). The other counties each contain well-established and moderately growing medium size centers: Kingfisher County, Kingfisher; Grady County, Chickasha; Stephens County, Duncan; Custer County, Weatherford and Clinton; Beckham County, Elk City; and Jackson County, Altus. There are several other important counties in Region II. Stillwater in Payne County is the location of Oklahoma State University. Sapulpa in Creek County is closely tied-in to the Tulsa industrial complex. Other major centers of medium-high growth in Region II include: Shawnee in Pottawatomie County, Ada in Pontotoc County, and Ardmore in Carter County.

Region III is comprised of a number of scattered counties. Several geographical groupings are clear. There are a number of medium-low counties northeast of Tulsa County. This medium-low standard-of-living area in the northeast is an extension of the low standard-of-living areas of eastern Oklahoma. The northeast has a standard-of-living that is somewhat higher because it is on a major transportation route, has a number of fair size central places, is close to the economic opportunities and spread effects from Tulsa and Washington counties, and had a past economic boom in the mining of non-ferrous metals.

Another cluster of medium-low counties exists in southwestern Oklahoma. This cluster focuses on the Lawton-Fort Sill center in Comanche County. This area is an agricultural area concentrating on livestock, cash grains, and cotton. Caddo County is clearly the outstanding agricultural county in this southwestern cluster.

A number of other scattered counties in eastern Oklahoma also experience a medium-low standard-of-living. Some of these counties appear as islands in a sea of low standard-of-living. Pittsburg County with the major regional trading center at McAlester is one such county. Other counties include: LeFlore County which is part of the Fort Smith SMSA, Muskogee County, Bryan County which is the location of Southeastern Oklahoma State University at Durant, and Marshall County. This entire medium-low standard-of-living region accounts for twenty-eight percent of the state's population, twenty-three percent of the state's total personal income, and generates nineteen percent of the state's sales tax revenue.

The region experiencing the lowest standard-of-living in Oklahoma is Region IV. This region accounts for only nine percent of the state's population, eight percent of the state's total personal income, and generates only five percent of the state's sales tax revenues. Even with the abscence of a geographic contiguity constraint in the regional clustering process, there is a clear clustering of the counties of Region IV in the east and southeastern hill country. The economy of southeastern Oklahoma is based largely on the timber in the area. Four southeastern counties (Pushmataha, McCurtain, Atoka, and Choctaw) produce about fifty percent of the state's forest products by value (Hagle, et. al., 1973, p. 6). There has been a decided shift toward livestock grazing and tree farming in many of the southeastern counties. Region IV also has a noticeable lack of a well-developed central place hierarchy and transportation network.

With the grouping of the counties of Oklahoma into standard-of-living regions completed, it is now possible to analyze some regional inequalities over the study years.

CHAPTER IV

REGIONAL INEQUALITIES IN OKLAHOMA

Introduction

This chapter will be comprised of an outline of the magnitude and trends of regional inequalities in: sales tax revenues generated per capita, per capita personal income, educational achievement, housing quality, infant mortality rates, divorce rates, and percentage change in net migration. A more detailed description and analysis of the regional inequalities will be contained in the next chapter.

Regional Inequalities in Sales Tax Revenues: 1933-1970

For the purpose of further improving the tax system of Oklahoma, Governor William H. Murray called the Fourteenth Legislature into special session on May 24, 1933. At this session, a sales tax law was passed (Harlow, 1961, p. 482). Because sales tax data are available beginning in 1933, the analysis of this variable includes the years 1933, 1940, 1950, 1960, and 1970.

For each of the specified years, total sales tax revenues were obtained on a county basis.[1] All of the data were calculated in the form of a sales tax revenue generated per capita for each county. The Clark-Fisher Thesis was discussed earlier (p.41). The thesis maintains that

---

[1]These data are reported for each year since 1933 in <u>Oklahoma Sales Tax and Use Tax</u>, a publication of the Oklahoma Tax Commission. The data sources for each of the sections of this chapter are listed in Appendix C.

tertiary activities will increase relative to primary and secondary activities during the process of development. Rather than representing the tertiary sector of the economy by a count of the number of retail establishments or by employment data, a consumption-output oriented surrogate was sought. Sales tax revenues generated per capita for each county were finally used as an indicator of the degree of activity in the tertiary sector of the economy in each county. Sales tax data also give an indication of participation of people in the free market system.

Analysis of Variance

The data were initially standardized in order to facilitate a comparision of the dollar values from 1933 to 1970. Z-scores for each county were calculated for each of the specified years; then the scores were analyzed to determine changes in the variance in sales tax within standard-of-living regions and among the four regions. To accomplish this, a one-way analysis of variance was run for each year with the results shown in Table 9.

TABLE 9

STATEWIDE SALES TAX ANALYSIS OF VARIANCE

Year	Variance Among Regions (V_b)	Variance Within Regions (V_w)	F-ratio
1933	16.19	.40	40.4
1940	16.84	.35	48.1
1950	15.67	.41	37.3
1960	16.08	.37	42.8
1970	13.64	.47	28.9

Source: Author's computations

The variance among (V_b) the regions increased slightly between 1933 and 1940, while the variance within (V_w) regions decreased. From 1940 to 1970, the variance among regions decreased, but the variance within regions increased. The F-ratio experienced an increase from 1933 to 1940, followed by a general decrease to 1970 (Figure 12). The overall trend of the F-ratio is one of decreasing magnitude. A difference of means test indicated that for each year, the means of the regions are significantly different at the .05α level.

A close analysis of Table 9 reveals that a higher F-ratio indicates a greater difference among regions and vice versa. The overall trend of a decreasing F-ratio is an indicator of decreasing variance between regions, i.e. convergence. The increasing F-ratio from 1933 to 1940 indicates a divergence process. During this time period, variance among regions increased while variance within regions decreased.

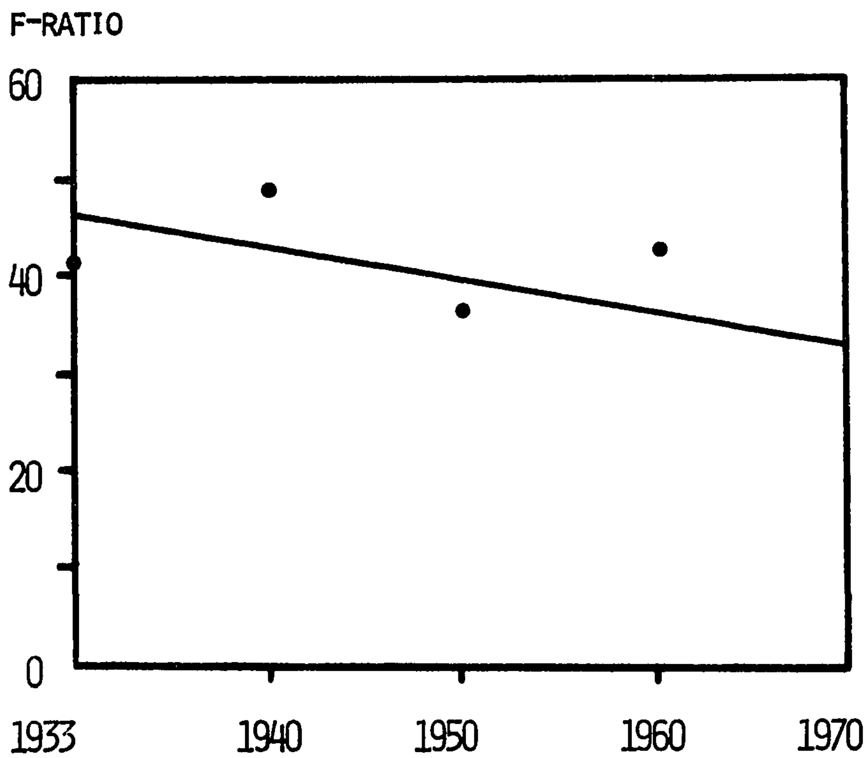
The nature of these scores for the 1930's can be understood only in terms of the economic and social upheaval that occurred in the United States, and especially in Oklahoma during the era of the depression and the dust-bowl. Oklahoma experienced both out-migration and internal migration among regions during the 1930's. As a result, many regions became more homogeneous with respect to income, savings, sales tax revenues, etc. at a lower standard-of-living level, i.e. variance within regions decreased. During this period, people searched for a better place to live. Survival in parts of Oklahoma became difficult due to drought and low farm prices so people "voted with their feet" and migrated.

Coefficient of Variation

By using the mean and standard deviation of the county sales tax data for each year, a simple coefficient of variation was calculated for

FIGURE 12

SALES TAX F-RATIOS
FOR THE ENTIRE STATE



SOURCE: AUTHOR'S COMPUTATIONS

the entire state (Warner, 1973). Table 10 shows the results of these calculations. The coefficient of variation is used as a simple check of the trends found in the analysis of variance.

TABLE 10

STATEWIDE COEFFICIENT OF VARIATION FOR SALES TAX

Year	Coefficient
1933	.570
1940	.538
1950	[illegible]
1960	[illegible]
1970	[illegible]

Source: Author's computa[illegible]

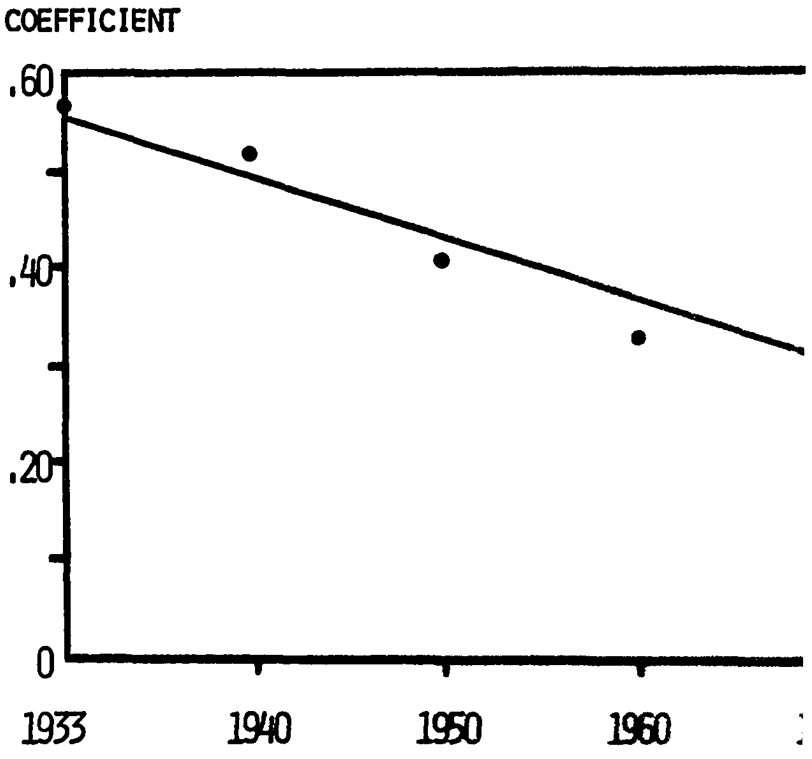
The overall trend o[illegible]clical decrease (convergence) from 1933 t[illegible]m 1960 to 1970 (Figure 13). The trend in t[illegible]n is in agreement with the trend of the F-ratio fr[illegible]of variance. For the entire state, disparities in sales tax revenues generated among the county have a decreasing trend.

Lorenz Curve Analysis

The Lorenz Curve is another way of measuring the degree of equality in the distribution of a characteristic among the population. From these curves, a direct comparative reading of a region's share of the state's population and its share of the state's sales tax revenues is possible (Table 11, Figure 14). Lorenz Curves were constructed for each of the specified years by calculating each region's share of the state's population and sales tax revenues. (Table 11) Regions were then ranked lowest (1)

FIGURE 13

COEFFICIENT OF VARIATION
FOR SALES TAX



SOURCE: AUTHOR'S COMPUTATIONS

the entire state (Warner, 1973). Table 10 shows the results of these calculations. The coefficient of variation is used as a simple check of the trends found in the analysis of variance.

TABLE 10

STATEWIDE COEFFICIENT OF VARIATION FOR SALES TAX

Year	Coefficient
1933	.570
1940	.538
1950	.419
1960	.330
1970	.341

Source: Author's computations

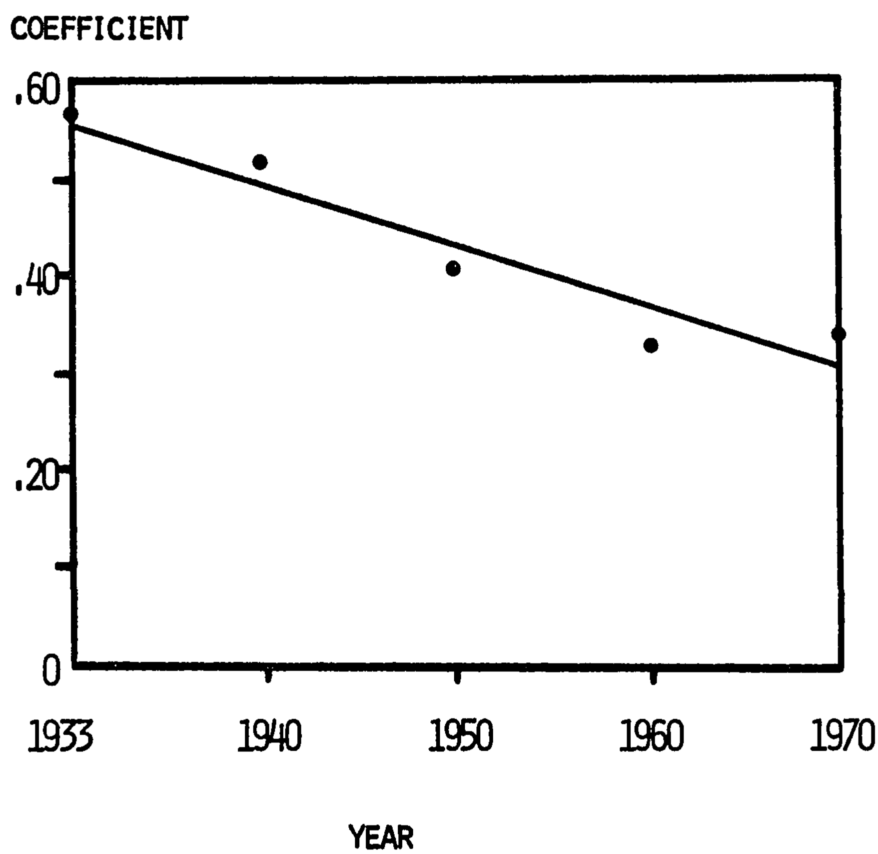
The overall trend of the coefficient is that of a cyclical decrease (convergence) from 1933 to 1960 with a stabilization from 1960 to 1970 (Figure 13). The trend in the coefficient of variation is in agreement with the trend of the F-ratio from the analysis of variance. For the entire state, disparities in sales tax revenues generated among the county have a decreasing trend.

Lorenz Curve Analysis

The Lorenz Curve is another way of measuring the degree of equality in the distribution of a characteristic among the population. From these curves, a direct comparative reading of a region's share of the state's population and its share of the state's sales tax revenues is possible (Table 11, Figure 14). Lorenz Curves were constructed for each of the specified years by calculating each region's share of the state's population and sales tax revenues. (Table 11) Regions were then ranked lowest (1)

FIGURE 13

COEFFICIENT OF VARIATION
FOR SALES TAX



SOURCE: AUTHOR'S COMPUTATIONS

TABLE 11

LORENZ CURVE DATA FOR SALES TAX

Region		Year				
		1933	1940	1950	1960	1970
I	% population	21	23	32	40	43
	% sales tax	48	45	48	54	59
	rank	4	3	3	4	4
	variance index	21	18	12	9	9
II	% population	25	25	23	21	20
	% sales tax	18	20	22	20	17
	rank	2	2	3	2	2
	variance index	-9	-7	-2	-1	-5
III	% population	40	37	33	30	28
	% sales tax	28	30	25	22	19
	rank	3	4	4	3	3
	variance index	-10	-6	-8	-9	-11
IV	% population	14	15	12	9	9
	% sales tax	6	5	5	4	5
	rank	1	1	1	1	1
	variance index	-23	-28	-24	-21	-17
Area under curve		72%	74%	83%	88%	88%

Source: Author's computations

to highest (4) by their percentage of total state sales tax revenues collected. For each year, the cumulative percentage of population and sales tax revenues were arranged in rank order; and then were plotted to construct the Lorenz Curves.

Figure 14 shows the Lorenz Curve for each of the years. The summary of curves on Figure 14 shows a steady movement of the curves from the 1933 line inward towards the 45 degree equality line. The historical movement of the curves is a clear indication of the existence of a convergence process for the entire state. In order to more clearly describe the movement of the curves from 1933 to 1970, the area under each curve was calculated as a percentage of the total area under the 45 degree equality line (Table 11).[1] The areas steadily increase (converge) from 1933 to 1960 with stabilization from 1960 to 1970.

One final measure was obtained from the Lorenz Curves. For each region, a Lorenz Variance Index was computed for each study year (Table 11).[2] This was accomplished by connecting every two points (regions) on each curve and measuring the angle formed with the baseline (abscissa). The difference between this angle and 45 degrees (the equality angle) was determined as the Lorenz Variance Index. A positive index (any angle greater than 45 degrees) indicates that a region generates a greater share of the state's sales tax revenues than it has of the state's population; Region I consistently falls into this category. A negative index indicates that a region generates a smaller share of the state's sales tax revenues

---

[1]These measurements were made with a compensating polar planimeter.

[2]The variance index was discussed earlier in Chapter II (p.33).

than it has of the state's population; Region IV shows a strong consistency in having a high negative index while Regions II and III hover closer to the equality index of zero. The Lorenz Variance Indices are summarized in Figure 15.

The consistent positive index for Region I is very clear. Region I has had the highest variance index of all the regions over all the study years. What this means is that Region I has consistently generated a greater share of the state's sales tax revenues than it has of the state's population. The trend of the variance index for Region I has been one of convergence on the zero equity line. Region II experienced convergence towards the equity line from 1933 to 1960. From 1960 to 1970, Region II diverged from the equity line. Region II has experienced a small but steady divergence. The counties of eastern and southeastern Oklahoma that comprise Region IV have consistently experienced the highest negative variance index scores. During the depression and dust-bowl years, Region IV generated a smaller share of the state's sales tax revenues relative to its share of the state's population. Although the index scores for Region IV have moved towards the equity line since 1940, this region has still had the highest negative scores in the state.

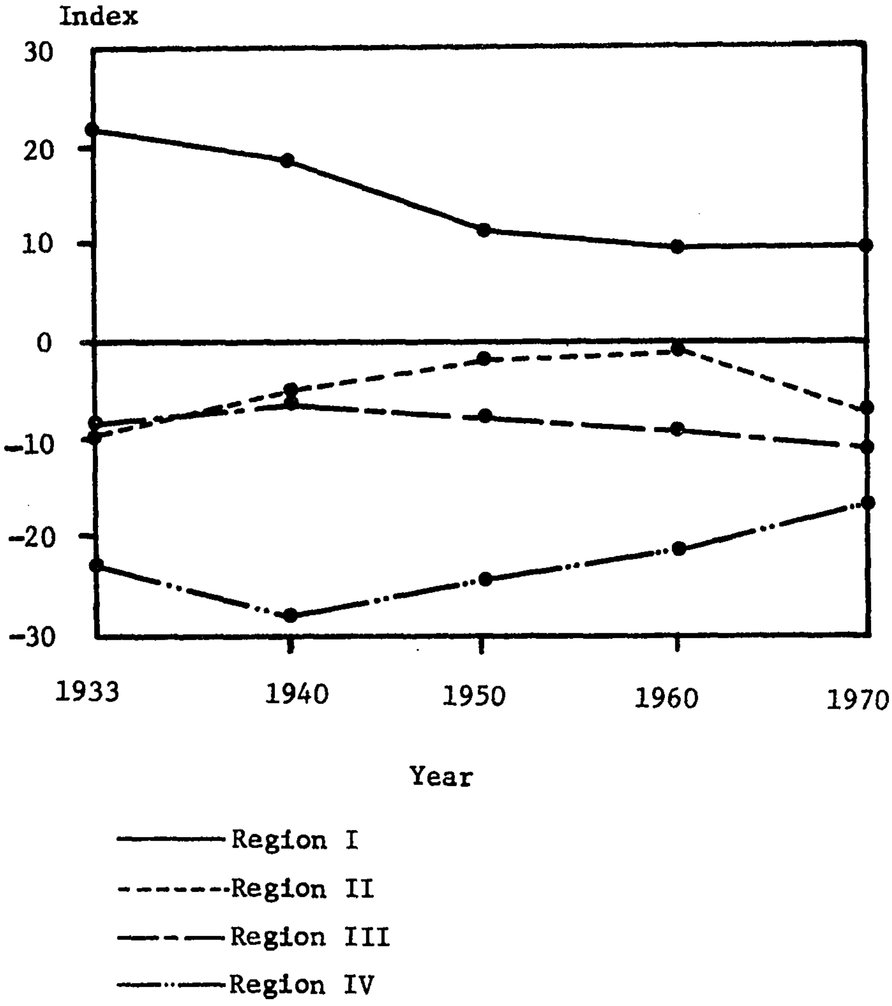
Williamson Inequality Index

To facilitate a closer analysis of disparities of sales tax revenues generated per capita within specific regions, a modified Williamson Inequality Index was used. The index for sales tax data was found by using the formula:

$$V = \frac{\sqrt{E\ (Y_i - \bar{Y})^2\ \frac{f_i}{n}}}{\bar{Y}}$$

FIGURE 15

LORENZ VARIANCE INDEX
FOR SALES TAX



Source: Author's computations

V = inequality index

Y_i = county sales tax revenues per capita

$\bar{Y}$ = region sales tax revenues per capita

f_i = county population

n = region population

For each region on each year, the data were standardized to Z-scores. These Z-scores differ from those used in the analysis of variance (p. 64). The earlier analysis was based on the mean and standard deviation of the entire set of data for each year. The Z-scores used in the calculation of the inequality index were based on the mean and standard deviation for each group in each year. Table 12 shows the Williamson Inequality Indices for sales tax revenues. This method allows convergence or divergence inside each of the four regions to be estimated.

TABLE 12

WILLIAMSON INEQUALITY INDICES FOR SALES TAX

Region	Year				
	1933	1940	1950	1960	1970
I	.59	.86	.82	.75	1.08
II	.82	.47	.22	.46	1.77
III	.28	.30	.68	.74	1.54
IV	1.49	2.60	2.36	3.71	5.04

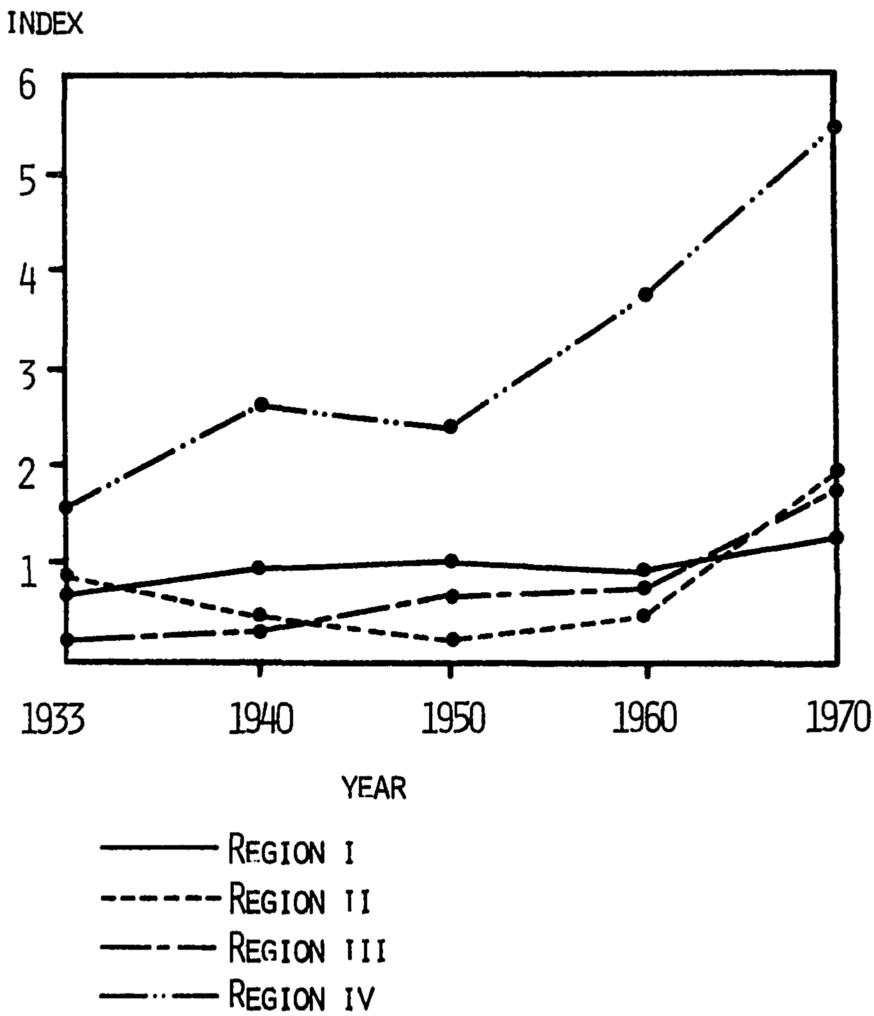
Source: Author's computations

The indices from Table 12 were plotted and are shown in Figure 16. Trend lines for each region over the time period are shown in Figure 17.

The trend line for Region I shows a slight internal divergence from 1933 to 1970. The actual plot on Figure 16 shows an increase in

FIGURE 16

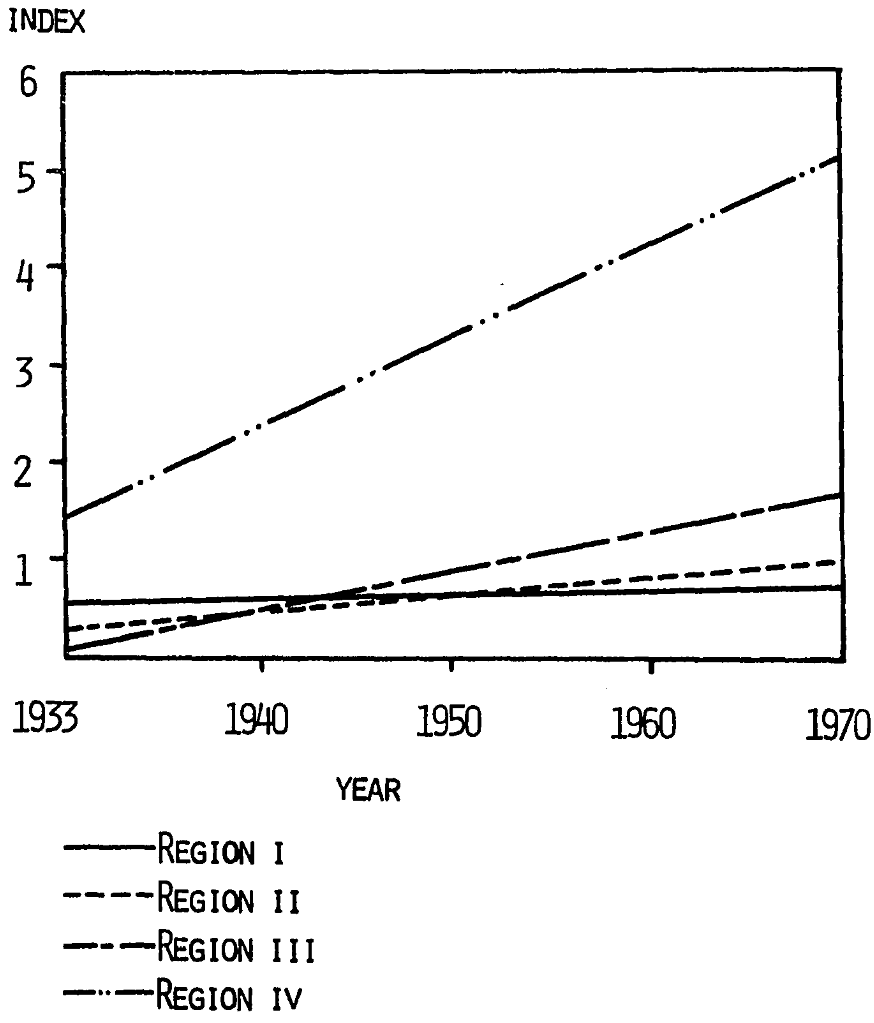
WILLIAMSON INEQUALITY INDICES
FOR SALES TAX



SOURCE: AUTHOR'S COMPUTATIONS

FIGURE 17

WILLIAMSON INEQUALITY INDEX
TRENDS FOR SALES TAX



SOURCE: AUTHOR'S COMPUTATIONS

inequality from 1933 to 1940, followed by a decrease to 1960, and then an increase to 1970. The trend line for Region II indicates a low degree of divergence until 1960. The actual plot shows convergence in Region II from 1933 to 1950, followed by divergence to 1970. Region III has a trend line that indicates a stronger divergence process than for Region II. The actual plot for Region III shows consistent divergence from 1933 to 1970. Region IV clearly stands out as the region with the greatest degree of inequality. The trend for Region IV has been one of increasing disparity except for the 1940 to 1950 period.

The Williamson Inequality Index has revealed several interesting trends of disparities in sales tax collections within standard-of-living regions of Oklahoma (Figure 17). The region with the highest standard-of-living has experienced an internal stability in sales tax collections with some very slight divergence. Indeed, the degree of inequality in Region I has been low. The medium range standard-of-living regions have experienced a small degree of divergence since 1933. The medium-low region experienced more divergence than the medium-high region. The lowest standard-of-living region of Oklahoma has experienced the greatest degree of sales tax inequality on each of the specified years. The trend of inequalities in Region IV has been one of very strong divergence.

Regional Inequalities in Per Capita Income: 1933-1970

Income is the economic characteristic of a population that has most often been investigated in terms of regional inequality. The form of income to be analyzed in this section is per capita personal income for the years 1930, 1940, 1950, 1960, and 1970. Since per capita income has not been reported in the U.S. census before 1970, it was necessary to calculate these incomes for each county on each of the study years prior to 1970. These data have been calculated for the counties of Oklahoma for 1960 by Homan and Dikeman (1971). The method used by Homan and Dikeman was used in this study to calculate per capita income for the years 1930, 1940, and 1950.[1] The first step was to find total personal income. Per capita income was then easily calculated as:

$$C_{ij} = \frac{T_{ij}}{P_{ij}}$$

C_{ij} = per capita income for the ith county on the jth year

T_{ij} = total personal income

P_{ij} = county population

Analysis of Variance

A one-way analysis of variance was performed on the per capita income data by using the same procedure that was used for the sales tax data, i.e. annual Z-scores were calculated from the data as input for the analysis of variance. A difference of means test indicated that the average per capita income in each region for each year were significantly different at the .05 α level. The results of the analysis of variance are shown in Table 13.

The variance among regions decreased slightly from 1930 to 1950. From 1950 to 1960, there was an increase, followed by a decrease from 1960 to 1970. The variance within regions also shows a rather fluctuating pattern.

---

[1]See Appendix D.

TABLE 13

STATEWIDE INCOME ANALYSIS OF VARIANCE

Year	Variance Among Regions (V_b)	Variance Within Regions (V_w)	F-ratio
1930	17.38	.34	49.79
1940	16.89	.34	49.26
1950	16.82	.34	48.44
1960	17.77	.30	58.32
1970	15.82	.38	41.05

Source: Author's computations

The general trend has been that of a slightly decreasing variance between regions accompanied by a slightly increasing variance within regions. The F-ratio shows an overall declining trend from 1930 to 1970 (Figure 18). The trend line on Figure 18 indicates slight convergence for the entire state over the study period.

Coefficient of Variation

A coefficient of variation for per capita income was calculated for each of the specified years (Table 14).

TABLE 14

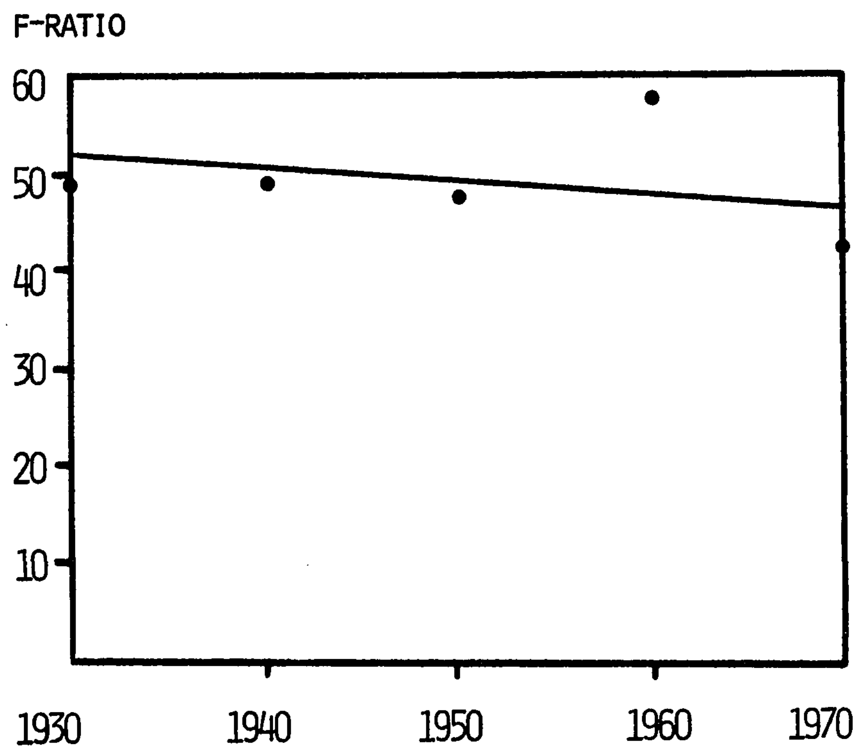
STATEWIDE COEFFICIENT OF VARIATION FOR PER CAPITA INCOME

Year	Coefficient
1930	.58
1940	.60
1950	.47
1960	.35
1970	.19

Source: Author's computations

FIGURE 18

PER CAPITA INCOME F-RATIOS
FOR THE ENTIRE STATE



SOURCE: AUTHOR'S COMPUTATIONS

The coefficient shows a very clear trend of convergence for the entire state from 1930 to 1970 (Figure 19). Oklahoma diverges from a 1930 coefficient of .58 to a 1940 coefficient of .60. The trend for the 1930's corresponds to a similar trend found in the sales tax data. A strong convergence process is indicated between 1940 and 1970.

Lorenz Curve Analysis

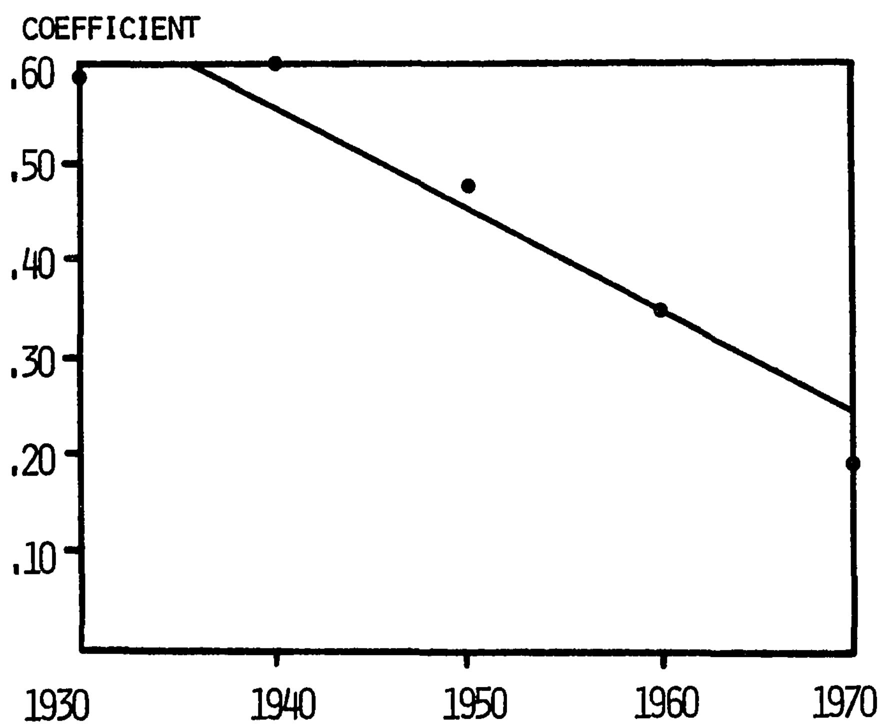
Lorenz Curves were calculated for each of the specified years. The curves were based on total personal income figures per county (Table 15).

Figure 20 shows the Lorenz Curves for each of the years. The summary of curves indicates a movement outward (divergence) from the 45 degree equality line from 1930 to 1940; this trend is in agreement with the coefficients of variation for these years. The 1940 to 1970 trend is one of strong steady convergence towards the 45 degree equality line. A more exact measure of these processes is indicated by the percentage of area underneath the curve for each year (Table 15). The area decreases from 76 percent in 1930 to 68 percent in 1940, i.e. there is divergence. The area increases steadily from 68 percent in 1940 to 92 percent in 1970.

The Lorenz Variance Index (Figure 21) shows some interesting trends. The overall trend on Figure 21 is clear; there is a strong convergence process occurring for the state between 1930 and 1970. Region I consistently has a positive index; this index declines from 20 in 1930 to 4 in 1970. In 1930, Region I had 21 percent of the state's population and 44 percent of the state's total personal income. In 1970, these figures were 43 percent and 51 percent respectively. Both figures

FIGURE 19

COEFFICIENT OF VARIATION
FOR PER CAPITA INCOME



SOURCE: AUTHOR'S COMPUTATIONS

TABLE 15

LORENZ CURVE DATA FOR INCOME

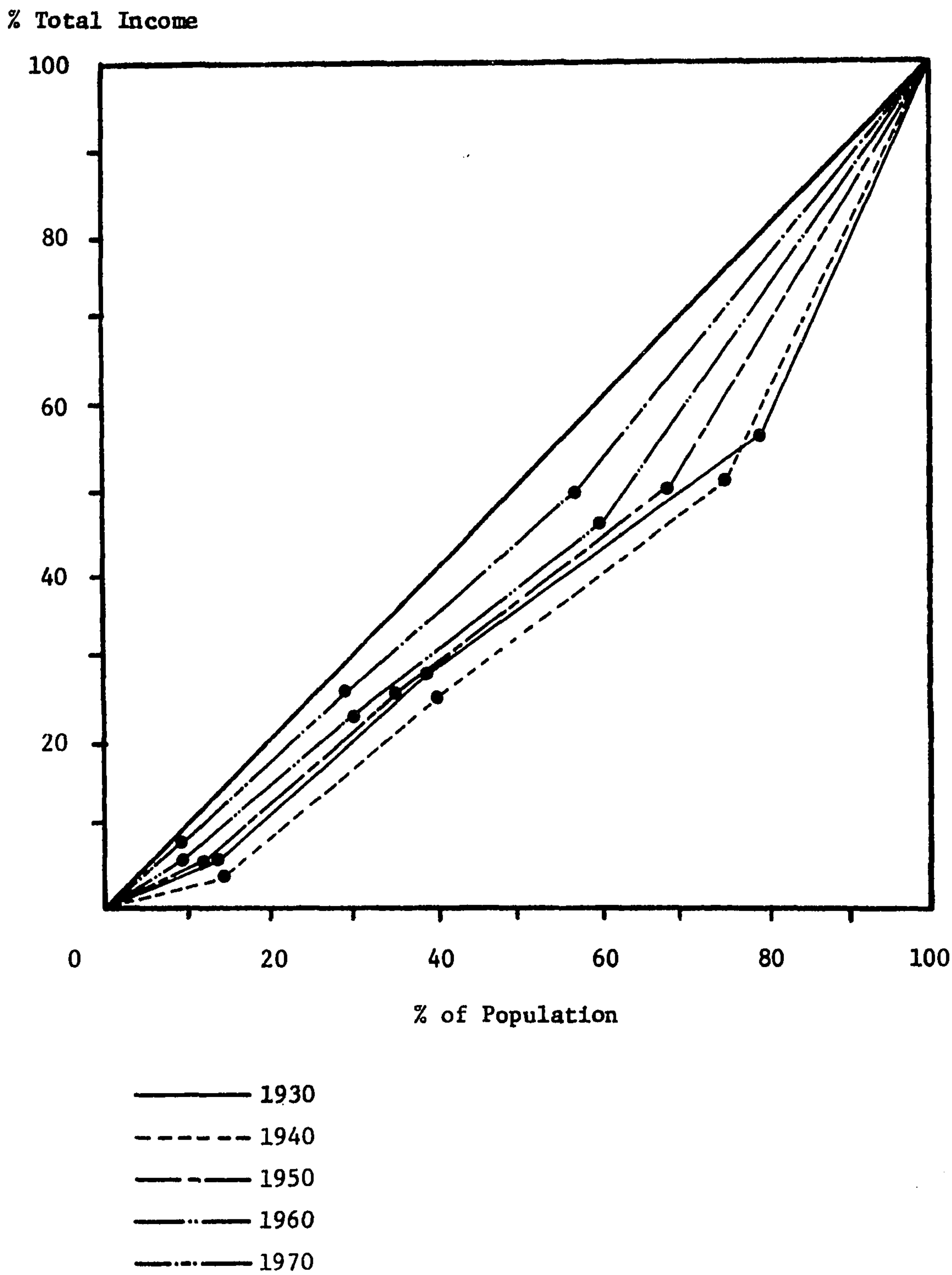
Region		Year				
		1930	1940	1950	1960	1970
I	% population	21	23	32	40	43
	% total income	44	49	51	55	51
	rank	4	4	4	4	4
	variance index	20	20	13	9	4
II	% population	25	25	23	21	20
	% total income	22	21	20	17	18
	rank	2	2	2	2	2
	variance index	-4	-5	-3	-6	-3
III	% population	40	37	33	30	28
	% total income	28	26	24	22	23
	rank	3	3	3	3	3
	variance index	-10	-9	-9	-8	-5
IV	% population	14	15	12	9	9
	% total income	6	4	5	6	8
	rank	1	1	1	1	1
	variance index	-22	-30	-23	-13	-4
Area under curve		76%	68%	80%	82%	92%

Source: Author's computations

FIGURE 20

LORENZ CURVES FOR INCOME

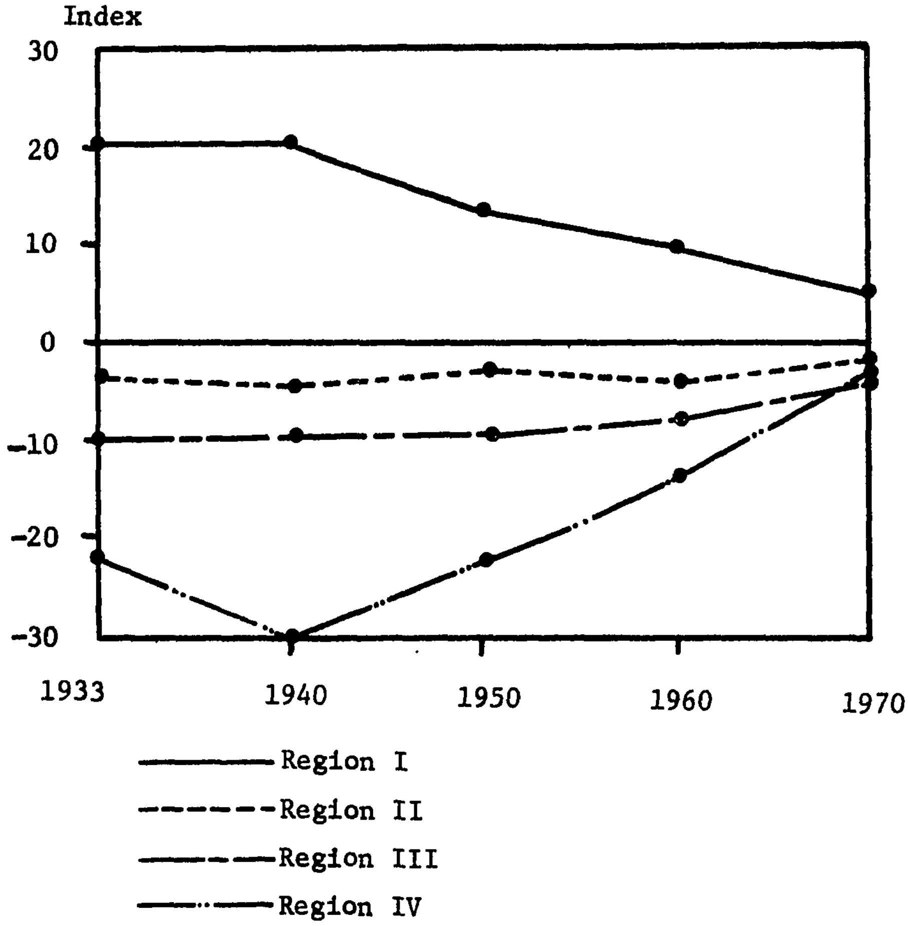
BY STANDARD-OF-LIVING REGIONS



Source: Author's computations

FIGURE 21

LORENZ VARIANCE INDEX
FOR INCOME



Source: Author's computations

have increased consistently since 1930. The maximum difference between the two figures occurred in 1940, following the turbulent period of the 1930's. Since 1940, the two figures have consistently come closer together, i.e. the Lorenz Variance Index for Region I is coming closer to the zero equality index. The Lorenz Variance Index for Region II has hovered close to the zero equality index since 1930, but it has always been on the negative side, i.e. Region II has had a slightly higher share of the state's people than it has had of the state's total personal income. The situation for Region III follows a pattern similar to that of Region II but with a more unequal distribution of population and income. From 1930 to 1960, Region IV was consistently the region with the highest negative Lorenz Variance Index. Region IV had 14 percent of the state's people in 1930, but it had only 6 percent of the total personal income. By 1970, Region IV had 9 percent of the people and 8 percent of the total personal income. Region IV is moving closer to the zero equality index from the negative side, but it has consistently lost in share of the state's population since 1930. The trend in population in the state is rather clear; Region I with its large urban areas accounts for a greater share of the state's population each year while the other regions account for less. This is part of the urbanization process that has occurred at an increasing rate in Oklahoma especially since 1960 when the state first counted more people in urban areas than in rural areas.

Williamson Inequality Index

In order to measure internal inequalities, Williamson Inequality Indices were calculated for each region on each year. Regional Z-scores were calculated in order to derive the indices, which are shown in Table 16.

The actual indices from Table 16 were plotted and are shown in Figure 22. Trend lines for each region are shown in Figure 23.

TABLE 16

WILLIAMSON INEQUALITY INDICES FOR INCOME

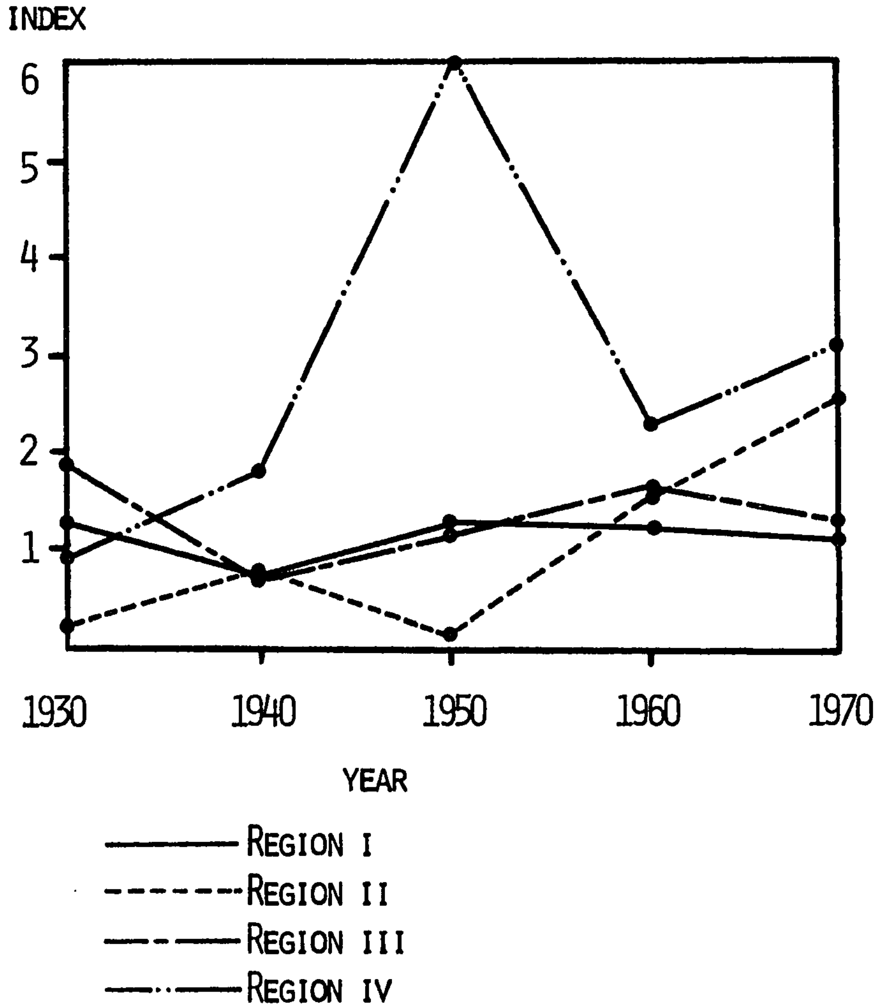
Region	Year				
	1930	1940	1950	1960	1970
I	1.19	.77	1.27	1.33	1.15
II	.14	.81	.03	1.44	2.51
III	1.94	.72	1.19	1.48	1.19
IV	.95	1.78	6.00	2.11	2.97

Source: Author's computations

The trend line for Region I shows a very slight divergence from 1930 to 1970. The actual plot on Figure 22 shows a decreasing index from 1930 to 1940 (convergence) followed by an increasing index from 1940 to 1960 (divergence). Region I experienced convergence from 1960 to 1970. Region II fluctuates between divergence and convergence with an overall trend of divergence. Region III also fluctuates between convergence and divergence with an overall trend of convergence. Region IV shows a clear trend of divergence. Region IV had increasing disparity in income from 1930 to 1940. During the 1940's, the degree of inequality in Region IV grew greatly to a high of 6.00 in 1950. The region experienced convergence from 1950 to 1960, followed by divergence once again from 1960 to 1970. Warner (1973, p. 14) also found divergence in personal income for Oklahoma during the 1940's. During the boom

FIGURE 22

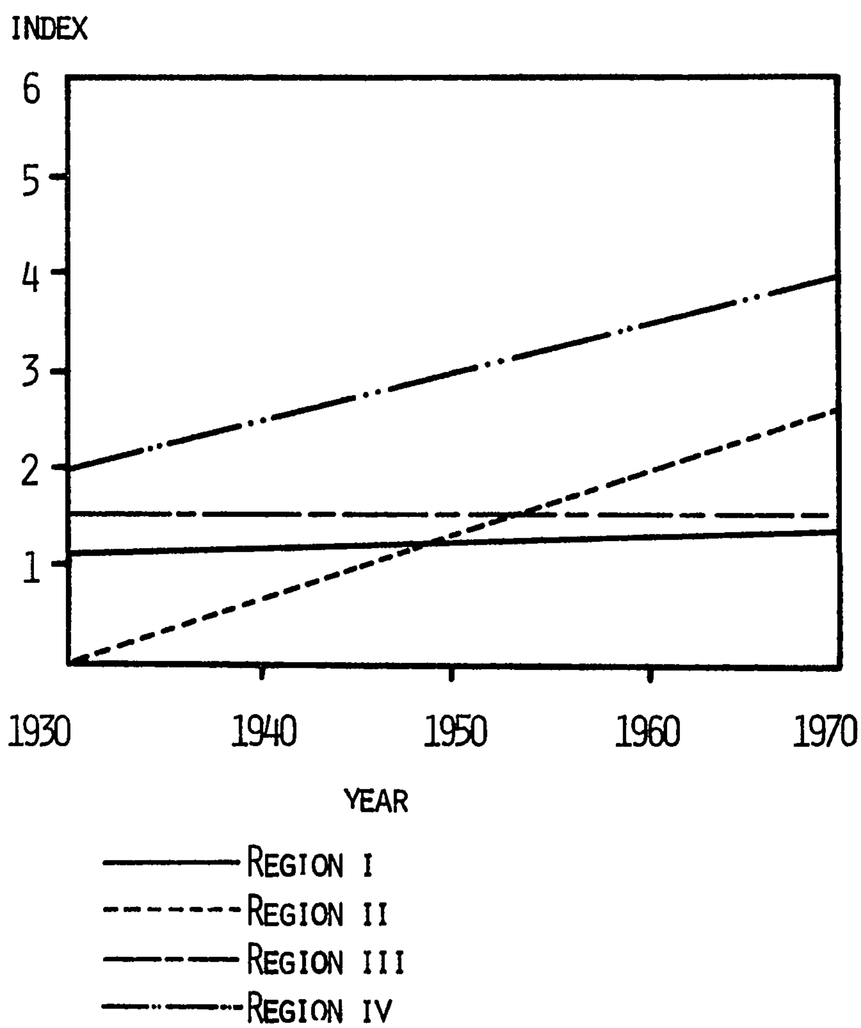
WILLIAMSON INEQUALITY INDICES
FOR INCOME



SOURCE: AUTHOR'S COMPUTATIONS

FIGURE 23

WILLIAMSON INEQUALITY INDEX
TRENDS FOR INCOME



SOURCE: AUTHOR'S COMPUTATIONS

years associated with World War II, there was heavy outmigration from the rural areas to the urban centers. The economic boom was associated with stabilization of disparity in the higher standard-of-living regions. Region IV did not share in the boom directly, but many of its people left the region for high wage areas.

The highest standard-of-living-region has experienced a rather stable condition with only slight divergence. The medium-high region experienced an overall divergence from 1930 to 1970. The medium-low region shows an overall trend towards slight convergence. The lowest standard-of-living-region experienced the greatest degree of inequality on each of the specified years. The overall trend for Region IV is one of strong divergence.

The changes for each region shown on Figure 22 have a very noticeable trend. By 1960, every region had a higher inequality index than Region I; this trend continued to 1970. Many Oklahomans feel that the decade of the 1960s was a prosperous one when the state really began to become industrialized (Warner, 1973, p. 14). Figure 22 shows that during the 1960s, the regions diverged from each other somewhat. There are several explanations for this trend. First, the increasing effects on per capita income through out-migration from rural areas were not as strong as in the period prior to 1960. Second, there was a continued decline in employment in the high-wage petroleum industry. Third, the mixture of new industry moving into the state was heavily weighted towards firms whose hourly wage rates were less than the national average (Warner, 1973, p. 14).

Regional Inequalities in Educational Achievement Levels: 1940-1970

In this section, a variable that is more social in nature will be analyzed. The set of data to be used will be the percentage of males 25 years old and older who have completed a minimum of 4 years of high school. The data for female education levels were not used because the male and female education levels correlate very highly (r = +.93 for 1970). The purpose of analyzing this variable is to measure an actual condition (education level) rather than some form of expenditures towards educational objectives, e.g. dollars expended per pupil.

Analysis of Variance

The analysis of variance for education levels was performed on the annual Z-scores for the years 1940, 1950, 1960, and 1970. The results of the ANOVA are shown in Table 17.

TABLE 17

STATEWIDE EDUCATION ANALYSIS OF VARIANCE

Year	Variance Among Regions (V_b)	Variance Within Regions (V_w)	F-ratio
1930	17.38	.34	49.79
1940	16.89	.34	49.26
1950	16.82	.34	48.44
1960	17.77	.30	58.32
1970	15.82	.38	41.05

Source: Author's computations

The variance among regions decreases consistently from 1940 to 1970; this decrease is accompanied by a consistent increase of the variance within regions. The F-ratio for the education variable shows a steady decrease from 1940 to 1970 (Figure 24). A difference of means test indicated that the means of the regions for each year are significantly different at the .05 α level. The trend of the F-ratio is a clear indication of an overall convergence process. The convergence process indicated by the trend of the F-ratios is concomitant with an increasing interregional equality (decreasing V_b) and a decreasing intraregional equality (increasing V_w).

Coefficient of Variation

A coefficient of variation for the education data was calculated from the raw data, and the results are shown in Table 18.

TABLE 18

STATEWIDE COEFFICIENT OF VARIATION FOR EDUCATION

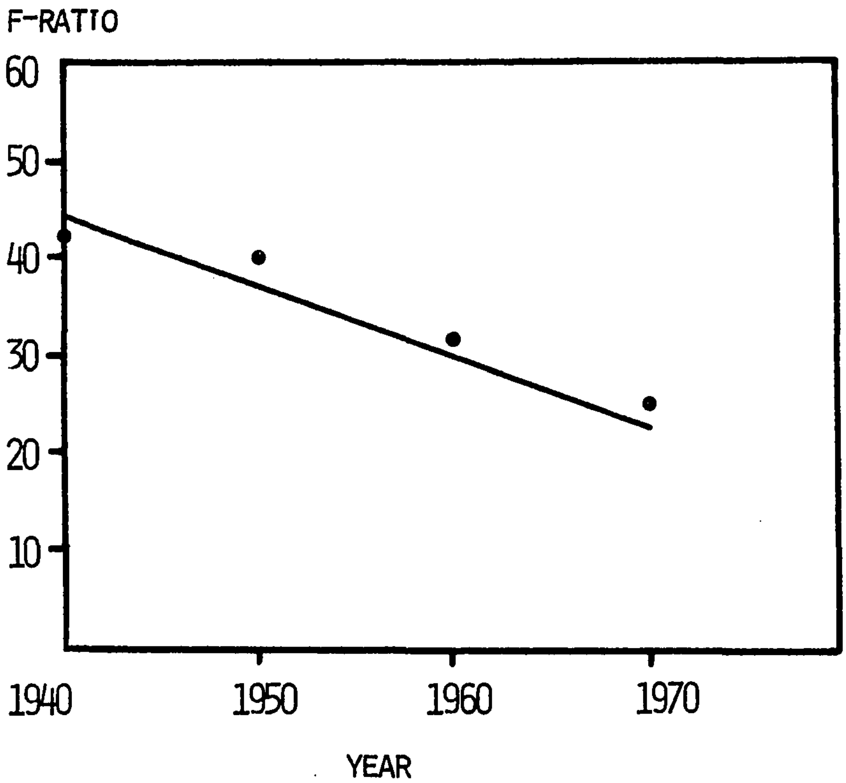
Year	Coefficient
1940	.327
1950	.344
1960	.308
1970	.209

Source: Author's computations

The coefficient of variation plotted in Figure 25 indicates a slight divergence between 1940 and 1950 as the coefficient increased slightly from .327 to .344; this indicates a slight divergence for the educational achievement level during the 1940's. Between 1950 and 1970, the coefficient steadily decreased during a process of convergence. The overall trend indicated by the coefficient is one of convergence for the entire state.

FIGURE 24

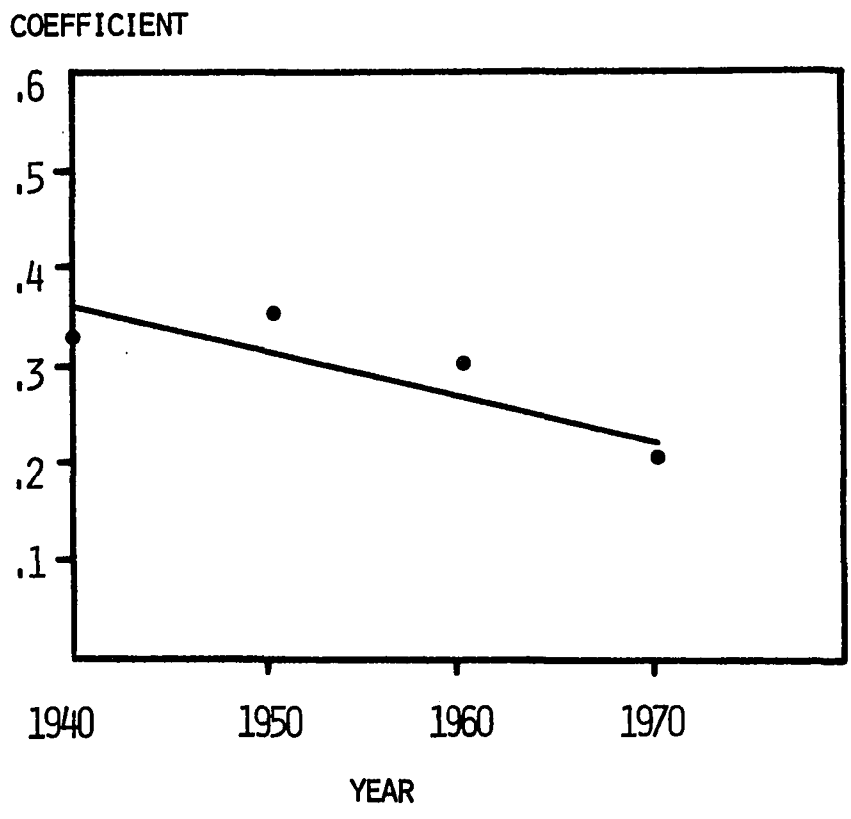
EDUCATIONAL ACHIEVEMENT F-RATIOS
FOR THE ENTIRE STATE



SOURCE: AUTHOR'S COMPUTATIONS

FIGURE 25

COEFFICIENT OF VARIATION
FOR EDUCATIONAL ACHIEVEMENT LEVELS



SOURCE: AUTHOR'S COMPUTATIONS

Lorenz Curve Analysis

The Lorenz Curve analysis is based on the total number of males 25 years old and older who have completed at least 4 years of high school (Table 19). Lorenz Curves were calculated for each of the specified years.

The summary of curves (Figure 26) indicates a steady progression toward the 45 degree equality line from 1940 to 1970; the movement of the curves shows a strong convergence process. A more exact measure of the convergence process is indicated by the increasing area under each curve (Table 19). The area increases from 81 percent in 1940 to 99 percent in 1970.

The Lorenz Variance Index is shown on Figure 27. The overall trend shown on Figure 27 is one of convergence over the time period by all regions on the zero equality line. Region I consistently has a positive index. This index declines from 14 in 1940 to 1 in 1970. Region I had 23 percent of the state's population in 1940 and 39 per cent of the males 25 and older with 4 years of high school. By 1970, Region I had 43 per cent of the population and 45 per cent of the schooled males. Region I has been approaching the zero equality index since 1940. Region II shows an interesting pattern. This region went from an index of -4 in 1940 to a zero equality index in 1950, and then to an index of 1 and 2 in 1960 and 1970. This means that Region II went from a situation of having a larger share of the state's population than of its schooled males to a situation of having a larger share of the state's schooled males than of its population.

Region III has consistently experienced a negative index, but the trend for this region has been one of approaching the zero equality

TABLE 19

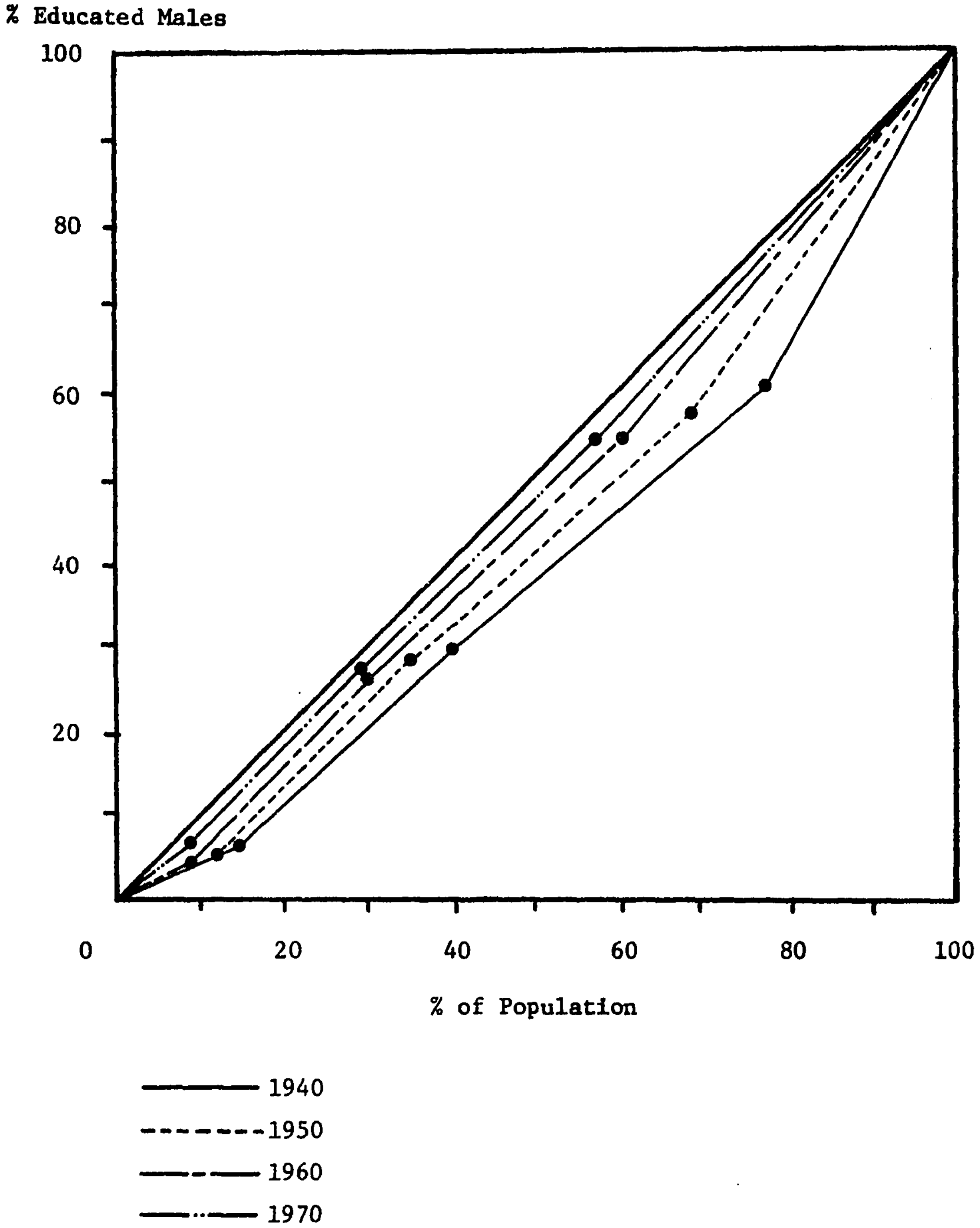
LORENZ CURVE DATA FOR EDUCATION

Region		Year			
		1940	1950	1960	1970
I	% population	23	32	40	43
	% males educated	39	42	45	45
	rank	4	4	4	4
	variance index	14	7	3	1
II	% population	25	23	21	20
	% males educated	23	23	22	21
	rank	2	2	2	2
	variance index	-4	0	1	2
III	% population	37	33	30	28
	% males educated	31	29	28	27
	rank	3	3	3	3
	variance index	-5	-4	-2	-1
IV	% population	15	12	9	9
	% males educated	7	6	55	7
	rank	1	1	1	1
	variance index	-20	-20	-17	-8
Area under curve		81%	82%	98%	99%

Source: Author's computations

FIGURE 26

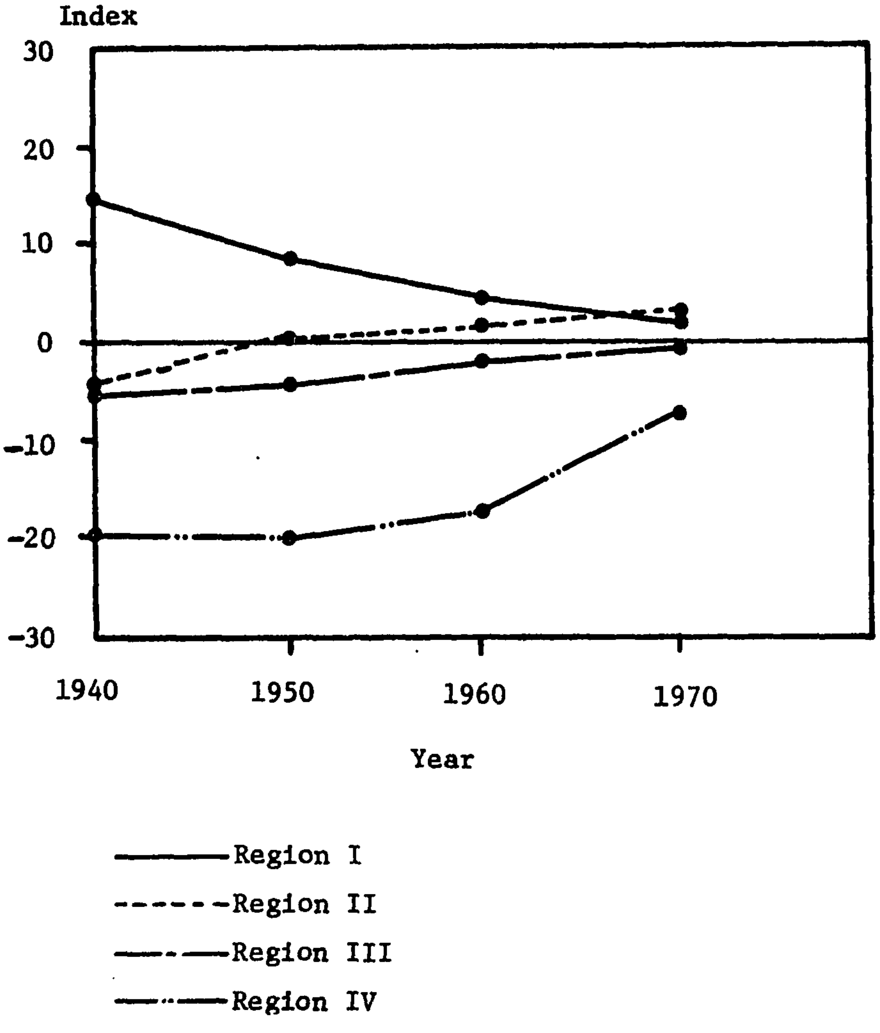
LORENZ CURVES FOR EDUCATIONAL
ACHIEVEMENT LEVELS



Source: Author's computations

FIGURE 27

LORENZ VARIANCE INDEX
FOR EDUCATIONAL ACHIEVEMENT LEVELS



Source: Author's computations

index very closely. By 1970, Region III had an index of -1. Region IV has consistently had the highest negative index of all of the regions. While the other regions were converging on the zero equality index between 1940 and 1960, Region IV showed a rather stable pattern of a high negative index. Between 1950 and 1960, Region IV did begin to approach the zero equality line. Between 1960 and 1970, Region IV showed a very noticeable trend towards the zero equality line.

Figure 27 shows that all of the regions of Oklahoma are approaching a more equitable distribution of population and schooled males, but it is still apparent that the medium-low and low standard-of-living regions have a less equitable share of such individuals than do the medium-high and high standard-of-living-regions.

Williamson Inequality Index

Williamson Inequality Indices were calculated for each region on each year. Regional Z-scores were calculated as input for the calculation of the indices which are shown in Table 20.

TABLE 20

WILLIAMSON INEQUALITY INDICES FOR EDUCATION

Region	Year			
	1940	1950	1960	1970
I	.18	1.28	1.28	1.20
II	.09	.44	1.95	1.08
III	2.08	1.20	1.47	1.35
IV	.33	1.37	9.72	2.38

Source: Author's computations

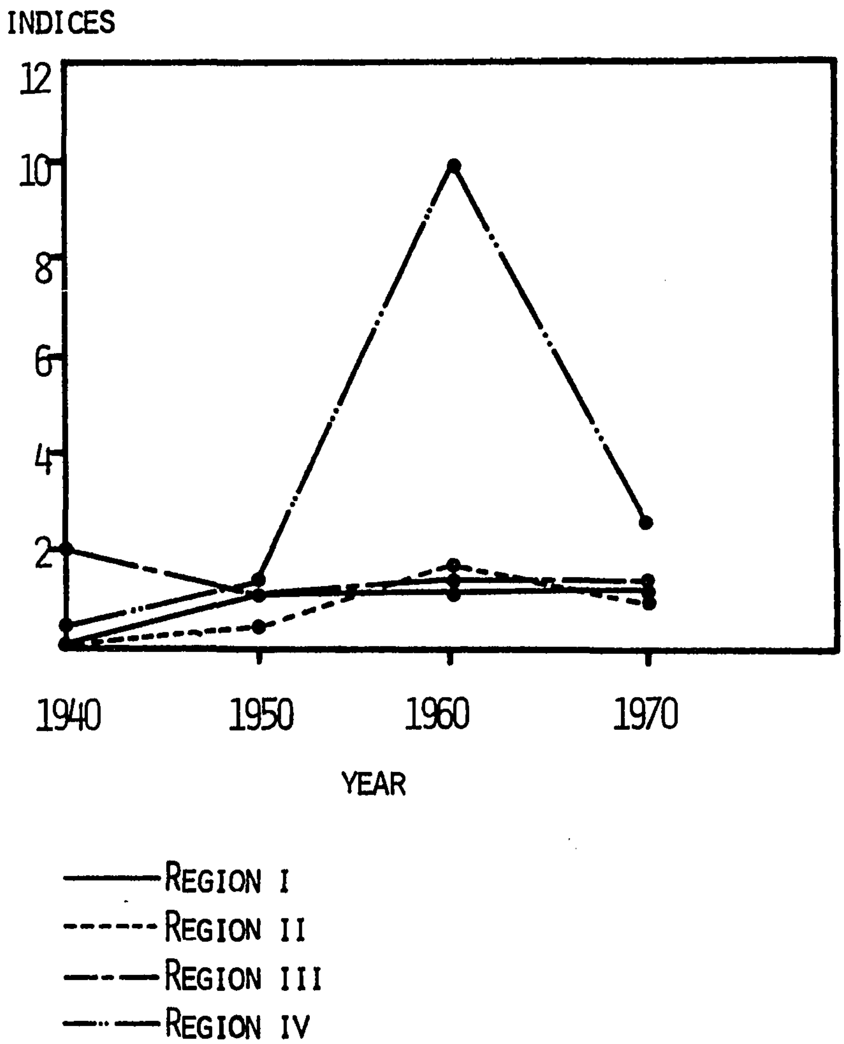
The indices from Table 20 are plotted and are shown in Figure 28. Trend lines for each region are shown in Figure 29. The trend line for Region I shows an overall low degree of divergence; this trend is somewhat misleading. Although the index for Region I did increase from 1940 to 1950, the index shows a stabilization from 1950 to 1970. Region II shows an overall trend of divergence. This region had an increasing inequality index from 1940 to 1960. Since 1960, Region II has experienced convergence. Region III experienced convergence from 1940 to 1950 when its inequality index declined from 2.08 to 1.20. Since 1950, Region III has had a rather stable index. Region IV had a very low inequality index in 1940; at this time, Region III had a greater inequality index than Region IV. By 1950, Region IV had diverged to become the region with the greatest amount of inequality. The inequality index for Region IV jumped greatly in 1960 to 9.72. From 1960 to 1970, the index declined (converged) to 2.38; but Region IV still remains the region with the greatest inequality index.

The trends for regional inequalities in education levels shown on Figure 28 are rather interesting. From 1940 to 1950, all of the regions became much more alike in degree of inequality. From 1950 to 1960, the regions spread apart greatly; Regions I and III remained rather stable. but Regions II and IV experienced divergence. By 1970, the gap of regional inequality indices closed once again but with the lowest standard-of-living-region still maintaining the highest degree of inequality in education level.

A very similar pattern for Region IV was previously found for per capita personal income (p. 87). Educational achievement levels

FIGURE 28

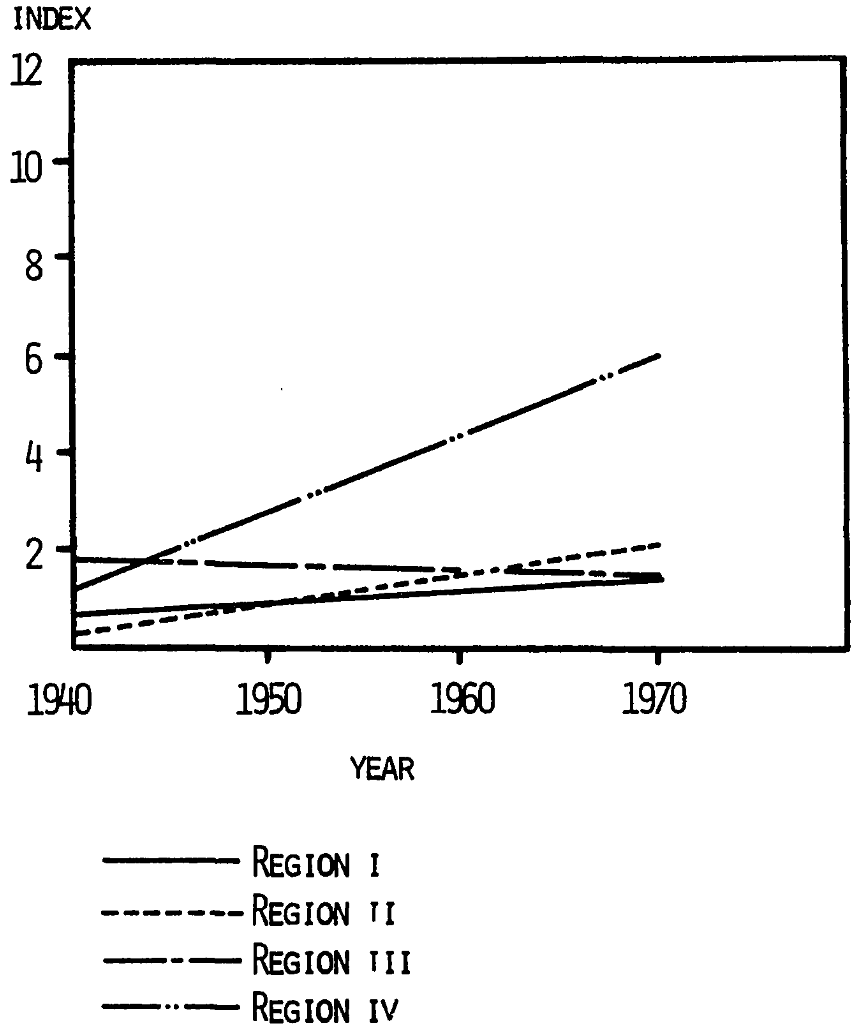
WILLIAMSON INEQUALITY INDICES
FOR EDUCATIONAL ACHIEVEMENT LEVELS



SOURCE: AUTHOR'S COMPUTATIONS

FIGURE 29

WILLIAMSON INEQUALITY INDEX
TRENDS FOR EDUCATIONAL ACHIEVEMENT LEVELS



SOURCE: AUTHOR'S COMPUTATIONS

and income have been found to be highly correlated (Ornati, 1966, p. 62). The great jump in the Williamson Inequality Index for Region IV on educational achievement levels and per capita personal income during the 1940s is related to migration patterns in the state. During the 1940 to 1950 period, Region IV had a percentage change in net migration of -.37; the change for Region I during this period was +.13. These were the highest negative and highest positive net migrations for all of the regions over the study years.[1]

Regional Inequalities in Quality of Housing: 1940-1970

That the quality of housing is an essential ingredient in each individual's perception of his well-being, status, and opportunity is a truism worth restatement. People's behavior and attitudes with regard to many facets of the total environment are pervasively influenced by physical conditions of home and neighborhood (Hagle, 1972, p. 1).

In his factor analysis of county housing characteristics in Oklahoma, Hagle (1972) found that the percentage of all occupied housing units which have incomplete plumbing facilities loaded high and positively on the same factor as the percentage of units with: (1) value less than $5,000, (2) average more than 1.51 persons per room, (3) households of more than eight persons, (4) complete plumbing facilities but 1.01 or more persons per room, (5) proportion of all vacant for sale housing units with incomplete plumbing, (6) proportion of units with a shared or no flush toilet, and (7) proportion of units with no telephone.

---

[1]A more detailed analysis of migration will be contained in the last section of this chapter.

Also loading on this factor were a number of high negative loadings which included: (1) percentage of all non-rental housing which are for sale but presently vacant, (2) proportion of all owner occupied housing units for which the value was $35,000 or more, and (3) percentage of total county population living in urban areas.

Because of difficulties in getting objective measures of other housing quality variables for past periods of time, plumbing has been commonly used as the census variable representing quality.

This section will analyze regional inequalities in the quality of housing for the years 1940, 1950, 1960, and 1970. The quality of a population's housing is a very key and tangible indication of standard-of-living. Quality of housing will be indicated here by using a set of data on the percentage of occupied dwelling units in a county with a bath or shower.

Analysis of Variance

The results of the analysis of variance on the quality of housing units for each of the years are shown in Table 21.

TABLE 21

STATEWIDE HOUSING ANALYSIS OF VARIANCE

Year	Variance Among Regions (V_b)	Variance Within Regions (V_w)	F-ratio
1940	15.84	.38	41.38
1950	19.51	.23	83.94
1960	16.95	.33	50.15
1970	17.98	.29	60.35

Source: Author's computations

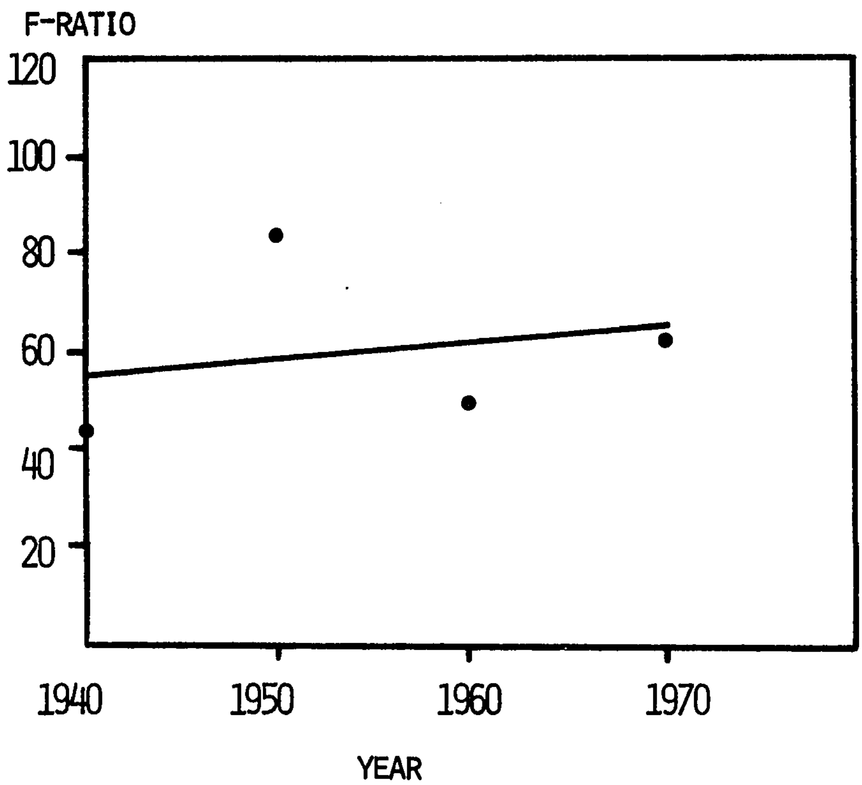
The variance among regions increases from 1940 to 1950, decreases from 1950 to 1960, and increases from 1960 to 1970. The variance within regions also fluctuates by decreasing from 1940 to 1950, increasing from 1950 to 1960, and decreasing from 1960 to 1970. The fluctuating nature of V_b and V_w is reflected in the F-ratio which also fluctuates in a pattern similar to V_b (Figure 30). A difference of means test indicated that the means of the regions are significantly different at the .05 α level. The results of the analysis of variance for quality of housing are not very clear, but there is a discernable trend towards an overall slight divergence for the entire state as indicated by the F-ratio.

The overall trends for housing quality in Oklahoma between 1940 and 1970 was that the statewide pooled disparities among regions (V_b) increased while the statewide pooled disparities within regions (V_w) decreased. These trends suggest that between 1940 and 1970, the standard-of-living regions of Oklahoma have become internally more homogeneous in terms of quality of housing. At the same time, differences between regions has tended to increase.

Hagle (1972, p. 33) suggests that concentrations and movements of the population are closely related to housing quality. Counties with fast growing populations have tended to have higher vacancy rates than slow growing counties (Hagle, 1972, p. 35). The fastest growing counties in Oklahoma have been the urbanized counties; these counties have also had the best housing conditions. The analysis of variance has indicated divergence between 1940 and 1950, followed by a generally convergent trend between 1950 and 1970. During the 1940 to 1950 time period, the

FIGURE 30

HOUSING F-RATIOS
FOR THE ENTIRE STATE



SOURCE: AUTHOR'S COMPUTATIONS

net migration F-ratio (see page 145) was much larger than it was for any ten year time period between 1930 and 1970. Also, during the 1940 to 1950 time period, net migration variance among regions was highest while that within regions was lowest. These trends correspond almost exactly with the trends found in the analysis of variance for housing quality.

During the 1940 to 1950 time period, Regions II, III, and especially IV experienced net outmigration while Region I experienced net inmigration. People were moving from the rural to the urban areas. The analysis of variance indicates that the result of these occurrences was divergence between 1940 and 1950 in the entire state for housing quality.

Coefficient of Variation

Coefficients of variation for the housing data were calculated and shown in Table 22.

TABLE 22

STATEWIDE COEFFICIENT OF VARIATION FOR HOUSING

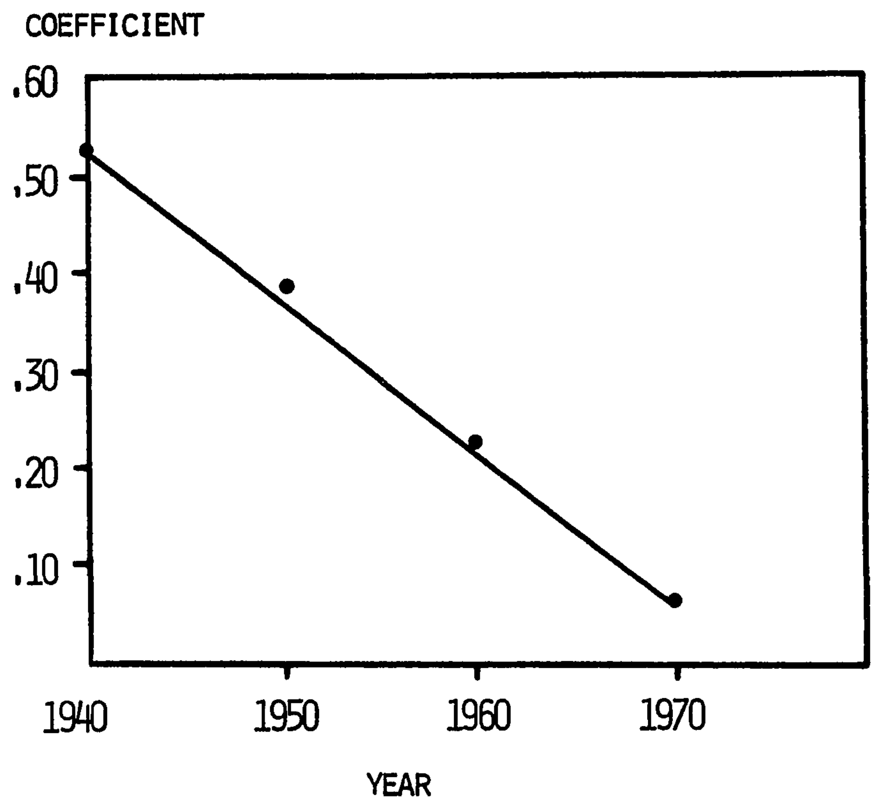
Year	Coefficient
1940	.53
1950	.39
1960	.23
1970	.07

Source: Author's computations

The coefficients of variation have been plotted and are shown in Figure 31. The trend of the coefficients is unmistakably clear; there is a steady pattern of convergence from 1940 to 1970.

FIGURE 31

COFFFICIENT OF VARIATION
FOR HOUSING



SOURCE: AUTHOR'S COMPUTATIONS

The trend of convergence from 1950 to 1970 is in agreement with the generally converging trend for the same time period found in the analysis of variance. The fact that the coefficient of variation indicates convergence and the analysis of variance indicates divergence between 1940 and 1950 is due to the basic differences in the two measures. The coefficient of variation uses the standard deviation (σ) while the analysis of variance uses total variance (σ^2) which is subdivided into variance among (V_b) and variance within (V_w) regions. It is the size of V_b and V_w that determined the F-ratios, and therefore the diverging trend between 1940 and 1950.

Lorenz Curve Analysis

The Lorenz Curve analysis is based on the total number of dwelling units per county with a bath or shower (Table 23). Lorenz Curves were calculated and plotted for each of the specified years (Figure 32). The summary of curves indicates a steady progression towards the 45 degree equality line from 1940 to 1970; this progression indicates a convergence process. The area under the Lorenz Curve increases from 73 per cent in 1940 to 99 per cent in 1970.

The Lorenz Variance Index shown on Figure 33 indicates an overall trend of convergence on the zero equality line by all regions over the time period. In 1940, the indices of the four regions were spread apart. Region I had a very high positive index of 17; Region II had a -1; Region III had a -8; and Region IV had a very high negative index of -30. Between 1940 and 1960, all of the regions converged on the zero equality line. In 1970, Regions I, II, and III were all remarkably

TABLE 23

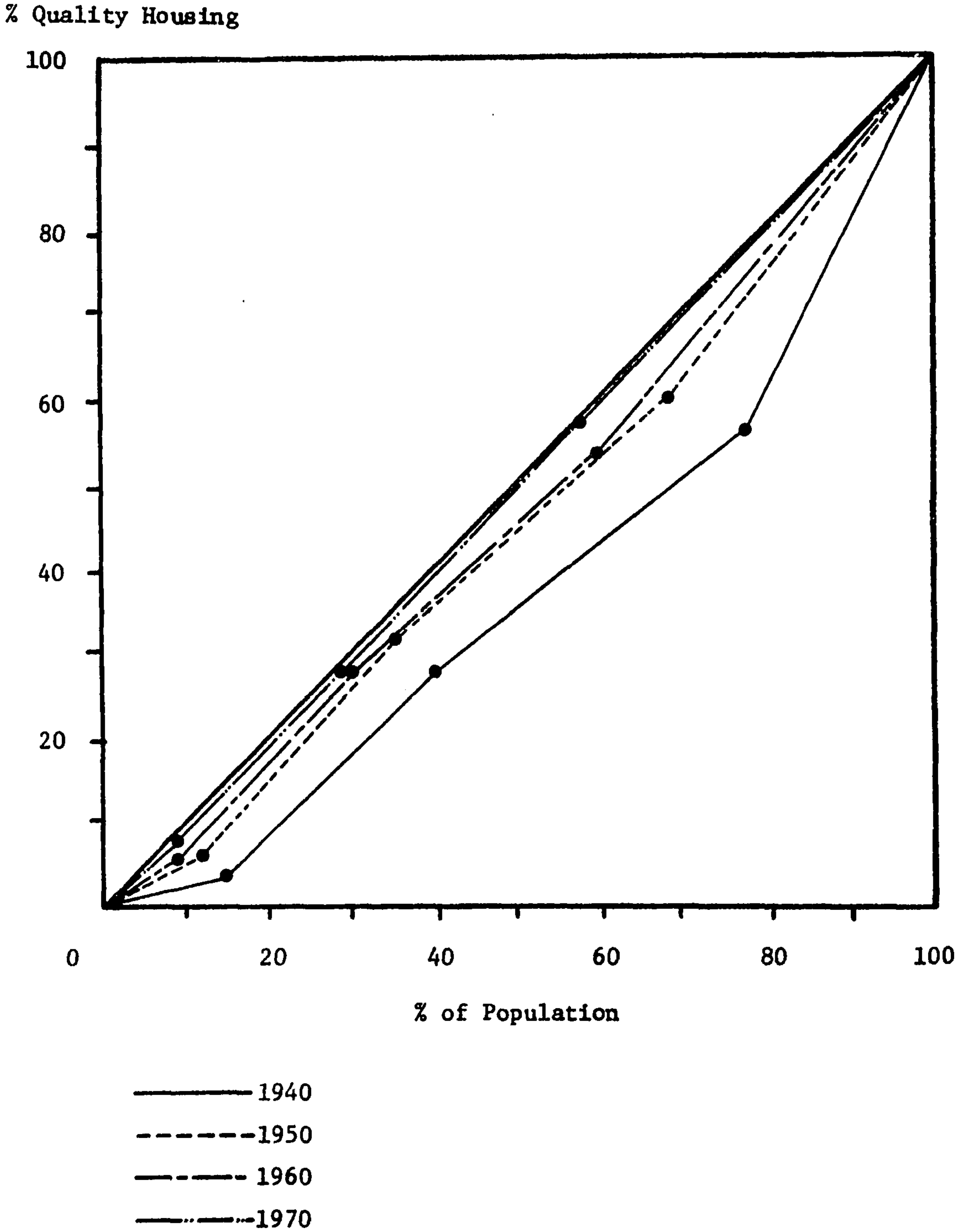
LORENZ CURVE DATA FOR HOUSING

Region		Year			
		1940	1950	1960	1970
I	% population	23	32	40	43
	% quality housing	44	40	47	43
	rank	4	4	4	4
	variance index	17	6	5	0
II	% population	25	23	21	20
	% quality housing	24	25	22	20
	rank	2	2	2	2
	variance index	-1	2	1	0
III	% population	37	33	30	28
	% quality housing	28	28	25	29
	rank	3	3	3	3
	variance index	-8	-4	-6	.5
IV	% population	15	12	9	9
	% quality housing	4	7	6	8
	rank	1	1	1	1
	variance index	-30	-17	-2	-5
Area under curve		73%	81%	83%	99%

Source: Author's computations

FIGURE 32

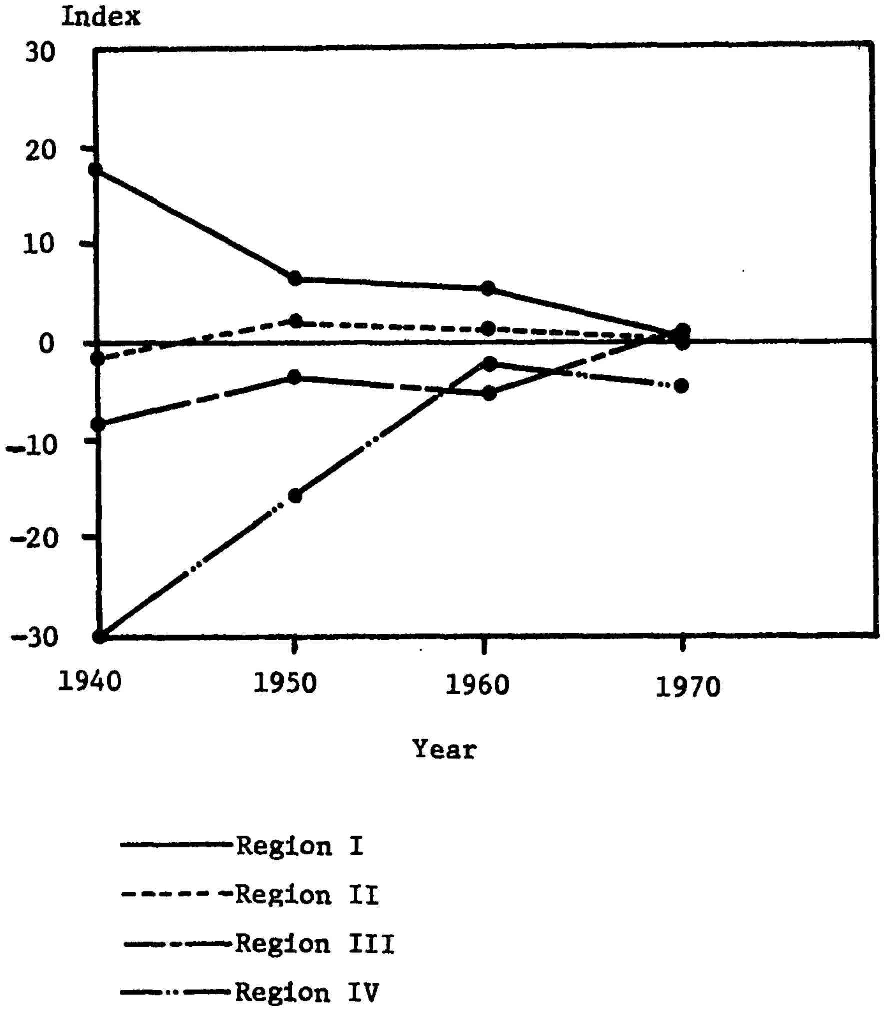
LORENZ CURVES FOR HOUSING



Source: Author's Computations

FIGURE 33

LORENZ VARIANCE INDEX
FOR HOUSING



Source: Author's Computations

similar in their variance index; all of these regions had a very low positive index that was extremely close to the zero equality index. This situation is also shown on Figure 32. Only Region IV maintained a negative index in 1970. Indeed, Region IV even had an increasing negative index from 1960 to 1970.

The Lorenz Variance Indices indicate that between 1940 and 1960, the housing quality disparities within regions of Oklahoma decreased. By 1970, Regions I, II, and III all had positive indices that were very similar. Region IV still maintained a negative index in 1970 which had increased since 1960, i.e. by 1970 Region IV still had a larger share of the state's population than it had of the state's quality housing. In 1970, the people of Region IV still lived in houses with more people per room, lower values, and poorer plumbing facilities than the people of the other regions (Hagle, 1972).

The unclear results of the analysis of variance are explained somewhat by the Lorenz Curve analysis. Figure 33 clearly shows that the distribution of quality housing, as indicated by bath and shower facilities, is becoming more equitable in all regions of the state. Although the lowest standard-of-living-region has a more equitable distribution in 1970 than it did in 1940, it still remains the region of the state with the least equitable distribution of quality housing.

Williamson Inequality Index

Williamson Inequality Indices were calculated for each region on each year. Regional Z-scores were used as input for the calculation of the indices shown in Table 24.

TABLE 24

WILLIAMSON INEQUALITY INDICES FOR HOUSING

Region	Year			
	1940	1950	1960	1970
I	.51	.18	.72	.33
II	.39	.34	.19	.73
III	.19	.21	.33	.70
IV	.41	.34	3.95	1.11

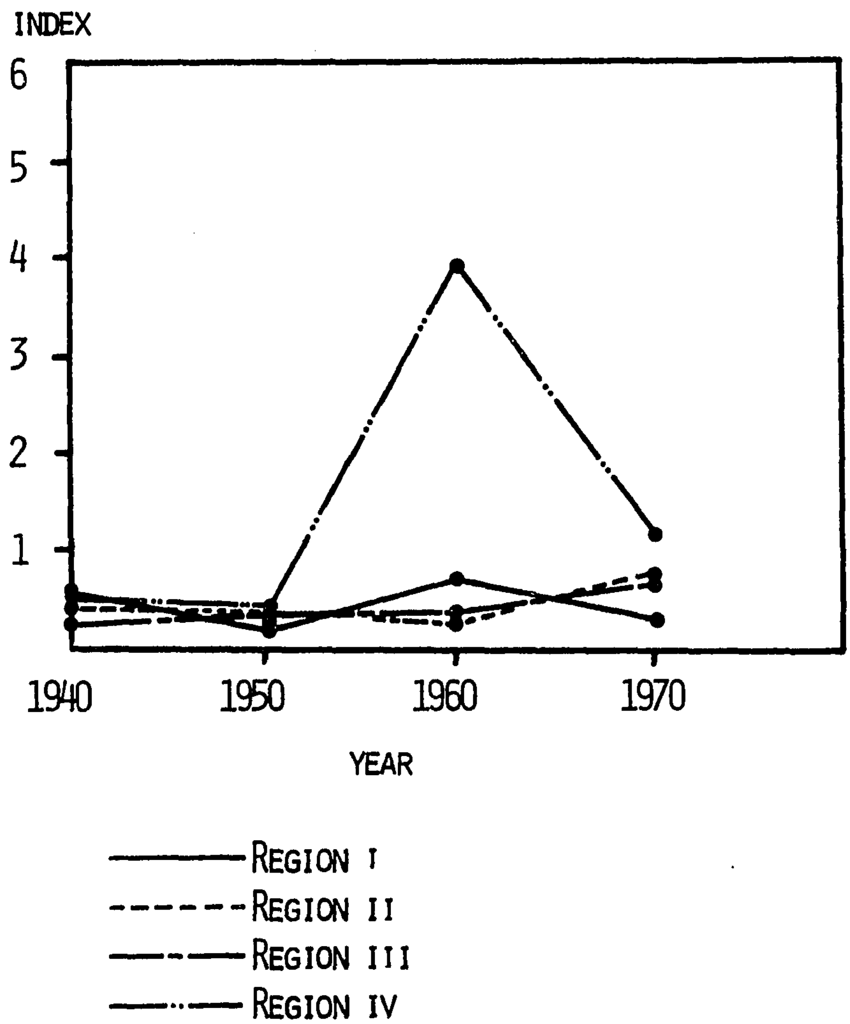
Source: Author's computations

The actual indices from Table 24 were plotted and are shown in Figure 34. Trend lines for each region are shown in Figure 35. The index for Region I fluctuates slightly. The trend line for Region I shows complete stability, i.e. the slope of the line is zero. Region II has an index that decreases from 1940 to 1960 (converges). From 1960 to 1970, Region II experiences divergence. Region III experiences a steady and low degree of divergence from 1940 to 1970. The overall trend for Region IV is one of divergence. Region IV's index decreased slightly from 1940 to 1950. From 1950 to 1960, the index jumped greatly. By 1970, the index for Region IV had decreased again. The jump in the Williamson Inequality Index for Region IV in 1960 occurred on the same year that the Lorenz Variance Index for Region IV approached zero. The inequality index suggests that the distribution of quality housing among the counties of Region IV was not as equitable as that suggested by the total population and total number of quality housing units used to determine the Lorenz Variance Index.

The trends for regional inequalities in quality of housing shown in Figures 34 and 35 agree somewhat with the trends found in the Lorenz

FIGURE 34

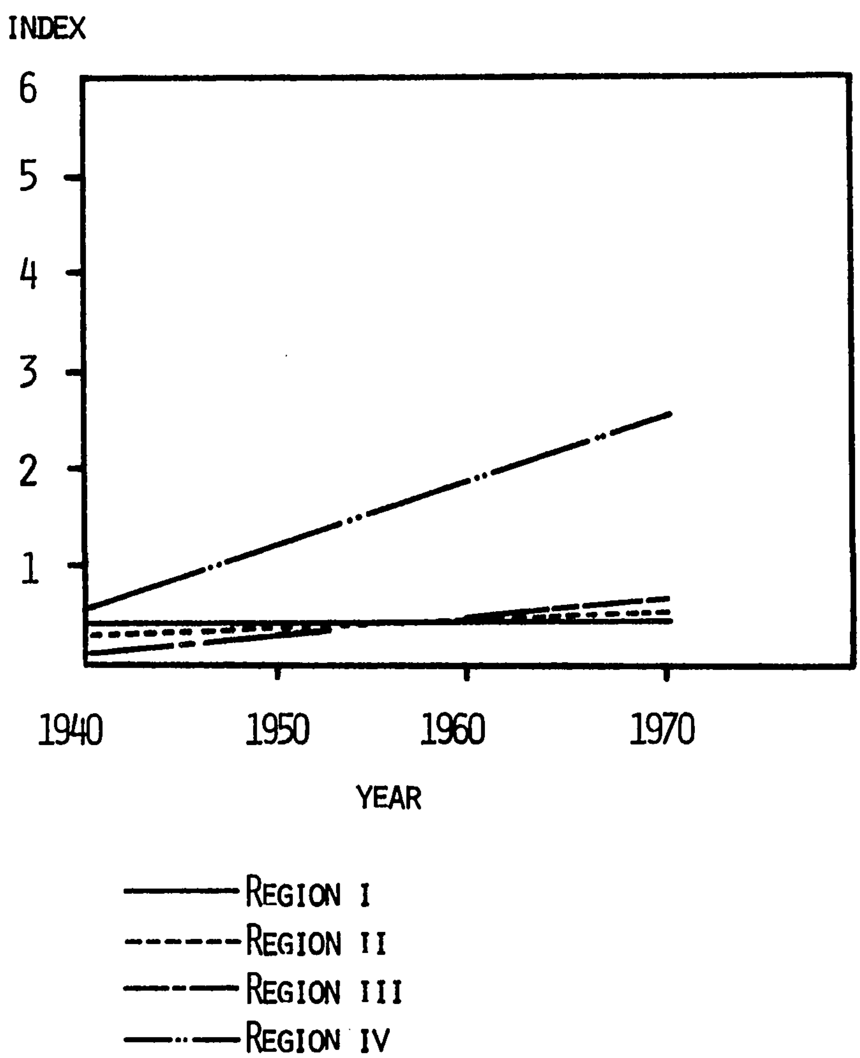
WILLIAMSON INEQUALITY INDICES
FOR HOUSING



SOURCE: AUTHOR'S COMPUTATIONS

FIGURE 35

WILLIAMSON INEQUALITY INDEX
TRENDS FOR HOUSING



SOURCE: AUTHOR'S COMPUTATIONS

Curve analysis. In 1940 and 1950, all of the regions experienced a rather similar low degree of inequality. The gap between the regional indices grew very wide by 1960. By 1970, the gap had closed, but Region IV still remained as the region with the greatest amount of inequality in housing. Except for the highest standard-of-living-region, every region has a higher inequality index in 1970 than it had in 1940.

The overall results of the analysis of regional inequalities in quality of housing have indicated a rather low degree of inequality for Regions I, II, and III over the time period. Region IV still stands-out as having the highest degree of regional inequality.

Regional Inequalities in Infant Mortality Rates: 1940-1970

In an earlier chapter, it was stated that health is a very important characteristic contributing to the status of a population's living standard. This section will analyze one aspect of a population's health, infant mortality rates for the study years from 1940 to 1970. This variable takes into account a county's birth rate as well as its infant mortality rate (deaths of infants under one year old). In order to avoid the problem of having the number of deaths reported inflated for counties with one or more large hospitals, the data were calculated per 1,000 live births by county of residence rather than by the county of occurrence.

Infant mortality is used as a surrogate for the general level of health of the population, and as a measure of access to medical care facilities. The Office of Economic Opportunity has used infant mortalities as one of the poverty indicators in its community profiles (Smith, 1973, p. 17).

Analysis of Variance

The analysis of variance was performed on the infant mortality data for each year; the results, shown in Table 25, indicate that there has been very little change in the disparities both among and within the standard-of-living regions.

TABLE 25

STATEWIDE INFANT MORTALITY ANALYSIS OF VARIANCE

Year	Variance Among Regions (V_b)	Variance Within Regions (V_w)	F-ratio
1940	1.13	.98	1.15
1950	.99	.99	1.00
1960	1.14	.98	1.15
1970	.37	1.01	.37

Source: Author's computations

The variance among regions decreases slightly from 1940 to 1950, increases slightly from 1950 to 1960, and decreases from 1960 to 1970. The overall trend is one of decreasing variance among regions. The decrease in variance among regions from 1960 to 1970 is the only substantial change for the study years. From 1940 to 1960, V_b was very low, i.e. the four regions were very much alike with regards to infant mortality rates. Between 1960 and 1970, the regions of the state became even more alike as indicated by the further decrease in V_b. During the 1960's improved public health service and preventive innoculation particularly benefited the poor. The decade of the 1960's was a prosperous one for Oklahoma when the state began to experience substantial industrial growth (Warner, 1973, p. 14). The level of the state's overall health is related to its economic progress, public health, level of education, and housing quality. In all of these areas, there has been generally statewide convergence in the past two decades.

The variance within regions shows an overall trend of remaining stable from 1940 to 1970. In 1950, V_w was equal to V_b. By 1970, V_w was almost three times greater than V_b. The overall trend for the F-ratio (Figure 36) is one of slight convergence from 1940 to 1970. Throughout the study period, the magnitude of the variance both among and within the regions has been small. The overall converging trend of the F-ratio is explained by decreasing variance among regions rather than an increasing variance within regions. A difference of means test indicated that the means of the regions were not significantly different at the .05α level.

Coefficient of Variation

Coefficients of variation for the entire state were calculated on the raw data for each of the years. The results of these calculations are shown in Table 26.

TABLE 26

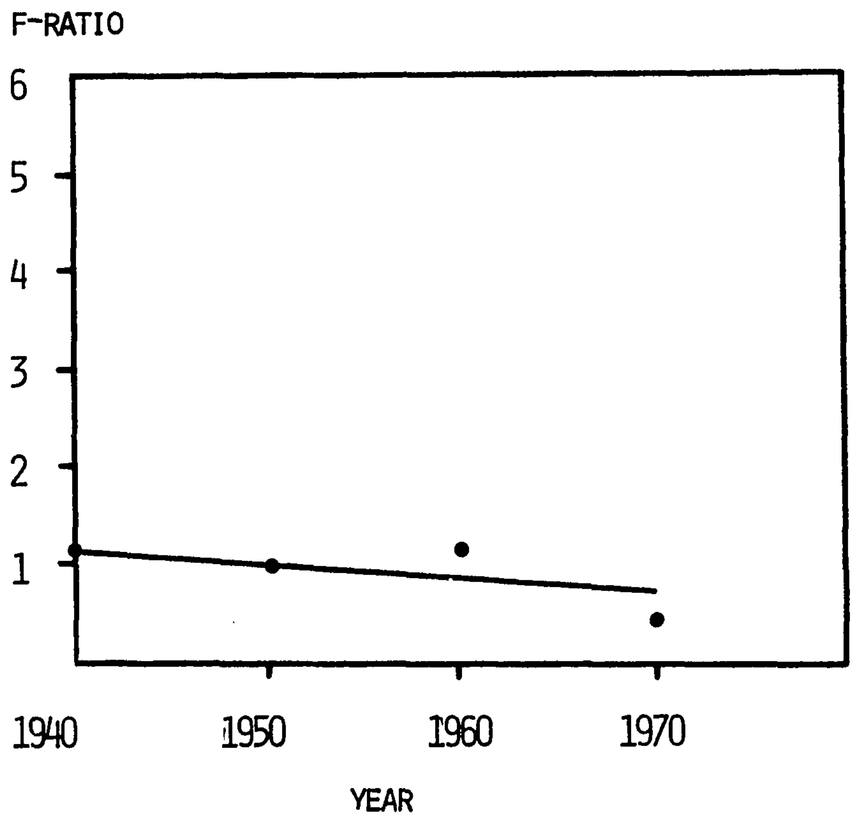
STATEWIDE COEFFICIENT OF VARIATION FOR INFANT MORTALITIES

Year	Coefficient
1940	.31
1950	.34
1960	.49
1970	.47

Source: Author's computations

FIGURE 36

INFANT MORTALITY F-RATIOS
FOR THE ENTIRE STATE



SOURCE: AUTHOR'S COMPUTATIONS

The coefficients were plotted, and the results shown on Figure 37 indicate that the coefficient of variation increases steadily from 1940 to 1960 with a slight decrease in 1970. It should be kept in mind that the moderate level of divergence between 1940 and 1960 as indicated by the coefficient of variation is based on the mean and standard deviation of the entire state. The mean and standard deviation for each year was calculated from the raw data. The coefficient is also not sensitive to the distinction between V_b and V_w that is made in an analysis of variance.

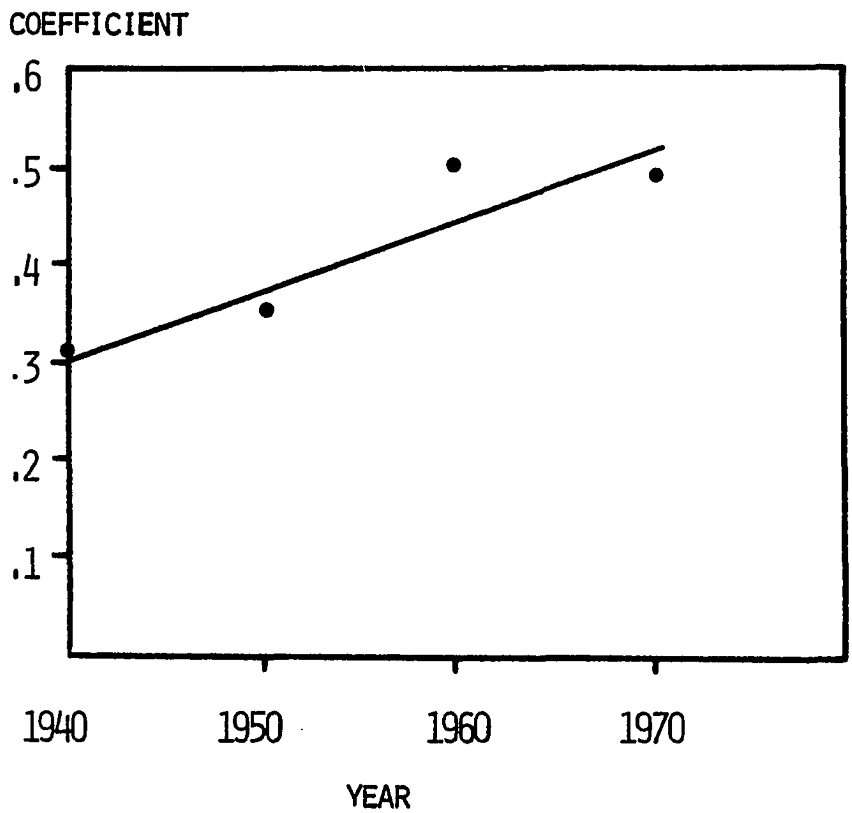
The results of the coefficient of variation suggest that between 1940 and 1960, the mean number of infant mortalities for the counties of Oklahoma decreased while the dispersion around the mean (standard deviation) remained stable. By 1970, the mean and standard deviation both increased slightly. This is a clear indication of divergence at the state level.

Lorenz Curve Analysis

The Lorenz Curve analysis was based on the total number of infant mortalities per county (Table 27). Lorenz Curves were calculated and plotted for each of the specified years (Figure 38). The summary of curves indicates that between 1940 and 1970, there has been a rather stable situation. The closeness of the curves to the 45 degree equality line indicates the near equal distribution of infant mortalities over the population. The variance indices (Table 27) are all very low; this also indicates the nearly equal distribution of infant mortalities.
In 1940 and 1950, the area under the Lorenz Curve remained at 82 per cent.

FIGURE 37

COEFFICIENT OF VARIATION
FOR INFANT MORTALITY



SOURCE: AUTHOR'S COMPUTATIONS

TABLE 27

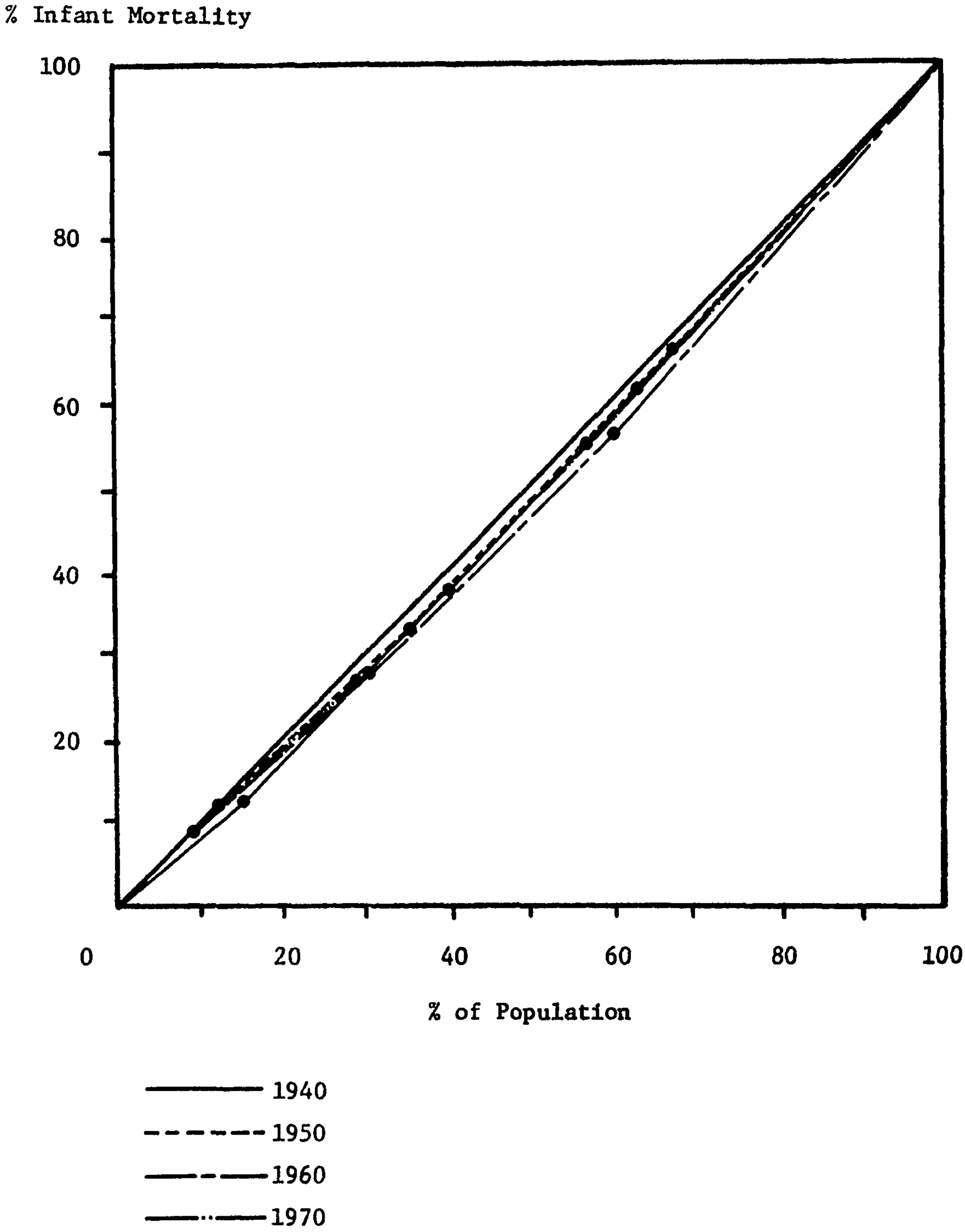
LORENZ CURVE DATA FOR INFANT MORTALITY

Region		Year			
		1940	1950	1960	1970
I	% population	23	32	40	43
	% infant mortality	24	33	44	45
	rank	3	3	4	4
	variance index	1	1	3	1
II	% population	25	23	21	20
	% infant mortality	21	21	19	18
	rank	2	2	2	2
	variance index	-6	-3	-4	-4
III	% population	37	33	30	28
	% infant mortality	38	34	28	28
	rank	4	4	3	3
	variance index	0	2	-2	0
IV	% population	15	12	9	9
	% infant mortality	17	12	9	9
	rank	1	1	1	1
	variance index	4	0	0	0
Area under curve		82%	82%	81%	82%

Source: Author's computations

FIGURE 38

LORENZ CURVES FOR INFANT MORTALITY



Source: Author's computations

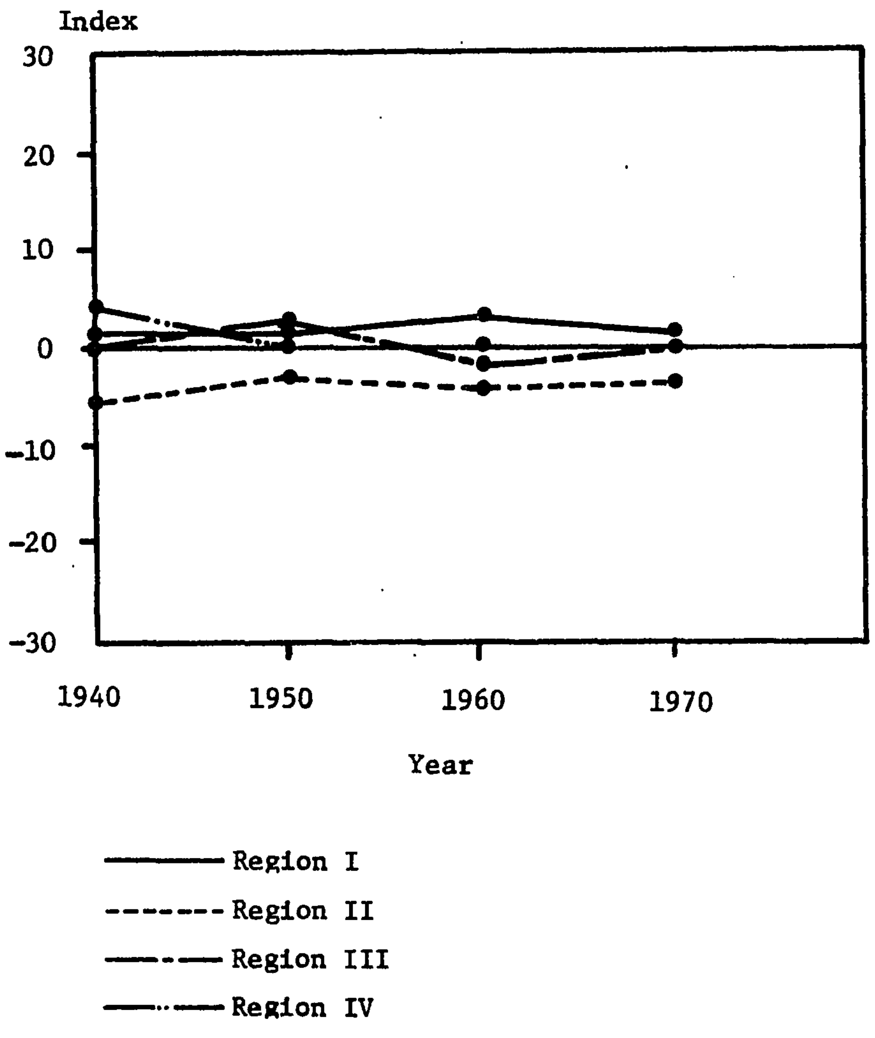
The Lorenz Variance Index is shown in Figure 39. The trend is for the regions to converge on the zero equality line between 1940 and 1950, and then to maintain a rather stable position to 1970. In 1940, Region IV had the highest positive index with a 4.0. Unlike the previously analyzed variables, this variable is a negative one, i.e. a high infant mortality rate is undesirable. For this reason, Region IV has a 4.0 index for 1940 when it had 15 per cent of the state's population and 17 per cent of the state's infant mortalities. By 1950, Region IV reached an equal distribution situation (zero index) which it maintained to 1970. Region II shows-up on Figure 36 as the region with the highest negative index between 1940 and 1970, i.e. this region consistently has a lower share of the state's infant mortalities than it has of the state's population. Region III started with a zero index in 1940, went to a 2.0 in 1950, a -2.0 in 1960, and back to zero in 1970. Region I has consistently had a positive index. By 1960, Region I had the highest positive index. The poor showing of Region I on this health indicator seems to be directly related to the degree of urbanization in these counties. Distress areas of cities can display very poor health conditions. The magnitude of these urban pathologies can easily overshadow those in distress areas of rural regions, but are masked by per capita statistics.

<u>Williamson Inequality Index</u>

Williamson Inequality Indices were calculated for each region on each year with the results shown in Table 28.

FIGURE 39

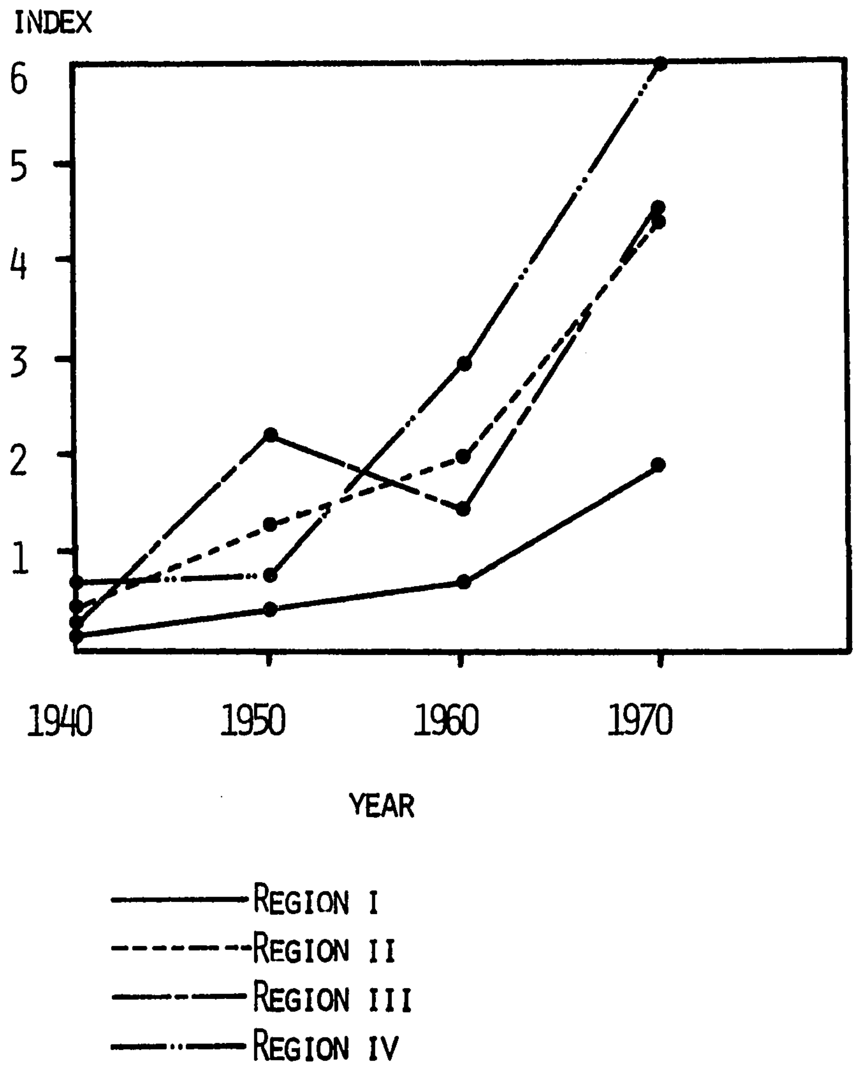
LORENZ VARIANCE INDEX
FOR INFANT MORTALITY



Source: Author's computations

FIGURE 40

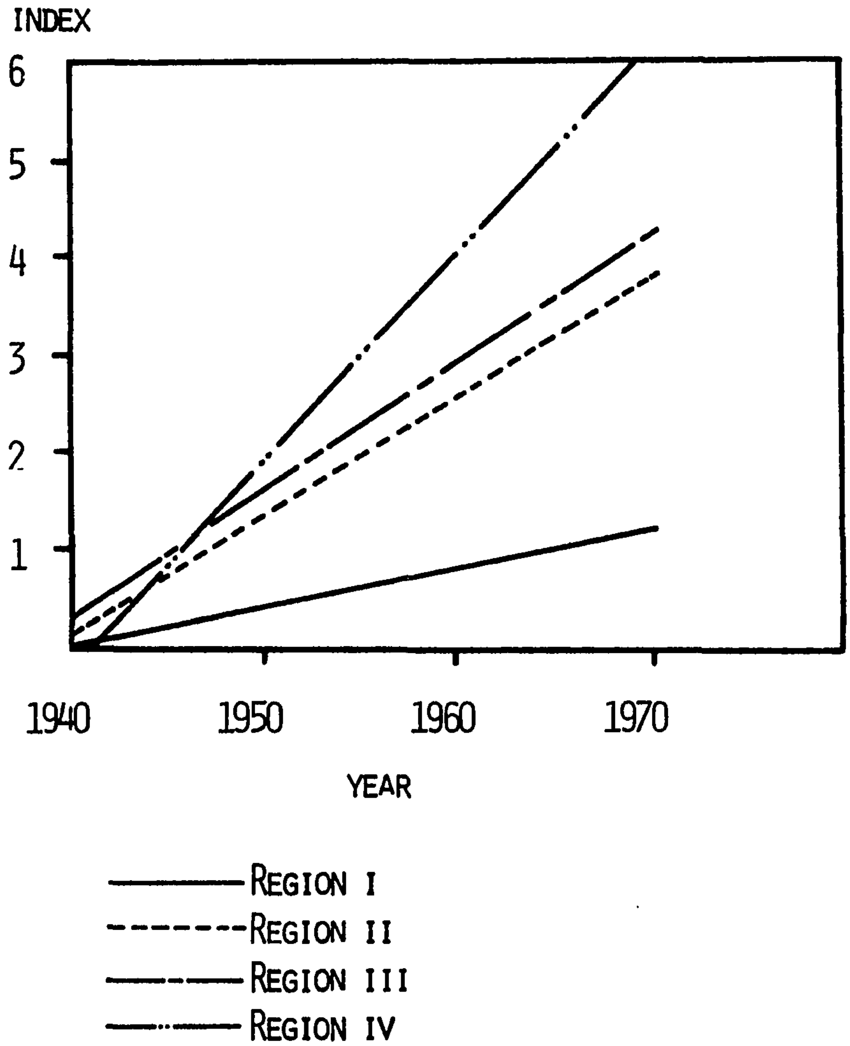
WILLIAMSON INEQUALITY INDICES
FOR INFANT MORTALITY



SOURCE: AUTHOR'S COMPUTATIONS

FIGURE 41

WILLIAMSON INEQUALITY INDEX
TRENDS FOR INFANT MORTALITY



SOURCE: AUTHOR'S COMPUTATIONS

TABLE 28

WILLIAMSON INEQUALITY INDICES FOR INFANT MORTALITY

Region	Year			
	1940	1950	1960	1970
I	.23	.40	.72	1.96
II	.41	1.34	2.02	4.41
III	.27	2.19	1.24	4.49
IV	.64	.67	2.96	5.83

Source: Author's computations

The indices were plotted and are shown in Figure 40; trend lines for each region are shown in Figure 41. The overall trend for every region is one of divergence. The trend line for Region IV has the greatest diverging slope, followed by Regions III, II, and I respectively. In 1940, all of the regions had very similar inequality indices. By 1970, every region had diverged, and there were greater differences between the indices of the regions than there had been in 1940. In 1970, there were greater inequalities in the infant mortality variable than there had been in all previous years. The resultant divergence trends shown by the Williamson Inequality Indices are in agreement with similar trends found in the coefficient of variation and the Lorenz Variance Index.

The Williamson Inequality Indices indicate increasing disparities among the counties within each region. This does not mean that health conditions as indicated by infant mortality rates are becoming worse. The diverging indices should be interpreted only in terms of the degree of disparity among the counties of each region. Indeed, the findings described previously in this section indicate an improvement in health conditions.

Although infant mortality rates were higher in 1940 than in 1970, the degrees of disparity among the counties of each region were small (Figure 40). By 1970, infant mortality rates were lower; but disparities were greater. The growth in disparities from 1940 to 1970 is an indication of urban and rural differences. During this period in Oklahoma, urbanization proceeded; by 1960, Oklahoma had 60.94 per cent of its population residing in urban areas (Adams, 1971, p. 21). The trends in disparities in infant mortalities were greatly affected by the growing urban-rural differences within the standard-of-living regions. It should be kept in mind that the findings of all of the approaches in this section point to the fact that there have not been great differences in infant mortality rates between 1940 and 1970 among the regions.

Regional Inequalities in Divorce Rates: 1950-1970

Community cohesion and family stability are important aspects of the standard-of-living of a population. A high standard-of-living and a high degree of economic growth do not necessarily mean that a population will be more content. It is rather difficult to measure intangible emotions such as satisfaction and happiness. In this section, an attempt is made to analyze family stability as a manifestation of personal satisfaction. The data will be the annual number of divorces and annullments per 1,000 marriages by county of residence for the years 1950, 1960, and 1970 as these vital statistics were not regularly reported to the federal government in earlier years. Although some states did maintain a central filing system on the number of divorces and marriages prior to 1950, Oklahoma did not.

Analysis of Variance

The analysis of variance was performed for the years 1950, 1960, and 1970, with the results shown in Table 29. The variance among regions steadily decreases from 1950 to 1970; the greatest decrease occurring during the 1950 to 1960 period. Variance within regions also decreased steadily from 1950 to 1970. The overall trends of V_b and V_w suggest that for divorce rates: (1) the standard-of-living

TABLE 29

DIVORCE ANALYSIS OF VARIANCE

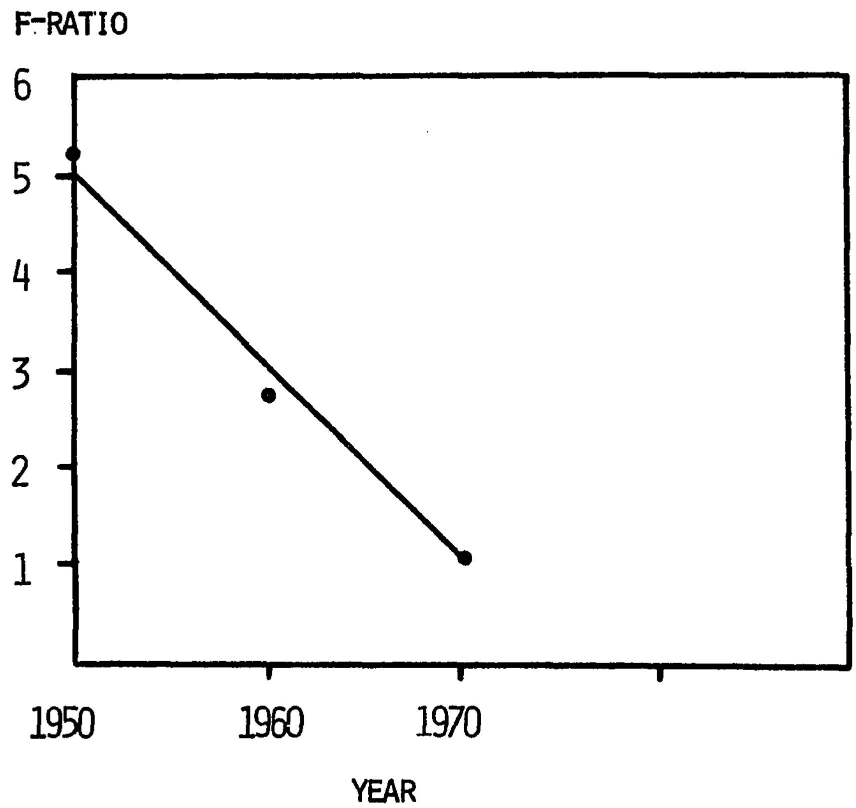
Year	Variance Among Regions (V_b)	Variance Within Regions (V_w)	F-ratio
1950	4.37	.83	5.21
1960	1.02	.37	2.69
1970	.06	.05	1.10

Source: Author's computations

regions of Oklahoma are becoming more alike, (2) the regions are becoming more internally homogeneous. The lessening of differences both within and among the regions is reflected in the steadily decreasing F-ratio (Figure 42). An F-test of the 1950 F-ratio indicates that the means of the regions were significantly different at the .05α level. In 1960, the means of the regions were near equal, i.e. the calculated F was 2.69 and the F-table value was 2.69. By 1970, the F-test indicated that the means of the regions were not significantly different at the .05α level.

FIGURE 42

DIVORCE F-RATIOS
FOR THE ENTIRE STATE



SOURCE: AUTHOR'S COMPUTATIONS

Coefficient of Variation

The coefficient of variation for each year was calculated from the raw data (Table 30). The coefficient decreases greatly from 1950 to 1960. In 1950, the large degree of dispersion is indicated by a coefficient of 1.21; the standard deviation of 793.7 was larger than the mean of 653.5. The magnitude of the 1950-1960 decrease of the

TABLE 30

STATEWIDE COEFFICIENT OF VARIATION FOR DIVORCE

Year	Coefficient
1950	1.21
1960	.52
1970	.50

Source: Author's computations

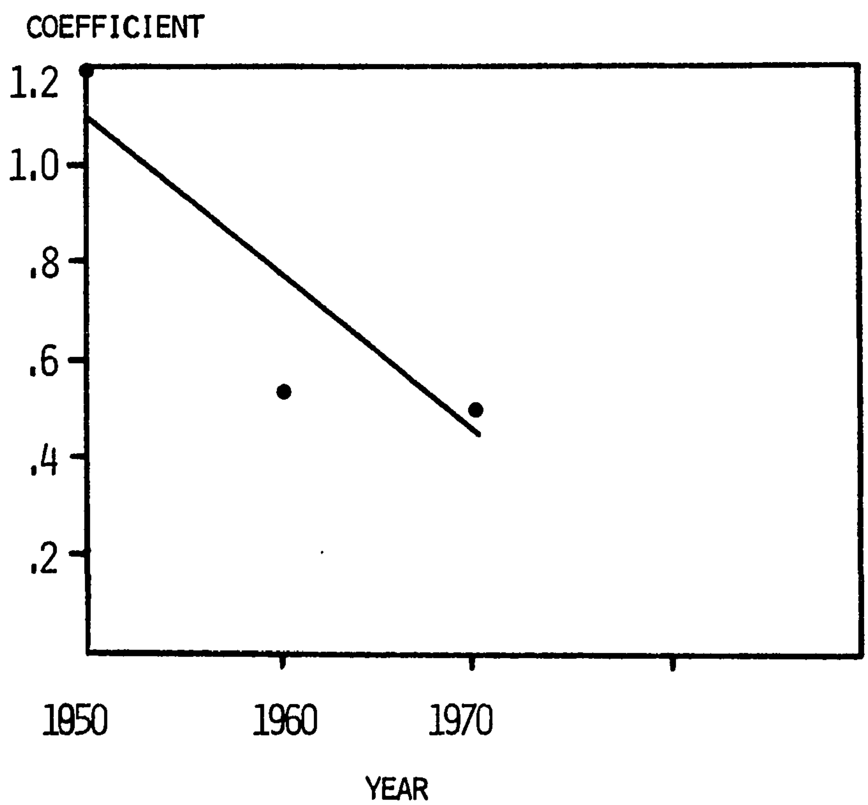
coefficient agrees with the decrease found for V_b and V_w in the analysis of variance. From 1960 to 1970, the coefficient decreased slightly. The overall trend for divorce rates in Oklahoma since 1950 has been one of convergence (Figure 43).

Lorenz Curve Analysis

The Lorenz Curve analysis was based on the total number of divorces and annullments per county (Table 31). Lorenz Curves were calculated for 1950, 1960, and 1970 and are shown in Figure 44. From 1950 to 1960, the curve converged slightly with the equality line, The curve remained rather stable from 1960 to 1970. These situations are reflected by the area under the curve for each year (Table 31): 80 per cent in 1950, 82 per cent in 1960, and 82 per cent in 1970.

FIGURE 43

COEFFICIENT OF VARIATION FOR DIVORCE



SOURCE: AUTHOR'S COMPUTATIONS

TABLE 31

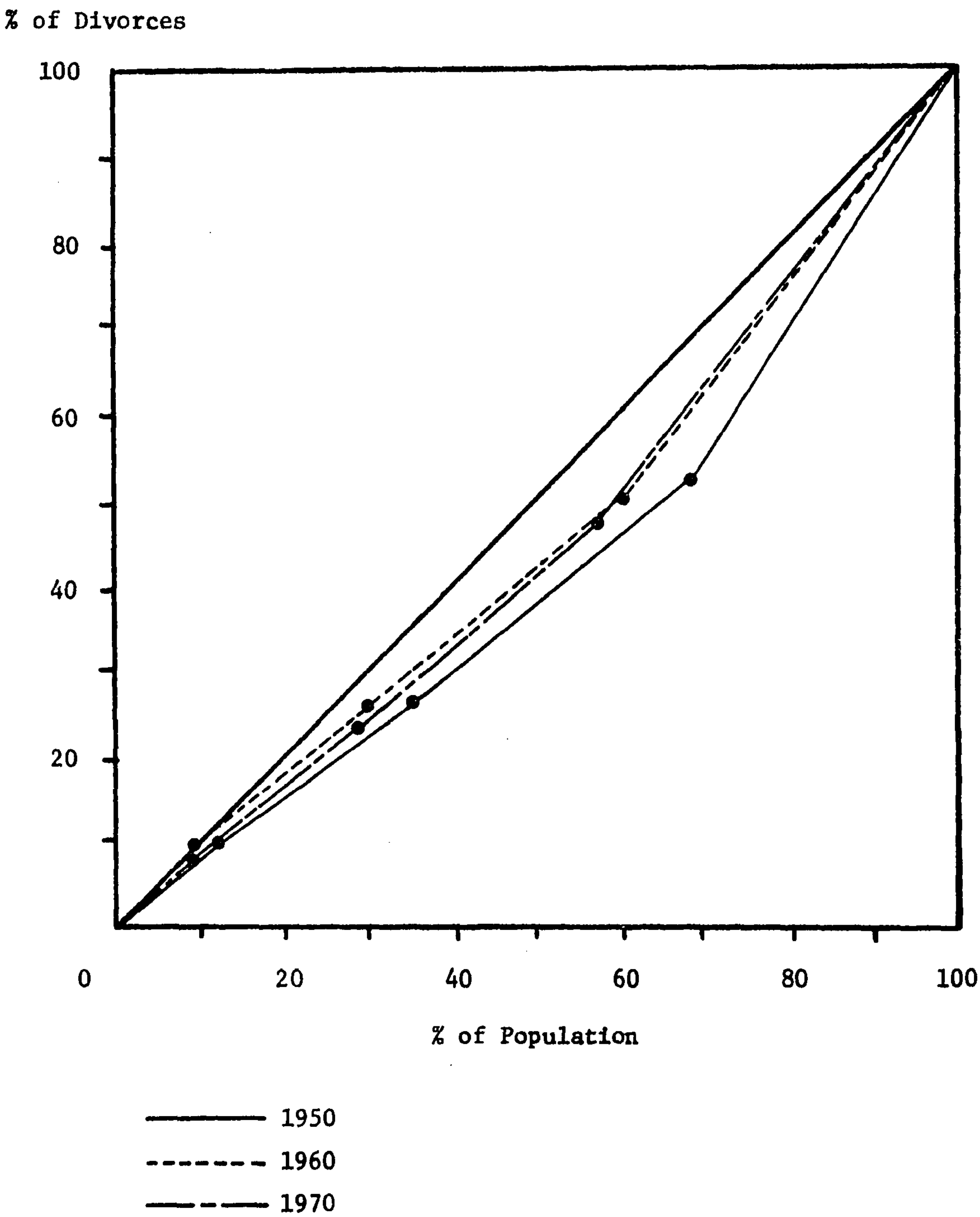
LORENZ CURVE DATA FOR DIVORCE

Region		Year		
		1950	1960	1970
I	% population	32	40	43
	% divorces	48	50	53
	rank	4	4	4
	variance index	11	6	6
II	% population	23	21	20
	% divorces	16	17	15
	rank	2	2	2
	variance index	-10	-6	-8
III	% population	33	30	28
	% divorces	26	24	24
	rank	3	3	3
	variance index	-7	-6	-5
IV	% population	12	9	9
	% divorces	10	9	8
	rank	1	1	1
	variance index	-6	0	-4
Area under curve		80%	82%	82%

Source: Author's computations

FIGURE 44

LORENZ CURVES FOR DIVORCE



Source: Author's computations

The Lorenz Variance Index (Table 31) was plotted for each region on each year (Figure 45). The regions were greatly different in 1950. Region I consistently had the highest positive index from 1950 to 1970. Since this index is a negative one, i.e. a positive score is a more unfavorable score for a region than a negative score since it indicates a higher percentage of the total number of divorces in the state. Region I shows-up very unfavorably on the divorce variable. The region with the second highest incidence of divorces is Region IV. From 1950 to 1960, all of the regions converged on the zero equality index. From 1960 to 1970, Region I remained stable; Regions II and IV had increasing negative indices; and Region III had a decreasing negative index.

Williamson Inequality Index

The Williamson Inequality Indices for divorce were calculated for each year with the results shown in Table 32.

TABLE 32

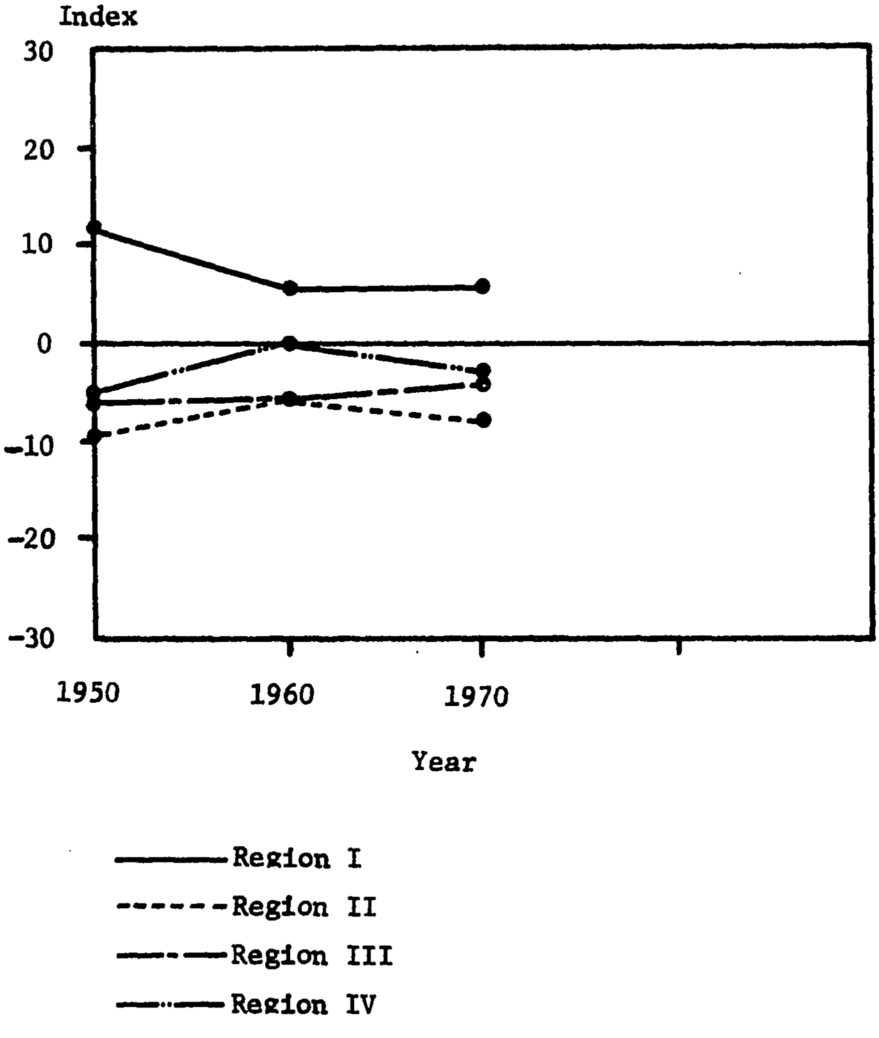
WILLIAMSON INEQUALITY INDICES FOR DIVORCE

Region	Year		
	1950	1960	1970
I	.59	.65	.49
II	1.07	1.22	.96
III	1.20	1.65	1.89
IV	.80	2.71	2.21

Source: Author's computations

FIGURE 45

LORENZ VARIANCE INDEX
FOR DIVORCE



Source: Author's computations

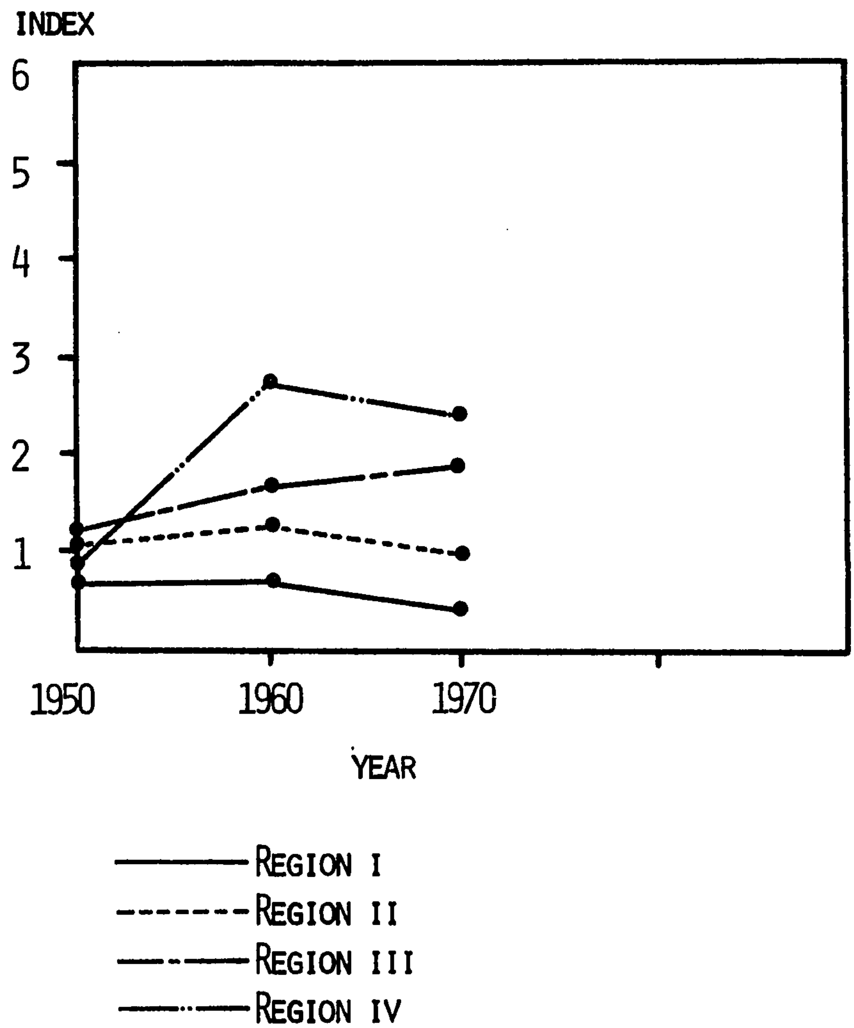
The actual indices were plotted (Figure 46). Trend lines for each region are shown in Figure 47. Region I has experienced the lowest degree of inequality from 1950 to 1970. The trend for Region I has been one of slight convergence. Region II has followed a pattern of convergence very similar to that of Region I, but the inequality for Region II has been greater on each year. The trend of the index for Region III has been one of increasing divergence from 1950 to 1970. Region IV has a smaller inequality index than Regions II and III in 1950. By 1960, Region IV had the highest degree of regional inequality in divorce. The overall trend for Region IV has been one of divergence.

The results from the various inequality measures of divorce rates are somewhat inconclusive due to the lack of data prior to 1950, but several trends have been exposed. The analysis of variance, Coefficient of Variation, Lorenz Curves, and Lorenz Variance Index all indicate that in 1950 the differences among the regions was greatest. Between 1950 and 1960, the total statewide degree of disparity decreased substantially and it stabilized between 1960 and 1970. The statewide mean number of divorces per 1,000 marriages decreased greatly from 653.50 in 1950 to 377.33 in 1960. By 1970 the mean had decreased slightly to 355.67.

In 1950, the mean number of divorces in Region I was slightly below that of the state. In 1960 and 1970, the mean for Region I greatly exceeded the state mean. Although the statewide mean number of divorces decreased between 1950 and 1970, the mean of the fast growing urbanized

FIGURE 46

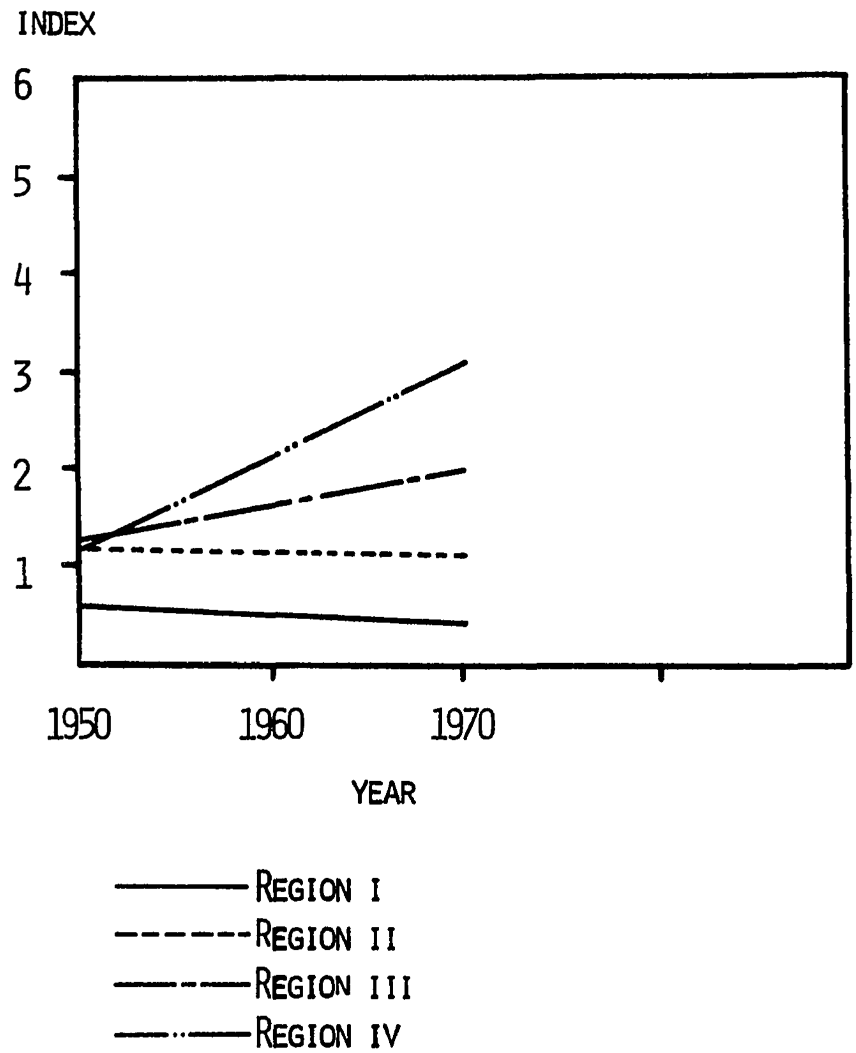
WILLIAMSON INEQUALITY INDICES
FOR DIVORCE



SOURCE: AUTHOR'S COMPUTATIONS

FIGURE 47

WILLIAMSON INEQUALITY INDEX
TRENDS FOR DIVORCE



SOURCE: AUTHOR'S COMPUTATIONS

region increased. The mean number of divorces in Regions II and III were below the state mean between 1950 and 1970. The counties of Region IV had the highest mean number of divorces in 1950. By 1960, Region IV still had a higher mean than that of the rest of the state, but lower than that of Region I. By 1970, Region IV had the lowest mean of all of the regions.

These figures reveal that it was the region with the greatest influx of people (Region I) and the region with the greatest outmigration (Region IV) that experienced the highest incidences of divorces between 1950 and 1960. Regions II and III experienced less turmoil and disorders during this period.

Regional Inequalities in Net Migration: 1930-1970

The phenomenon of human migration is very clearly associated with regional disparities in standards-of-living, degrees of satisfaction, level of development of the transportation infrastructure, etc.

Between 1930 and 1970, Oklahoma as a state was consistently an exporter of people. From 1965 to 1970, the state experienced a net in-migration total of 4,164 persons (Hadley, 1973, p. 14-15). This change suggests growth in population as well as in economic opportunities. Most long-distance analyses of migration conclude that the move is economically motivated and towards areas of greater economic opportunity. Regional net in-migration has been equated with economic growth (Bohland, 1974, p. 8).

This section will analyze the percentage change in net migration for the ten-year periods: 1930-1940, 1940-1950, 1950-1960, and 1960-1970.

All of the variables analyzed to this point have been level variables, i.e. variables measured at fixed points in time. This variable differs in that it measures change through time. The percentage change in net migration will be calculated by a residual method (Henderson, 1964, p. 174):

$$M_{i,1,2} = (P_{i,2} - P_{i,1}) - (B_{i,1,2} - D_{i,1,2})$$

$M_{i,1,2}$ = net migration for county i between years 1 and 2

$P_{i,2}$ = population of county i at year 2

$P_{i,1}$ = population of county i at year 1

$B_{i,1,2}$ = total number of births in county i between years 1 and 2 by county of residence

$D_{i,1,2}$ = total number of deaths in county i between years 1 and 2 by county of residence

$$PC_{i,1,2} = \frac{M_{i,1,2}}{P_{i,1}}$$

$PC_{i,1,2}$ = percent change in county i between years 1 and 2

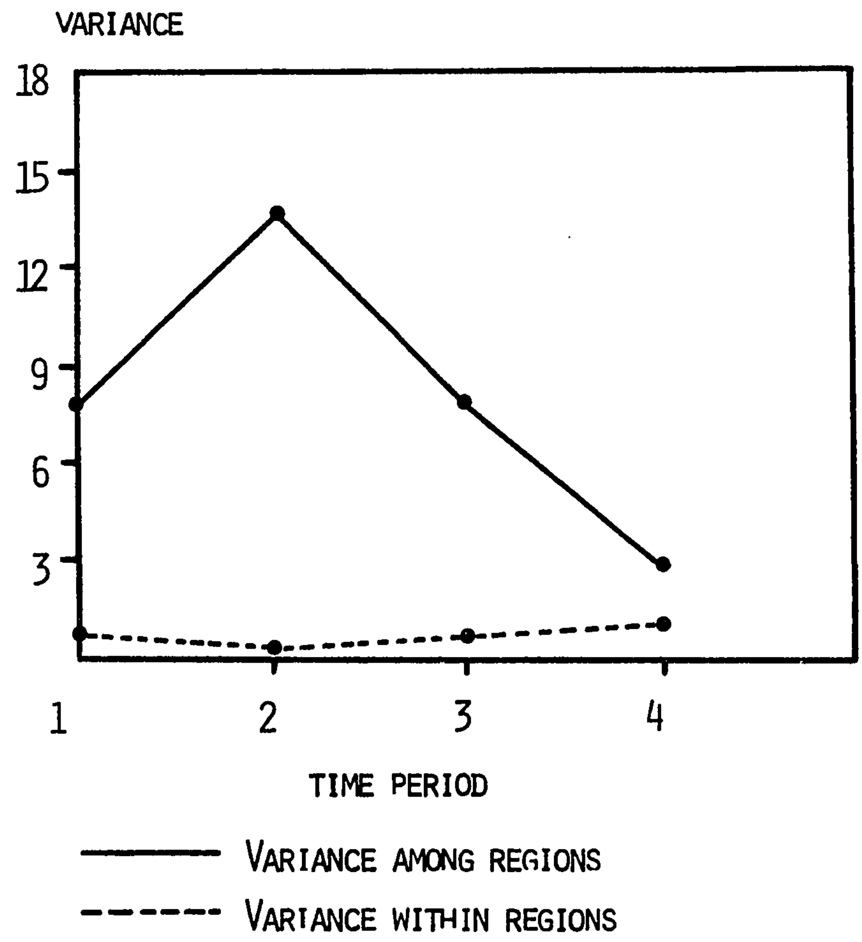
Analysis of Variance

The analysis of variance was performed on the percentage change net migration data with the results shown in Table 33.

Variance among regions increases between period 1 and period 2 but after period 2 there is a steady decline. Variance within Regions decreases between period 1 and period 2 but from period 2 to period 4, there is a steady increase (Figure 48). Clearly, during Oklahoma's greatest period of out-migration (period 1), V_b increased while V_w decreased. From period 2 to period 4, the disparity within regions increased while the disparity between regions decreased.

FIGURE 48

VARIANCE AMONG AND WITHIN REGIONS
FOR NET MIGRATION



SOURCE: AUTHOR'S COMPUTATIONS

TABLE 33

STATEWIDE MIGRATION ANALYSIS OF VARIANCE

Period	Years	Variance Among Regions (V_b)	Variance Within Regions (V_w)	F-ratio
1	1930-40	7.71	.86	8.95
2	1940-50	13.79	.60	22.98
3	1950-60	8.22	.78	10.54
4	1960-70	3.14	.95	3.27

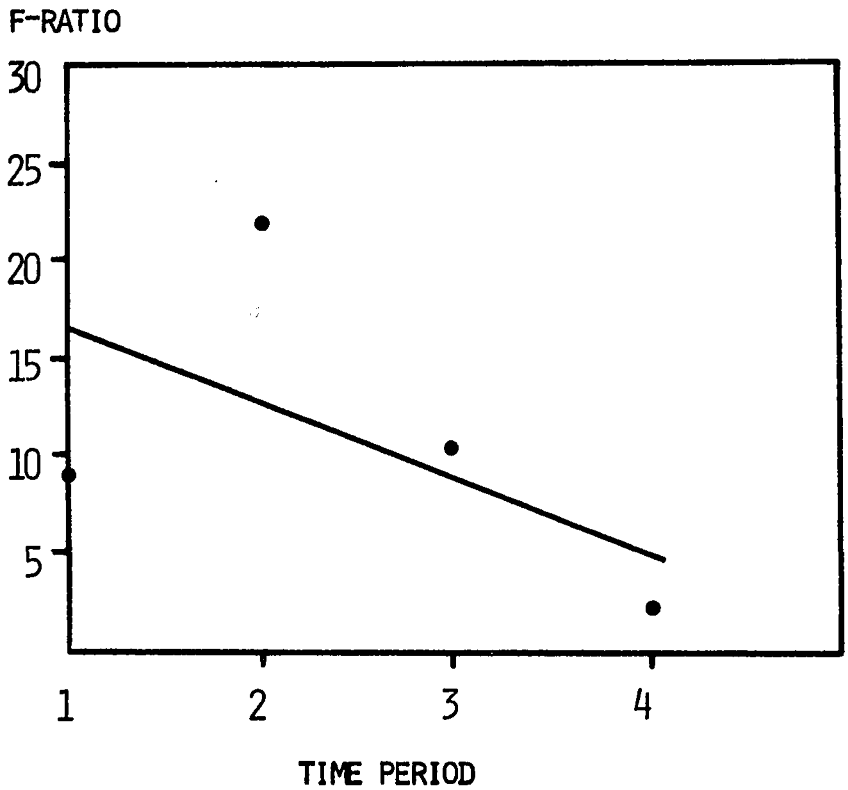
Source: Author's computations

From period 1 to period 2, the urbanized areas of Region I experienced a net in-migration. During these same period, Region IV experienced the state's highest percentage in out-migration. These periods include the years between 1930 and 1950 when there were large movements of Oklahomans from rural to urban areas and to other states. During these periods variance among regions increased as the regions differed more in the net migration characteristics (Table 35). Between 1950 and 1970, Region I continued to experience in-migration but at a decreasing rate; Regions II, III, and IV continued to experience out-migration but at decreasing rates. The mass movements of the 1930's and 1940's had subsided. As Oklahoma experienced economic growth during the 1950's and especially during the 1960's, the migration into the expanding growth centers of Region I continued but at a slower pace.

The changes in V_b and V_w are reflected in the F-ratio (Figure 49). The F-ratio increased from period 1 to period 2. From period 2 to period 4, the F-ratio declined. The overall trend of the F-ratio has been one of convergence. This convergence should only be viewed in light of the concomitant changes in V_b and V_w.

FIGURE 49

MIGRATION F-RATIOS
FOR THE ENTIRE STATE



SOURCE: AUTHOR'S COMPUTATIONS

<u>Coefficient of Variation</u>

The coefficient of variation was calculated for each of the time periods (Table 34).

TABLE 34

STATEWIDE COEFFICIENT OF VARIATION FOR MIGRATION

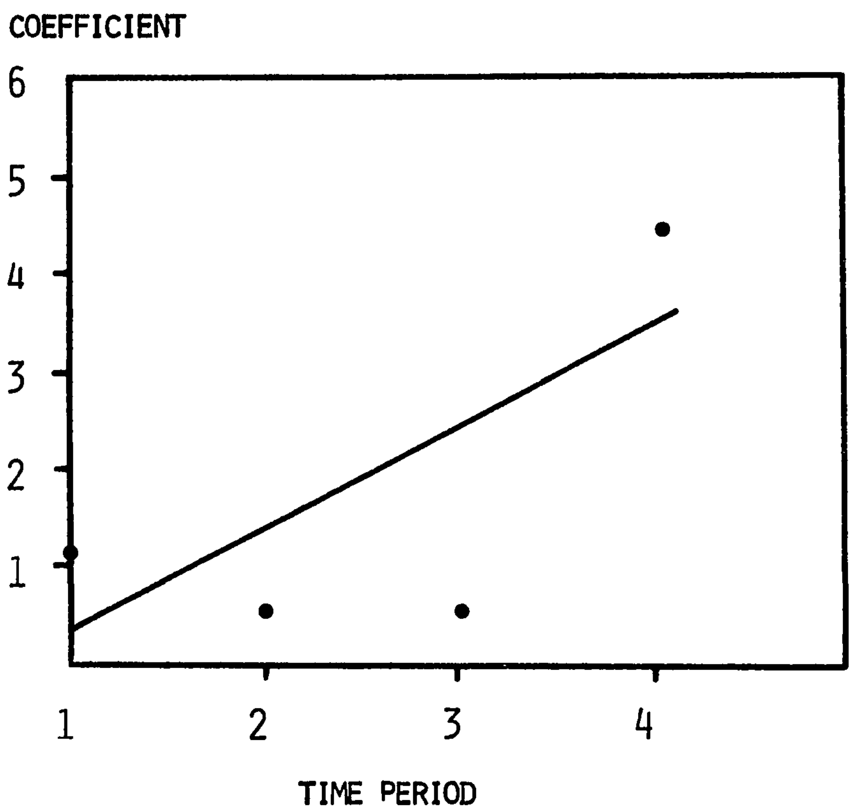
Time Period	Coefficient
1	1.13
2	.68
3	.67
4	4.25

Source: Author's computations

The trend of the coefficient shown on Figure 50 is quite understandable. From period 1 to period 3, the trend in the coefficient is one of decline (convergence). The changing trend to divergence that occurred during period 4 agrees with the change in migration patterns found by Hadley (1973). Hadley found that prior to the last census period, Oklahoma had consistently been an exporter of population. However, from 1965 to 1970 the state had a net in-migration total of 4,164 persons. During period 4, Oklahoma experienced a net in-migration. At the beginning of period 4 (1960), Oklahoma first counted more people living in urban areas than in rural areas. Although the pattern changed to one of net in-migration during period 4, the mean (Table 35) for all of the counties for that period still remained negative, i.e. there was net out-migration. From period 1 to period 2, the net migration mean increased negatively. From period 2 to period 4, the mean decreased in the positive direction to a low negative value of -.03.

FIGURE 50

COEFFICIENT OF VARIATION
FOR MIGRATION



SOURCE: AUTHOR'S COMPUTATIONS

TABLE 35

MIGRATION MEANS AND STANDARD DEVIATIONS

Period	Mean	Standard Deviation
1	-.13	.15
2	-.24	.16
3	-.20	.13
4	-.03	.17

Source: Author's computations

Migration Trends

In place of a Lorenz Curve analysis, a trend analysis was performed on the migration variable by region.[1] Percentage change in net migration data for the regions are shown in Table 36.

TABLE 36

REGIONAL PERCENTAGE CHANGES IN NET MIGRATION

Region	Period			
	1	2	3	4
I	.01	.13	.08	.04
II	-.18	-.20	-.11	-.03
III	-.17	-.26	-.28	-.06
IV	-.02	-.37	-.28	-.06

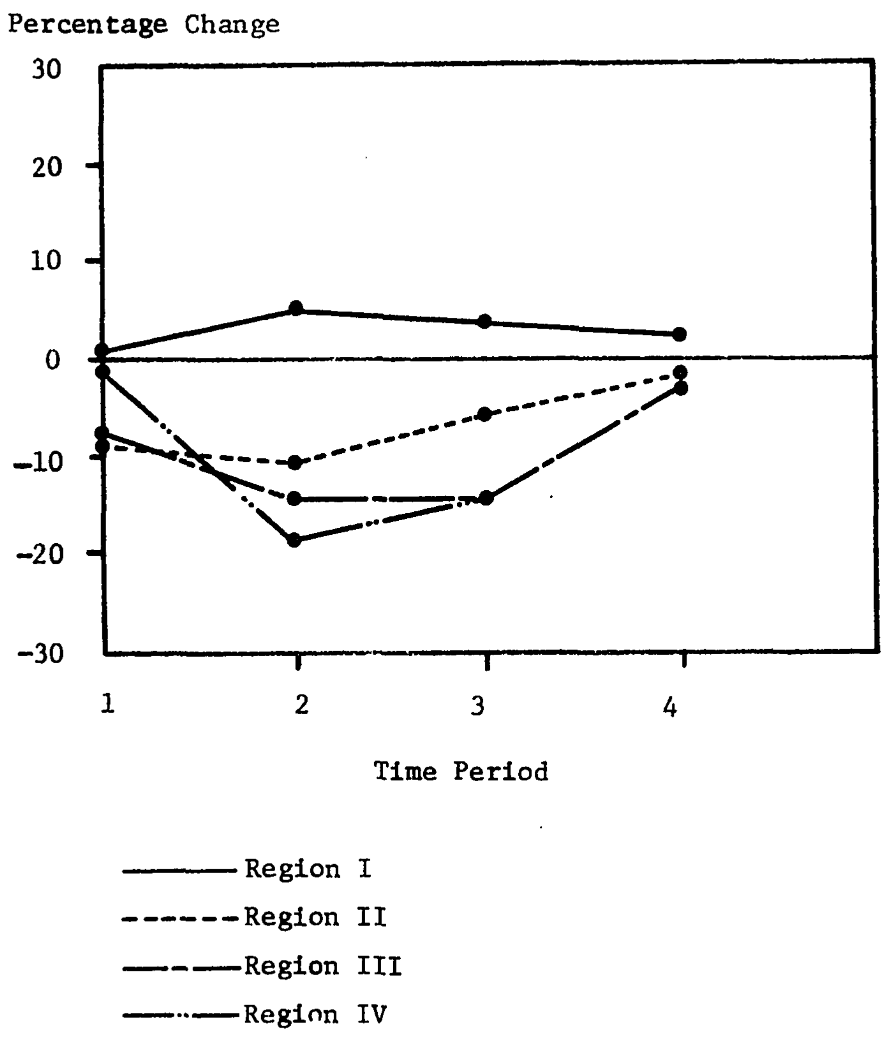
Source: Author's computations

The actual regional data were plotted and are shown on Figure 51. Figure 52 shows trend lines for the regions. Region I has experienced a consistent in-migration through all four time periods; the overall

[1]See Appendix E for regional migration data.

FIGURE 51

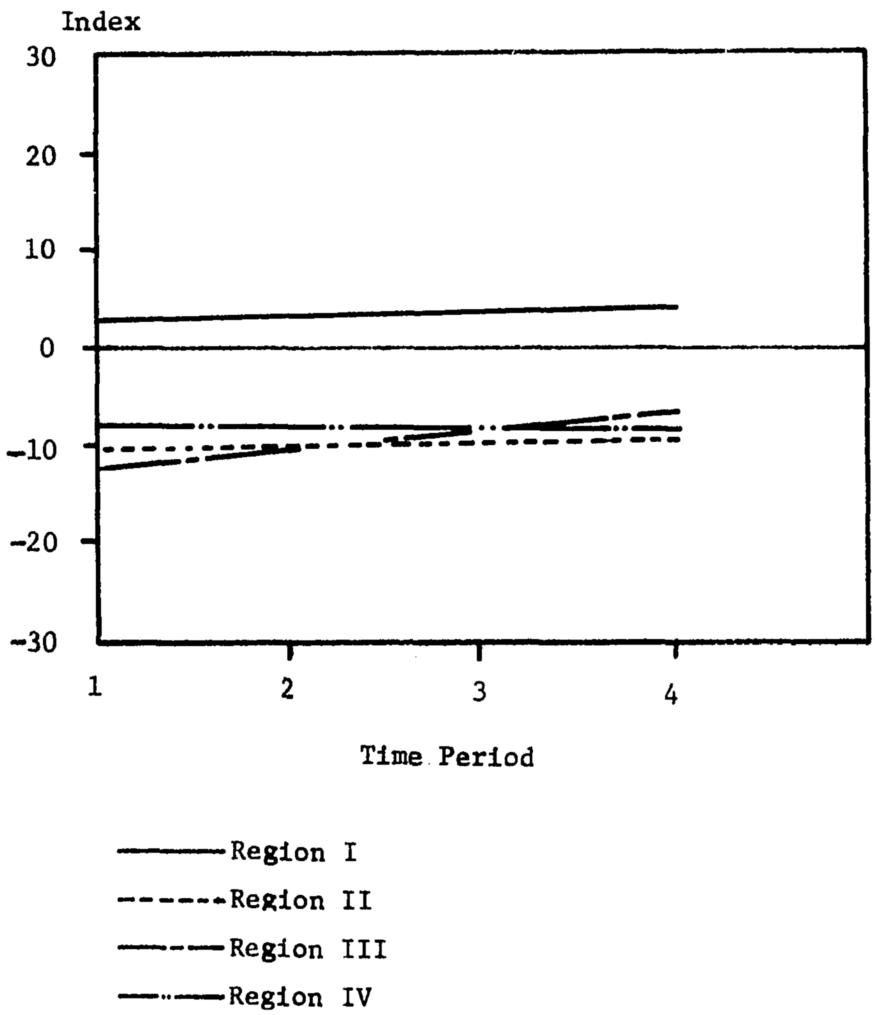
PERCENTAGE CHANGE IN NET MIGRATION



Source: Author's computations

FIGURE 52

PERCENTAGE CHANGE IN NET MIGRATION TRENDS



Source: Author's computations

trend is one of slight increase. Region II has consistently experienced net out-migration. From period 1 to period 3, the trend for Region III was one of an increase in out-migration. From period 3 to period 4, Region III has moved in the positive direction. Region IV had a very low degree of net out-migration in period 1. From period 1 to period 2, Region IV experienced a greater percentage change in net out-migration than any other region of the state. Although the overall trend line for region IV shows an increase in out-migration, the actual plot shows that this region has steadily moved in the positive direction during time periods 3 and 4.

Figure 51 shows that the regions were ranged farthest apart in percentage change of net migration in period 2. In period 4, the ranges have converged on the zero line. The overall trend for the state has been one of turmoil in periods 1 and 2, followed by stabilization in periods 3 and 4.

Williamson Inequality Index

Williamson Inequality Indices for each region during each time period were calculated and are shown in Table 37.

TABLE 37

WILLIAMSON INEQUALITY INDICES FOR MIGRATION

Region	Time Periods			
	1	2	3	4
I	3.09	6.39	.47	2.87
II	2.60	.89	.43	1.18
III	1.23	.88	.02	.91
IV	19.28	53.85	28.23	4.93

Source: Author's computations

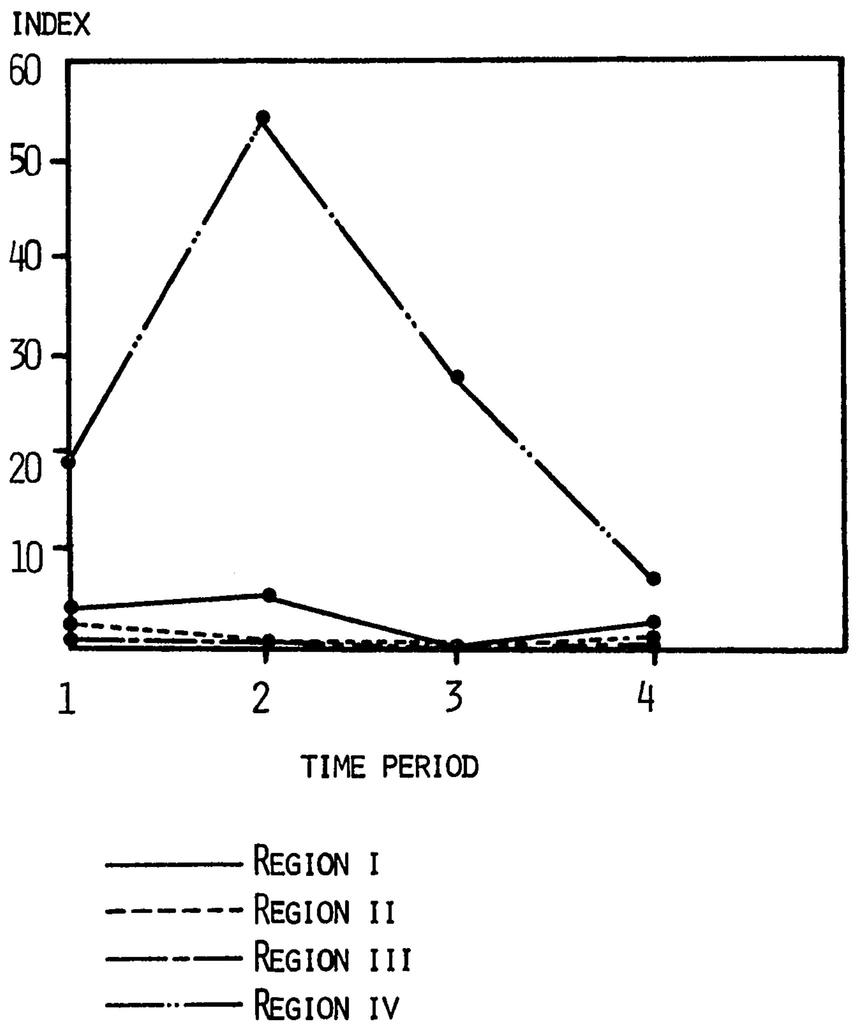
The indices were plotted and are shown in Figure 53. Figure 54 shows trend lines for each region over the time periods. Region I shows divergence from period 1 to period 2. From period 2 to period 3, convergence occurs, followed by divergence from period 3 to period 4. The overall trend for Region I is one of stabilization to slight convergence, i.e. inequality in net migration among the counties of Region I have a slightly declining trend. Both Regions II and III have experienced very similar stable trends from period 1 to period 4. The inequality indices for Region II and III were less than the index for Region I during each time period. The greater degree of inequality among the counties of Region I is due to the much higher degree of in-migration into just two of the counties of the region: Oklahoma and Tulsa Counties. Although all of the counties of Region I had in-migration, the number of people entering the Oklahoma City and Tulsa metropolitan areas far exceeded migration into Garfield, Washington, or Cleveland Counties.

Region IV experienced great divergence from period 1 to period 2. From period 2 to period 4, Region IV experienced convergence; but the degree of inequality among the counties of Region IV has remained higher than that of all of the other regions during every time period.

The Williamson Inequality Index trends shown on Figure 53 are in close agreement with the percentage change net migration data for the regions shown in Figure 51, i.e. an increasing range of inequalities between regions from period 1 to period 2, followed by a settling down and stabilization from period 2 to period 4.

FIGURE 53

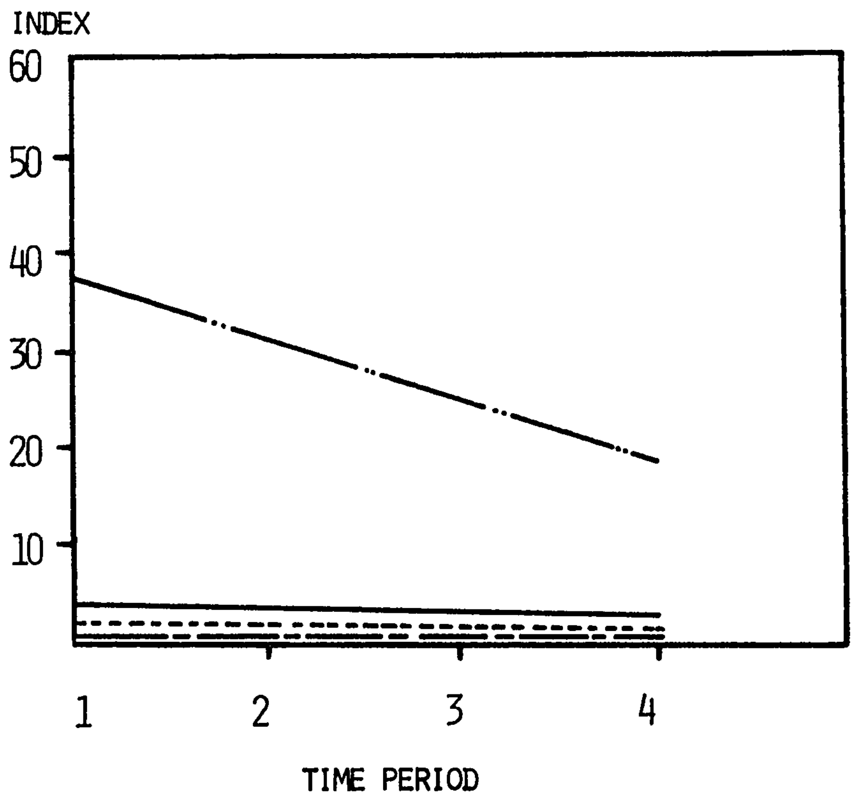
WILLIAMSON INEQUALITY INDICES
FOR MIGRATION



SOURCE: AUTHOR'S COMPUTATIONS

FIGURE 54

WILLIAMSON INEQUALITY INDEX
TRENDS FOR MIGRATION



REGION I
REGION II
REGION III
REGION IV

SOURCE: AUTHOR'S COMPUTATIONS

Region IV has been outstanding in its high out-migration especially between 1930 and 1950. Historically, the distribution of Oklahoma's population has been affected by the supply and location of natural resources (Adams, 1971, p. 20). Agriculture and mining have employed most of the Oklahoman labor force. An example of the effect of the resource base on population density can be found in the history of Ottawa County, With the discovery of lead and zinc in Ottawa County around 1915, the county became densely populated. Due to changes in mining technology and the depletion of the high-grade ore, the high population density soon decreased. In its infancy, Oklahoma's manufacturing activity was somewhat decentralized with respect to location. The early manufacturing activities were comprised mainly of food and timber processing. With the discovery of oil and gas, and the rise of Oklahoma and Tulsa Counties as the manufacturing centers of the state; areas such as southeastern Oklahoma suffered economically. The accompanying migration patterns reflect this change in the state's resource base as well as changes in the relative important of location factors which favored the large centers.[1]

---

[1]The resource base concept used here is that of the functional viewpoint. For a detailed description of the functional viewpoint in the definition of resources see: Zimmermann, Erich. Introduction to World Resources. Constantin, J. and Peach, W.N. (eds.). N.Y.: Harper & Row, 1972.

CHAPTER V

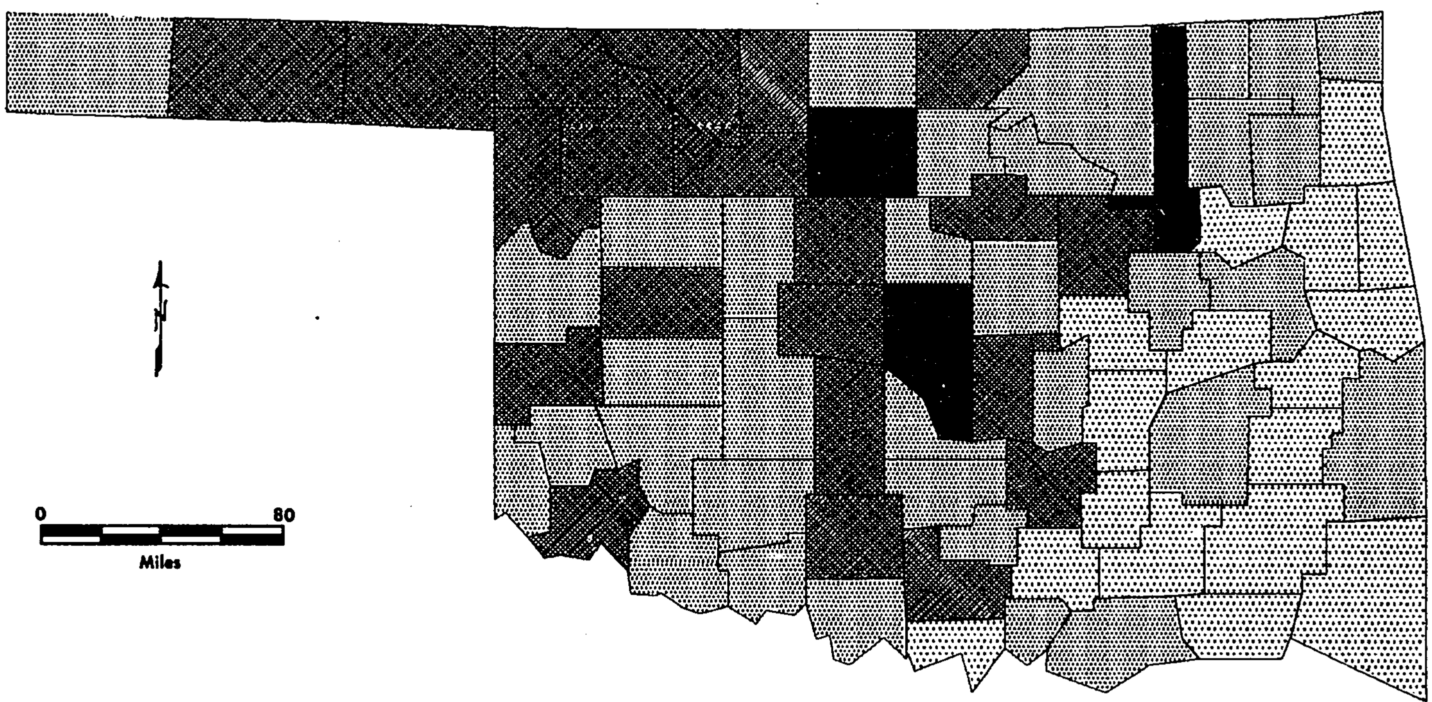
SUMMARY, CONCLUSIONS, AND THOUGHTS FOR THE FUTURE

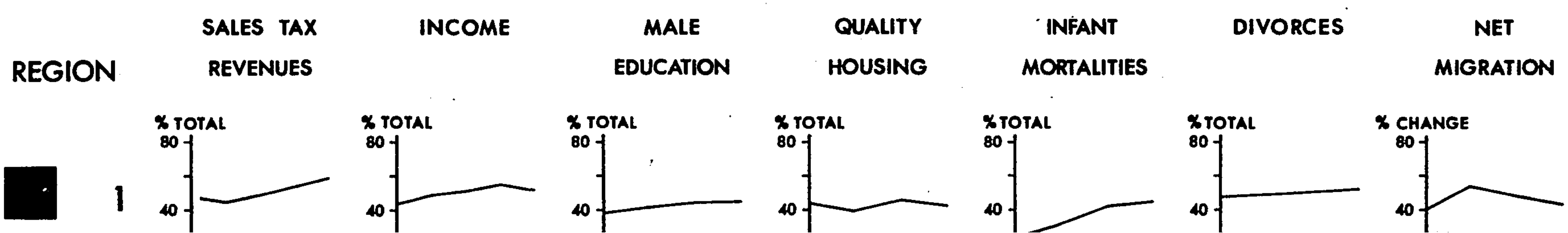
Summary

Does regional growth in a private enterprise economy lead to the convergence of per capita income, quality of housing, health, education levels, and other elements of standard-of-living? The answer to this question may indicate the necessity of formulating regional development policies. Richardson (1969, p. 55) claims that since growth models differ greatly in their predictions of the likelihood of convergence, the question can only be settled empirically.

It has been the goal of this study to provide empirical evidence of the existence or non-existence of a convergence process at the state and sub-state regional scales. To meet this goal, Oklahoma was initially regionalized into four standard-of-living-regions based on 1970 data for 20 socio-economic variables. Then, for a series of years ranging from 1930 to 1970, the degree of convergence or divergence was determined for a number of economic and social characteristics of the population of the entire state and of individual regions. The characteristics included: sales tax revenues generated per capita, per capita personal income, education levels, housing quality, infant mortality rates, divorce rates, and net migration. The regional percentage share of state totals in each characteristic for the study years are briefly summarized in Figure 55.

Summary of Trends in Selected Standard-of-Living Characteristics





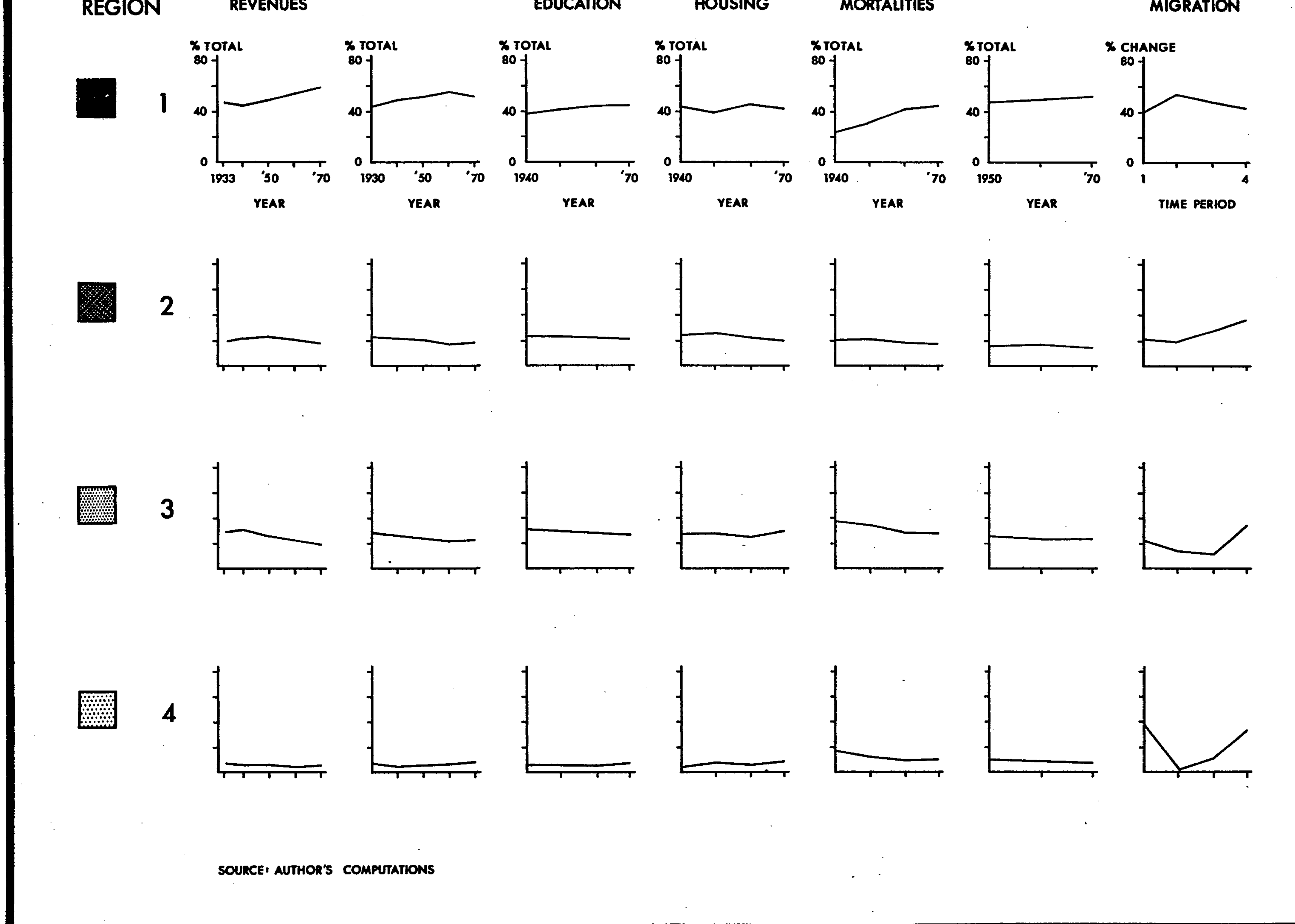

REGION
REVENUES
EDUCATION
HOUSING
MORTALITIES
MIGRATION
1
2
3
4
% TOTAL
% CHANGE
80
40
0
1933
'50
'70
1930
1940
1950
1
4
YEAR
TIME PERIOD
SOURCE: AUTHOR'S COMPUTATIONS

Figure 55

Region I, the urban areas, accounts for an increasing percentage of total sales tax revenues between 1933 and 1970. The region's share of the state's total personal income increases from 1930 to 1960 with a slight decrease from 1960 to 1970. The level and trend of the region's percentage share of educated males and the quality housing are high and increasing. The region also experienced a high and increasing trend in the two negative characteristics of infant mortalities and divorces. Net migration change percentages increased between 1930 and 1950. Since 1950, there has been a decline in the percentage change in net migration; still Region I remains the highest in the state.

Region II shows a stable trend in its percentage share of sales tax revenues, total personal income, schooled males, quality housing, infant mortalities, and divorces. The percentage change in net migration was stable during time periods one and two, but it has increased since. Some of this may be due to spread effects and decentralization from the centers of Region I.

Region III shows a moderate to low level with a slightly declining trend in its percentage share of sales tax revenues, total personal income, schooled males, quality housing, infant mortalities, and divorces. The percentage change in net migration declines during period four.

Region IV shows a very low level and stable trend in its percentage share of sales tax revenues, total personal income, schooled males, and quality housing. There is a declining trend in Region IV's percentage share of infant mortalities and divorces. The percentage change in net migration declines greatly during the two time periods (1930-1950).

Since time period two, there has been an increase, but the percentage change in net migration was still negative in the most recent time period.

The next stage of the study was to measure the magnitude and trends of regional disparities for the seven aforementioned characteristics. The degree of convergence or divergence was determined by the trends in a number of regional inequality measures which included: a one-way analysis of variance, a coefficient of variation, a Lorenz Curve analysis, and the Williamson inequality index. The results of these measures have made possible several important conclusions.

CONCLUSIONS

Several conclusions are appropriate. The first relates to the state as a whole. The county arithmetic means of the variables studied have been converging very markedly over the study period. This conclusion is supported by the summary of trends shown in Table 38. The F-ratios from the analysis of variance show convergence for six of the seven analyzed characteristics, and stability for one (housing). Table 39 illustrates this convergence by showing the analysis of variance data. In each case, as the state converges on a characteristic (i.e. the F-ratio decreases) the disparities among regions (V_b) decrease while the disparities within regions (V_w) increase.

The coefficient of variation also indicates convergence at the state scale; five characteristics converge (sales tax, income, education, housing, divorce); one is stable (migration), and one diverges (infant mortality). The one category showing divergence is infant mortality rates.

TABLE 38

CONVERGENCE-DIVERGENCE SUMMARY TABLE

INEQUALITY MEASURE		CHARACTERISTIC						
		Sales Tax	Income	Education	Housing	In. Mort.	Divorce	Migration
ANOVA F-RATIO	C	x	x	x		x	x	x
	S				x			
	D							
COEFFICIENT OF VARIATION	C	x	x	x	x		x	
	S					x		x
	D							
LORENZ CURVE	C	x	x	x	x		x	(none)
	S					x		
	D							
WILLIAMSON INEQUALITY								
Region 1	C						x	x
	S	x	x	x	x			
	D					x		
Region 2	C						x	
	S							
	D	x	x	x	x	x		x
Region 3	C		x					
	S			x				x
	D	x			x	x	x	
Region 4	C							
	S							
	D	x	x	x	x	x	x	x

C = Convergence S = Stability D = Divergence

TABLE 39

ANALYSIS OF VARIANCE SUMMARY TABLE

Variable	Measure	1930	1940	1950	1960	1970
Sales Tax Revenue	F	40.40	48.11	37.32	42.87	28.94
Per Capita	V_b	48.58	50.53	47.01	48.26	40.92
	V_w	29.25	25.55	30.64	27.39	34.40
Per Capita Income	F	49.97	49.26	48.44	58.32	41.05
	V_b	52.16	50.67	50.47	53.33	47.47
	V_w	25.40	25.03	25.34	22.25	28.13
Education	F		42.07	40.85	31.20	23.23
	V_b		48.20	47.45	42.57	36.94
	V_w		27.88	28.26	33.19	38.69
Housing	F		41.38	83.94	50.15	60.35
	V_b		47.54	58.55	50.85	53.94
	V_w		27.95	16.97	24.67	21.74
Divorces	F			5.21	2.69	1.10
	V_b			13.13	3.07	.91
	V_w			61.24	27.72	4.35
Infant Mortality	F		1.15	1.00	1.15	.37
	V_b		3.41	2.99	3.43	1.13
	V_w		71.97	72.50	72.15	74.31
Net Migration*	F		8.95	22.98	10.54	3.27
	V_b		23.14	41.39	24.67	9.42
	V_w		62.90	43.82	56.93	70.02

*Net Migration figures are for the ten year periods: 1930-40, 1940-50, 1950-60, 1960-70.

As was pointed out in Chapter IV, the diverging trend in infant mortality rates is related to the fact that the coefficient of variation is based on the mean and standard deviation; by 1970, the pooled variance within regions exceeded that between regions.

The Lorenz Curve analysis also shows a very clear pattern of convergence. Five of the six characteristics subjected to a Lorenz Curve analysis showed convergence; the sixth (infant mortality) was stable.

The F-ratio, coefficient of variation, and Lorenz Curve have all revealled very similar patterns. At the aggregate state scale, these approaches all point towards a strong convergence process over the study years. The coefficient of variation is concerned with the entire state; standard-of-living regions within the state are not recognized by this approach. The coefficient of variation results in an actual measure of statewide inequality.

Although the analysis of variance also indicates convergence at the state scale in the form of a decreasing F-ratio, this approach recognizes the individual regions of the state. The recognition of individual regions by the analysis of variance makes this approach significantly different from the coefficient of variation. The F-ratio can be disaggregated into a decreasing degree of disparity among regions and an increasing degree of disparity within regions. Although the analysis of variance gives more information than the coefficient of variation, it is still limited. The V_b and V_w are pooled variances, i.e. they do not pertain to specific regions.

Like the coefficient of variation and the analysis of variance, the Lorenz Curve approach also indicates a convergence process at the state scale. The Lorenz Variance Index developed in this study is an inequality measure for each individual region. The Lorenz Curve analysis as used in this study results in an indication of a convergence process as well as a measure of inequality for each region. The amount of information resulting from a complete Lorenz Curve analysis is more than that resulting from the coefficient of variation and analysis of variance.

The second conclusion relates to the sub-state regional scale. At the sub-state regional scale, the situation is quite different. The total Williamson Inequality Index figures from Table 40 and the summary of trends in Table 38 show that for each of the study years, the lowest standard-of-living region, the southeast, clearly experienced the greatest degree of inequality. The Williamson Inequality Index totals for each region are plotted on Figure 56. The Williamson Inequality Index gives more information than do the coefficient of variation or analysis of variance. This index gives an indication of the degree of disparity among the counties within specific regions. The Williamson Inequality Index does not result in a measure of the degree of inequality at the aggregate state scale. The types of information resulting from the use of each of the approaches are summarized in Table 41 and Figure 57.

The third conclusion is that, contrary to what was expected, Region I did not experience the smallest total inequality on every year. For 1930, 1940, and 1950, it was Region II that experienced the smallest degree of inequality. For 1960 and 1970, Region I had the smallest degree of inequality. The larger degree of inequality in Region I between 1930 and 1950 is related to the fast growth and urbanization that occurred. By 1950, the economic and social aspects of the growth process had become more stabilized.

TABLE 40

WILLIAMSON'S INEQUALITY INDEX* SUMMARY TABLE

Variable	Region	1930	1940	1950	1960	1970
Sales Tax Revenues Per Capita	I	.59	.86	.82	.75	1.08
	II	.82	.47	.22	.46	1.77
	III	.28	.30	.68	.74	1.54
	IV	1.49	2.60	2.36	3.71	5.04
Per Capita Income	I	1.19	.77	1.27	1.33	1.15
	II	.14	.81	.03	1.44	2.51
	III	1.94	.72	1.19	1.48	1.19
	IV	.95	1.78	6.17	2.11	2.97
Education	I		.18	1.28	1.28	1.20
	II		.09	.44	1.95	1.08
	III		2.08	1.20	1.47	1.35
	IV		.33	1.37	9.72	2.38
Housing	I		.51	.18	.72	.33
	II		.39	.34	.19	.73
	III		.19	.21	.33	.70
	IV		.41	.34	3.95	1.11
Divorce	I			.59	.65	.49
	II			1.07	1.22	.96
	III			1.20	1.65	1.89
	IV			.80	2.71	2.21
Infant Mortality	I		.23	.40	.72	1.96
	II		.41	1.34	2.02	4.41
	III		.27	2.19	1.24	4.49
	IV		.64	.67	2.96	5.83

WILLIAMSON'S INEQUALITY INDEX SUMMARY TABLE (continued)

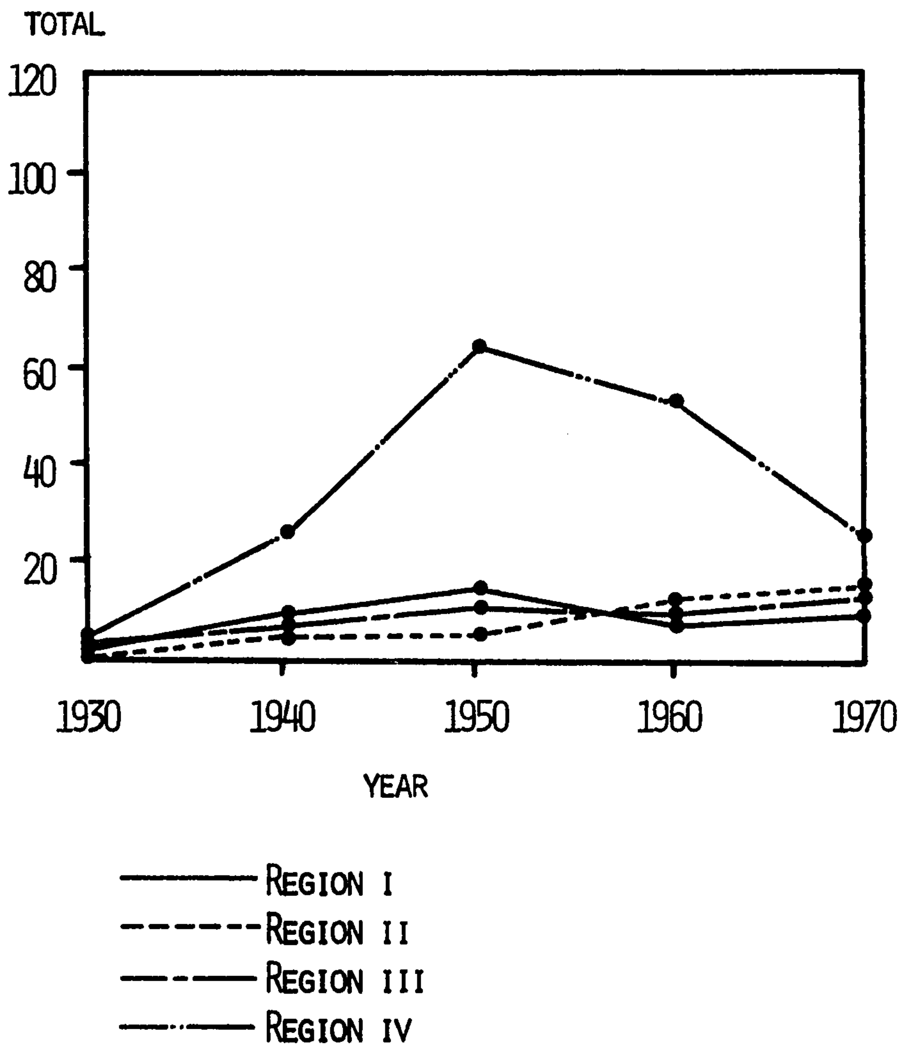
Variable	Region	1930	1940	1950	1960	1970
Net Migration	I		3.09	6.39	.47	2.87
	II		2.60	.89	.43	1.18
	III		1.23	.88	.02	.91
	IV		19.28	53.85	28.23	4.93
Total Index	I	1.78	5.64	10.93	5.92	9.08
	II	.96	4.38	4.33	7.71	12.64
	III	2.19	4.79	7.55	6.93	12.07
	IV	2.44	25.04	65.56	53.39	24.47
Range		1.48	20.66	61.23	47.47	15.39
Total		7.37	39.85	88.37	73.95	58.26

*All indices are in standardized form. The indices are, therefore, comparable from year to year and from variable to variable.

Source: Author's computations

FIGURE 56

WILLIAMSON INEQUALITY INDEX TOTALS



SOURCE: AUTHOR'S COMPUTATIONS

FIGURE 57

DEGREE OF INFORMATION FROM

THE INEQUALITY MEASURES

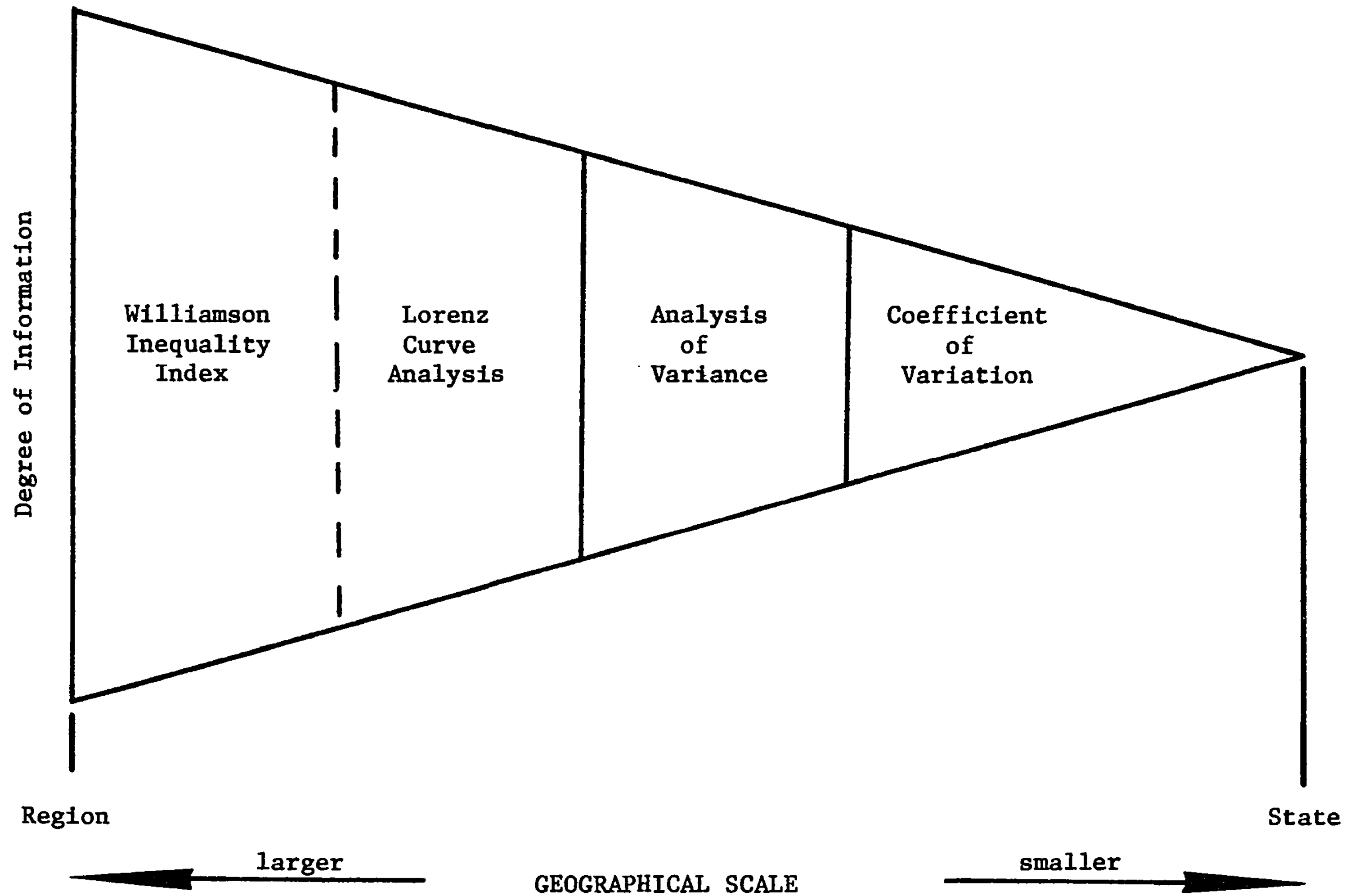


TABLE 41

APPROACHES TO INEQUALITY MEASUREMENT

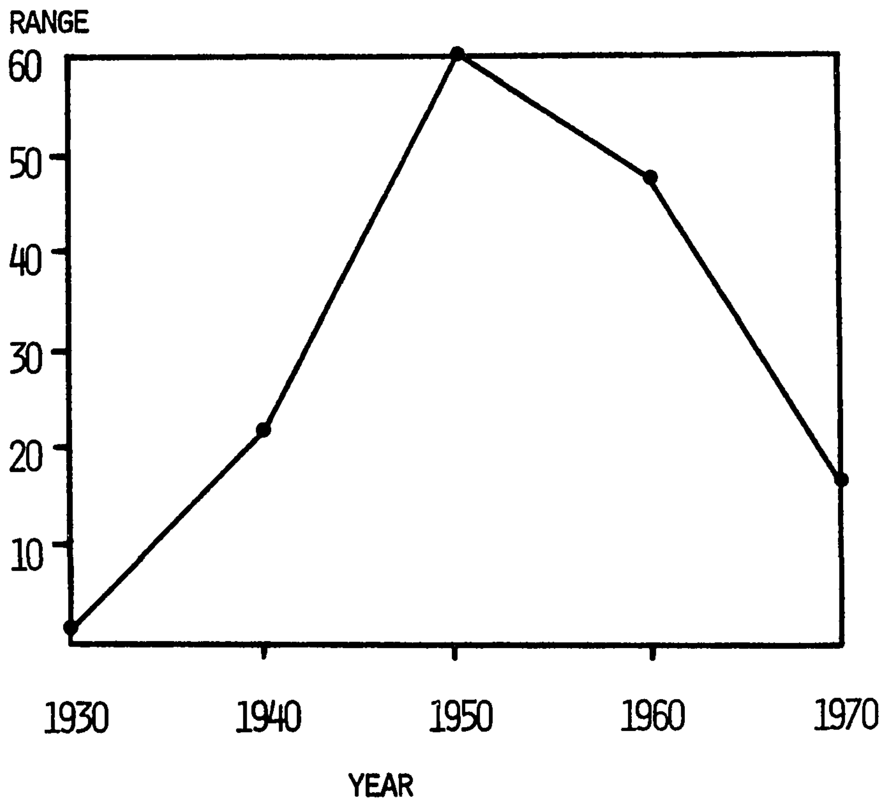
Technique	Results
1. Coefficient of Variation	An aggregate state inequality measure
2. Analysis of Variance	An aggregate state inequality measure
	A pooled measure of: variance among regions variance within regions
3. Lorenz Curves	An indication of an aggregate state convergence or divergence process
	A measure of inequality for each region from the Lorenz Variance Index
4. Williamson Inequality Index	A measure of inequality among counties within specific regions

The next conclusion also relates to the sub-state regional scale. The range between the highest and lowest Williamson Inequality Index for each year follows an inverted U process (Figure 58). In 1930, the range was small. The range grew steadily from 1930 to 1950. After 1950, the range began to decline as the regional degrees of inequality once again began to become more similar.

In Chapter I (p. 3) mention was made of the stubborn persistence of regional inequalities as a feature of the modern socio-economic landscape. The findings of this study support the belief that the persistence of these lesser-developed areas is due, in part, to the fact that the slowness of the factor migrations prevents such areas from approaching or surpassing the levels of economic development

FIGURE 58

RANGE OF WILLIAMSON
INEQUALITY INDICES



SOURCE: AUTHOR'S COMPUTATIONS

in the more highly developed regions. The people of Southeastern Oklahoma are certainly experiencing an absolute higher standard-of-living today than they did in 1930. What remains is the fact that the people of this region also still experience the greatest amount of internal disparity and the lowest level of standard-of-living in the state. This lag area has not been able to catch-up to the rest of the state. This means that the people of Southeastern Oklahoma are still not able to fully participate in the growth economy of the state. Due to their spatial location, these people are denied the opportunities of better education, higher income, better health, better housing quality, etc. The benefits that the people have received over the past few decades have been the result of spin-offs and spread effects from the more dynamic growth centers of the state economy.

The recognition of the stubborn persistence of lag areas leads directly to several other points. Earlier in this study (p. 7), a question was raised concerning whether or not the present planning methodology in Oklahoma has increased or decreased the degree of inequality both among and within standard-of-living regions. The findings of this study reveal that the overall state convergence process pertains only to the higher standard-of-living regions. Indeed, the lowest standard-of-living region has experienced divergence. These findings indicate that there are definite faults in the planning methodology. The ideological basis of the planning methodology is one that advocates a more equitable system. The ideology of the system does not say that the people living in Washington County should live in a more equitable environment than the people in Pushmataha County. The findings of this study indicate that the laissez faire attitude towards regional planning in Oklahoma has allowed for the evolution of a dualistic "quality of life scale." People living in Garfield, Washington, Oklahoma, Cleveland, and Tulsa counties have good opportunities to improve their standards-of-living. The spatial segment of the population residing in the southeast have less opportunity for such improvement. The increasing degree of disparity in Southeastern Oklahoma indicates that there is a direct and strong conflict between planning attitudes and ideology for this region.

It is the feeling of this writer that a vicious circle of self-perpetuating and cumulative reinforcement of inequalities exists in the lower standard-of-living region. The direction of the circle is reversed in the higher standard-of-living regions. As was stated earlier (p. 10) the purpose of this study is the diagnosis of the problem and not the treatment of it. A few brief remarks about possible treatments will be made later in this chapter.

Based on the aforementioned conclusions, an important general conclusion can be stated. At the state scale, Oklahoma has been experiencing a convergence of the analyzed characteristics. This trend agrees with the international and national scale studies conducted by Williamson (1965), Borts and Stein (1962), Easterlin (1961), and others. In terms of sub-state regional planning policies and needs, a faith in the overall convergence towards a more equitable system through a naturally occurring evolutionary process is misleading and, indeed, dangerous. The analysis of Oklahoma at the larger scale, i.e. by counties and regions, indicates that the lowest standard-of-living region has experienced the greatest internal regional disparities on each year. It would be difficult to try to convince the people of eastern and southeastern Oklahoma that they are part of a system that is converging towards a more equitable system. As the disparities among the regions of Oklahoma have decreased, the variance within regions has increased (Table 39). The criticisms of the convergence hypothesis by Myrdal (1957), Hicks (1959), and others are pertinent. Hicks believes that inequalities will be maintained and enlarged after growth. Myrdal also believes that inequalities will become larger with the economic growth of a country because backwash effects are generally stronger than spread effects.

In relation to social and economic analyses of lesser-developed areas of mature economies, the geographical scale of analysis is very critical to an understanding of the results. National or state scale analyses may easily show convergence processes at work, but county scale studies, such as this one, may indicate that different changes are occurring at a local level. This suggests that the hypotheses of Myrdal and Williamson both can be concurrently valid depending on the geographical scale of analysis. Support can be lent ot this conclusion by the study on Canadian cities by Semple and Griffin (1971). Semple reasoned that in view of the classical economic view of factor of production flows and equilibrating processes, the degree of inequality among cities in regions of Canada should be lessening, i.e. that Canadian cities are becoming more homogeneous. After analyzing the sample of Canadian cities by information statistics, the initial hypothesis could not be substantiated. Semple could not clearly show that the degree of inequality within and between the cities was lessening.

The convergence found to be occurring at the national scale was not found at the urban scale.

THOUGHTS FOR THE FUTURE

This research has raised a series of related questions. Although they are beyond the scope of this study, many of these questions must eventually be answered in order to facilitate the understanding of regional disparities.

One of the questions which remains to be answered is why Region I did not experience the lowest degree of inequality for each year. Why did Region I register unfavorably on the infant mortality and divorce variables? The answer seems to be related to the fact that Region I is dominated by two large metropolitan areas: Oklahoma City and Tulsa. The existence of areas within a city with populations that experience high infant mortality rates and/or high divorce rates are masked by the use of county level data. It is possible that spread effects from the centers in Region I is a major reason why Region II experienced less inequality than Region I in some years. Region II also possesses a number of medium size growth centers. It is possible that larger centers such as Oklahoma City and Tulsa could be experiencing some diseconomies of scale and a larger degree of urban pathologies.

The question of scale is basic to what has been said thus far. In order to fully understand the nature of geographic disparities, more work is needed at the sub-state-regional and urban scales. Apparently, too much attention has been given to smaller scale national level studies. The use of county mean data in this study is a possible source of error. It is very possible to have several very different distributions with the same mean. This study has been concerned with the mean data and the distribution of these means about the state mean. Possibilities exist for larger scale studies that would be concerned with actual individual units rather than mean values; such an approach could reveal inequalities more clearly at the individual human scale.

Another major question was touched upon earlier in this study with the question: Is growth necessarily good? Although beyond the scope of this work, the answer to this broad question must eventually be pursued. Why is it that higher incomes of present-day Americans co-exist with so many manifestations of discontent and despair. When one looks at the sweep of history, it is by no means clear that periods of economic growth were the most quiescent politically; they were often periods of protest and violence (Olson, 1974, p. 1). Why do higher income countries have higher suicide rates than poor ones? We are not really sure what happens when rapid economic growth occurs. Does economic growth increase social well-being and make most of the people happier; or is it associated with subtle forces that reduce well-being in some dimensions just as it improves it in others (Olson, 1974, p. 1)? Another question that is directly related to this study is: are some parts of the population worse off in some sense than they would have been had the economic growth not occurred? If economic growth is highly desirable, why does it fail to diminish proportionately discontent and social pathology?

It is the feeling of the author that economic growth is very desirable. But, economic growth accompanied by a laissez faire attitude towards regional planning may be dangerous! Economic growth, among other things, means technological change and capital accumulation.

Some people rise in the social order while others sink. Economic growth has economic, environmental, and social costs. It is essential to be aware of the full ramifications of growth and to formulate planning policies to ameliorate some of the negative effects of growth.

Another set of questions centers around reasons for the existence of lesser-developed areas such as eastern and southeastern Oklahoma. It seems that Region IV is characterized by less intensive interactions with the other regions of the state and of surrounding states. In a very broad sense, the strategies for raising the level of development of depressed regions will be to activate interactions with other regions and to turn these interactions more in favor of the depressed region's development (Stöhr, 1974, p. 22). A negative strategy to intensify interactions is to encourage outmigration; this is not usually explicitly adopted due to political reasons. Other positive alternatives include an increase in the production of exportable items, and a rationalization of the region's internal structure for providing intraregional products and services at less cost and more efficiently. These strategies require cities to play a key role as potential seats of manufacturing and central place functions. Region IV is noticeably lacking in a well-balanced central place system of settlements. For such an area, Stöhr (1974, p. 22) recommends changes in the spatial pattern of settlement and productive activities within the region by concentrating dispersed central place functions in a few major centers, and re-ordering of manufacturing activities. Implicit in Stohr's statements is an agreement with the place prosperity approach mentioned earlier in this study (p. 5); this writer also agrees with this approach.

Although it was not within the scope of this study, the role of sub-cultures in explaining regional lag or advancement is quite important. The analysis of disparities both among and within the major segments of the population could be an approach that would result in some interesting findings. This would be especially true with regards to the Indian sub-population in Oklahoma.

It is obvious by now that much work remains to be done on the nature of regional inequalities. Such an initial understanding is basic to many present day problems of a political, social, and economic nature. The nature of the problem requires a truly inter-disciplinary effort. The need for a spatial perspective in such an effort is essential.

APPENDIX A

STANDARD-OF-LIVING SURROGATE VARIABLES[1]

		VARIABLES	SOURCE KEY
	I.	Health	
*	1.	Number of Births per 1,000 Population	(1)
*	2.	Number of Deaths per 1,000 Population	(1)
*	3.	Number of Deaths Under One Year per 1,000 Population	(1)
	4.	Number of Suicides per 1,000 Population	(1)
*	5.	Diabetes Milletus per 1,000 Population	(1)
	6.	Influenza per 1,000 Population	(1)
	7.	Pneumonia per 1,000 Population	(1)
*	8.	Number of Doctors per 1,000 Population	(1)
	9.	Number of Hospital Beds per 1,000 Population	(1)
	II.	Crime	
*	10.	Number of Juvenile Arrests per M	
*	11.	Number of Drug Arrests per M	(2)
*	12.	Percent Alcohol Related Arrests	(2)
	13.	Index Crime per M	(2)
*	14.	Total Arrests per M	(2)
	III.	Income-Savings	
*	15.	Median Family Income	(3)
	16.	Bank Deposits per Capita	(4)
	17.	Percent Families with Less than $3,000 Income	(3)
	IV.	Education	
*	18.	Pupil-Teacher Ratio	(5)
	19.	Median Number of Years School Completed: Males	(3)
	20.	Median Number of Years School Completed: Females	(3)
	21.	Per Capita Expenditures for Education	(6)
	V.	Employment	
*	22.	Retail Location Quotient	(7)
*	23.	Unemployment Rate	(3)
*	24.	Percent Employed in Agriculture	(8)
	25.	Percent Employed in Domestic Service, Self-Employed, etc.	(8)

	26.	Percent Employed in Manufacturing	(8)
*	27.	Percent Employed in Wholesale-Retail	(8)
	28.	Percent Employed in Government	(8)
*	29.	Percent Employed in Other Activities	(8)
VI.		Demographic	
	30.	Percent Population Rural	(3)
*	31.	Percent Population Non-White	(3)
*	32.	Percent Households Female-Headed	(3)
	33.	Median County Age	(7)
VII.		Miscellaneous	
*	34.	Number of Telephones per Capita	(3)
*	35.	Aid Cases per 1,000 Population	(9)
	36.	Assistance per 1,000 Population	(9)
	37.	Percent Housing With All Plumbing	(10)

---

[1]This is a complete list of the surrogate variables used on the initial run of the factor analysis.

*These were the variables used in the final analysis.

DATA SOURCE KEY

(1) Oklahoma State Department of Public Health. Public Health Statistics: Birth and Deaths, 1970.

(2) Unpublished report of the Oklahoma Crime Commission, 1973.

(3) U.S. Bureau of the Census. General Social and Economic Characteristics, Oklahoma, 1970, PC-1-C-28.

(4) University of Oklahoma, Bureau of Business Research. Statistical Abstract of Oklahoma, 1970.

(5) State of Oklahoma, Office of the Governor, Office of Community Affairs and Planning. County Situation Profiles, 1970.

(6) U.S. Bureau of the Census. Census of Governments, Oklahoma, 1970.

(7) Hagle, Paul, et. al. Basic Data and Projections for the Oklahoma Economy, Stillwater: Oklahoma State University Research Foundation, 1973.

(8) Oklahoma Employment Security Commission, Research and Planning Division. Oklahoma Labor Force Estimates, 1970.

(9) Oklahoma Department of Institutions, Social and Rehabilitative Services. Oklahomans Receiving Public Assistance, June 1971.

(10) U.S. Bureau of the Census. Census of Housing, Detailed Characteristics: Oklahoma, 1970.

CORRELATION MATRIX OF SURROGATE VARIABLES

	1	2	3	4	5	6	7	8	9	10
1	1.00000									
2	-0.55209	1.00000								
3	-0.11270	0.24223	1.00000							
4	-0.07807	0.27074	-0.04339	1.00000						
5	-0.27414	0.35462	0.16244	0.15859	1.00000					
6	0.03891	0.19511	0.09566	-0.12198	-0.00856	1.00000				
7	-0.26622	0.33203	0.17286	-0.15806	0.15254	-0.05003	1.00000			
8	0.13612	-0.06739	0.11510	0.01695	-0.09151	-0.13950	0.05130	1.00000		
9	0.02346	0.16991	0.26360	0.04206	0.16198	-0.14141	0.10043	0.61406	1.00000	
10	-0.03415	-0.04239	-0.18864	-0.06942	-0.04580	-0.04240	-0.00906	-0.24135	-0.24335	1.00000
11	-0.04912	-0.15526	-0.20324	-0.11751	-0.20522	0.02268	0.07981	-0.17596	-0.22728	0.60741
12	-0.07349	0.18353	-0.06202	0.07641	0.03800	-0.04105	0.08621	-0.19771	-0.02130	-0.01208
13	0.05776	-0.03948	-0.04282	0.29698	-0.06803	0.04741	-0.06035	0.00470	-0.03724	0.09970
14	0.16115	0.13120	0.02204	0.09013	-0.06677	0.15064	0.09557	-0.30521	-0.19757	0.45706
15	0.21251	-0.57021	-0.09309	-0.10010	-0.13723	-0.15225	-0.12995	0.47677	0.15003	-0.13380
16	-0.11713	-0.00413	0.01017	0.10710	-0.00759	-0.09316	0.16328	0.12311	0.04660	0.09042
17	-0.15091	0.53490	0.04118	0.12016	0.00617	0.12791	0.12759	-0.38935	-0.14270	0.14216
18	0.59425	-0.49767	-0.08077	-0.13183	-0.34309	-0.15241	-0.14632	0.24618	-0.00790	0.01162
19	0.15740	-0.52562	0.03276	-0.15668	-0.03633	-0.12179	-0.13211	0.44991	0.18156	-0.10566
20	0.03234	-0.42107	0.01196	-0.10645	0.02002	-0.13551	-0.07198	0.47598	0.21130	-0.11178
21	-0.01536	-0.04896	-0.09711	-0.06713	0.02844	0.10775	0.08512	0.01718	0.06461	0.09762
22	0.31340	-0.24331	0.14307	-0.06823	-0.05825	-0.08198	-0.06176	0.58984	0.31055	-0.14540
23	0.17296	0.07791	-0.07962	0.02503	-0.18692	0.15154	-0.07341	-0.26913	-0.18155	0.09829
24	-0.55723	0.34856	0.01469	-0.00961	0.24112	0.16160	0.11355	-0.38589	-0.16104	0.18984
25	-0.28180	0.33134	0.12782	0.01604	0.09034	0.01574	0.05999	0.17208	0.08332	-0.05120
26	0.22304	0.00160	-0.10046	-0.01263	-0.17826	-0.02430	-0.00390	-0.16677	-0.11350	-0.03430
27	0.28869	-0.24351	-0.03220	-0.06338	-0.05471	-0.15213	0.02258	0.43423	0.29749	-0.04505
28	-0.00929	0.13341	0.03449	0.10687	-0.03797	0.05105	-0.10697	-0.01389	0.10216	0.03099
29	0.44475	-0.39457	-0.10093	-0.01960	-0.19902	-0.14451	-0.11044	0.30645	0.06856	-0.10930
30	-0.48228	0.36856	-0.12563	0.07631	0.15652	0.15408	0.04766	-0.56145	-0.21727	0.20956
31	0.24131	0.04032	0.06112	-0.03227	-0.03807	0.08477	0.03093	-0.12228	-0.12415	0.11825
32	0.36956	0.07269	0.00955	-0.04465	-0.14387	0.11204	-0.01847	-0.02747	-0.12692	0.07480
33	-0.74917	0.79708	0.12443	0.29114	0.29982	0.09760	0.26909	-0.06479	0.00367	0.02911
34	-0.41358	0.11115	0.07605	0.10258	0.23973	-0.06270	0.09232	0.59586	0.20058	-0.07625
35	-0.11030	0.55694	0.03509	0.14542	0.04021	0.08982	0.10804	-0.31439	-0.15363	0.12318
36	-0.05321	0.52163	0.06059	0.02823	0.02271	0.05920	0.10503	-0.30571	-0.17364	0.17914
37	0.07368	-0.28504	0.08166	-0.02662	0.06877	-0.14687	-0.05106	0.51536	0.21281	-0.19539

	11	12	13	14	15	16	17	18	19	20
11	1.00000									
12	-0.07374	1.00000								
13	0.10271	-0.39835	1.00000							
14	0.33742	0.21590	0.37126	1.00000						
15	0.04119	-0.24589	0.05079	-0.36548	1.00000					
16	0.03431	0.07693	-0.05383	-0.03731	0.14429	1.00000				
17	-0.11473	0.24971	-0.03096	0.39804	-0.92881	-0.11723	1.00000			
18	-0.00176	-0.17166	-0.05599	0.04610	0.34652	-0.07717	-0.19927	1.00000		
19	0.20586	-0.30893	0.08096	-0.30972	0.85251	0.11128	-0.86801	0.21450	1.00000	
20	0.18681	-0.31696	0.03363	-0.42794	0.84137	0.10736	-0.87266	0.11612	0.92775	1.00000
21	0.10863	0.17536	0.11060	0.09672	0.13932	0.11891	-0.11056	-0.23764	0.17700	0.17402
22	-0.06889	-0.22755	0.04592	-0.14145	0.56756	0.18220	-0.49625	0.42943	0.57415	0.50797
23	-0.09267	0.23385	-0.05293	0.30315	-0.54499	-0.15723	0.61860	0.12461	-0.56051	-0.61880
24	0.14173	0.08558	0.12972	0.02567	-0.36778	0.08265	0.24895	-0.70731	-0.27292	-0.15463
25	-0.18338	-0.32055	0.06630	-0.16148	-0.10632	0.04734	0.11049	-0.25442	-0.00375	0.02121
26	-0.08987	0.05521	-0.02293	0.20701	-0.14509	-0.19860	0.25121	0.30612	-0.29821	-0.35102
27	0.08114	-0.12584	-0.01623	-0.05122	0.46392	0.18587	-0.40705	0.31051	0.45550	0.42399
28	0.08342	0.11739	0.01221	0.10337	-0.26121	-0.05292	0.23812	-0.11539	-0.11708	-0.07117
29	-0.05749	-0.09293	-0.12941	-0.10960	0.46178	-0.03920	-0.38940	0.58864	0.30009	0.24913
30	0.10208	0.30381	0.09433	0.21397	-0.53081	-0.07126	0.44871	-0.63482	-0.53288	-0.44013
31	-0.09072	0.20181	-0.05062	0.40028	-0.44979	-0.21350	0.50916	0.31346	-0.46119	-0.52523
32	-0.10023	0.09192	-0.07653	0.32905	-0.40127	-0.15488	0.48100	0.40336	-0.46590	-0.54414
33	-0.01568	0.07906	0.00194	-0.05884	-0.38540	0.08147	0.34485	-0.61403	-0.35386	-0.22873
34	0.18033	-0.24410	0.05070	-0.38129	0.53663	0.18744	-0.59770	-0.22664	0.63594	0.71410
35	-0.22908	0.27833	-0.05865	0.33200	-0.81375	-0.11216	0.87514	-0.12208	-0.87531	-0.89250
36	-0.20154	0.30458	-0.16516	0.39684	-0.75811	-0.06892	0.80804	-0.08781	-0.82013	-0.83121
37	0.07865	-0.39189	0.08142	-0.41227	0.77097	0.07975	-0.81241	0.09825	0.80959	0.84904

	21	22	23	24	25	26	27	28	29	30
21	1.00000									
22	0.10185	1.00000								
23	-0.09745	-0.31318	1.00000							
24	0.20006	-0.49029	-0.04694	1.00000						
25	-0.15587	0.15008	-0.14230	0.00875	1.00000					
26	-0.16261	-0.03454	0.32845	-0.38990	-0.16767	1.00000				
27	0.08099	0.47263	-0.23876	-0.51091	0.16355	-0.01549	1.00000			
28	-0.04025	-0.14272	0.26898	0.06361	0.03950	-0.23281	-0.01212	1.00000		
29	-0.02643	0.33438	-0.17739	-0.69811	-0.28802	0.19359	0.28608	-0.40770	1.00000	
30	0.25562	-0.66006	0.22726	0.68231	-0.17258	-0.02661	-0.46658	0.13612	-0.52035	1.00000
31	-0.04044	-0.12973	0.50574	-0.17946	-0.12898	0.46996	-0.20282	0.02105	0.05102	-0.02420
32	-0.20797	0.04871	0.41957	-0.38387	0.05452	0.44049	-0.04552	-0.04447	0.19081	-0.18472
33	-0.01284	-0.26361	-0.12400	0.54695	0.33671	-0.14576	-0.34846	-0.08132	-0.37018	0.46202
34	0.00741	0.37491	-0.66802	0.13363	0.24987	-0.34550	0.22505	-0.17122	-0.02366	-0.20923
35	-0.18039	-0.40469	0.58825	0.10737	0.16833	0.35150	-0.38775	0.12183	-0.22818	0.34878
36	-0.20765	-0.32545	0.55550	0.04232	0.18536	0.32448	-0.26560	0.16142	-0.25525	0.25846
37	0.05803	0.55458	-0.67216	-0.25061	0.18149	-0.29152	0.42356	-0.12679	0.30656	-0.48247

	31	32	33	34	35	36	37
31	1.00000						
32	0.75111	1.00000					
33	-0.17642	-0.14873	1.00000				
34	-0.57185	-0.53027	0.38147	1.00000			
35	0.54817	0.58751	0.36641	-0.57203	1.00000		
36	0.53218	0.61629	0.27473	-0.53483	0.88255	1.00000	
37	-0.57849	-0.44868	-0.12416	0.67864	-0.73213	-0.67425	1.00000

Source: Author's computations

A P P E N D I X B

AN INFORMATION ANALYSIS OF TRENDS IN SALES TAX REVENUES IN OKLAHOMA: 1933-1970

This analysis is based on the approach used by Semple and Griffin (1971). Entropy is used as a measure of growth equality, and it is calculated as:

$$H\ (Y) = \sum_{i=1}^{n} Y_i \log_2 \frac{1}{Y_i}$$

where: $H\ (Y)$ = entropy

Y_i = % of total growth accounted for by each county, so that:

$$\sum_{i=1}^{n} Y_i = 1$$

$$Y \geq 0$$

$$i = 1, \ldots, n$$

Entropy takes on a maximum value of $\log_2 n$ when the growth of each county is the same. Entropy has a minimum value of zero when one county's growth is equal to the growth of all counties and the others have zero growth. By substracting entropy from its own maximum, an inequality measure is obtained:

$$I\ (Y) = \log_2 n - H(Y)$$

If $I(Y) = 0$, complete inequality exists. If $I(Y) = \log_2 n$, complete equality exists.

The computer program used here to calculate entropy and inequality was written by R. K. Semple. Minor modifications were made by this author. The program produces measures of entropy and total inequality. Total inequality is then subdivided into among region and within region inequality.

The information analysis was performed on the 77 counties composing the four regions of Oklahoma. The data used was sales tax revenues between 1933 and 1970. The results are shown in Table B-1.

TABLE B-1

SOURCE OF INEQUALITY

Time Period	Total Inequality	Among Region Inequality	Within Region Inequality
1933	1.53	.99	.54
1940	1.46	.94	.51
1950	1.51	1.00	.50
1960	1.82	1.24	.58
1970	1.77	1.17	.59
	A	B	C

B + C = A

Source: Author's computations

In this problem, $\log_2 n = 6.266$. If $I(Y) = 0$, total inequality exists. If $I(Y) = \log_2 n$, total equality exists. In view of this statement, a scale was constructed (Figure B-1). From 1933 to 1940, total inequality changed from 1.53 to 1.46. It can be seen on the scale that this was a movement towards greater total inequality. From 1940 to 1960, there was a movement towards greater equality (convergence), followed by divergence from 1960 to 1970. Figures B-2 and B-3 show the trends for the two components of total inequality, i.e. among and within region inequality. Inequality among regions follows a pattern similar to the total inequality. Inequality within regions shows a movement toward greater inequality from 1933 to 1950, followed by a movement towards more equality from 1950 to 1970. These trends are shown on Figure B-4.

FIGURE B-1

TOTAL INEQUALITY SCALE

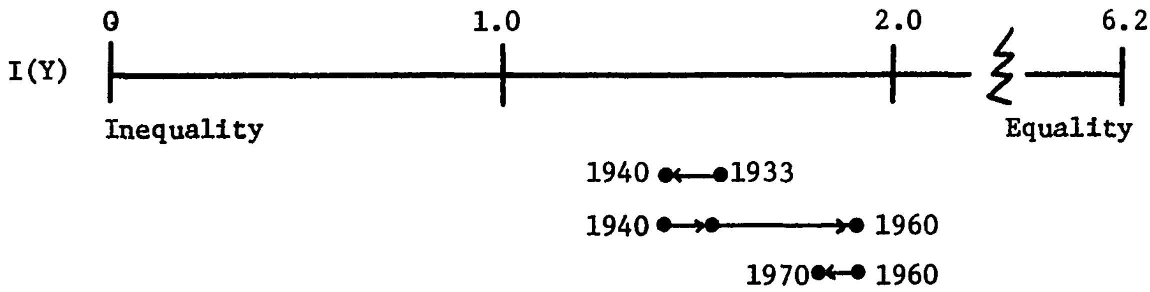


FIGURE B-2

BETWEEN REGION INEQUALITY SCALE

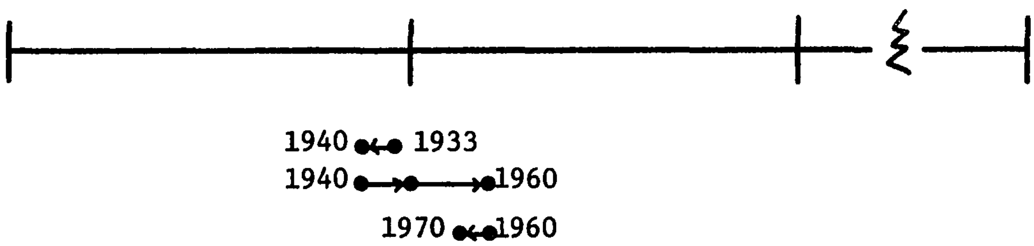


FIGURE B-3

WITHIN REGION INEQUALITY SCALE

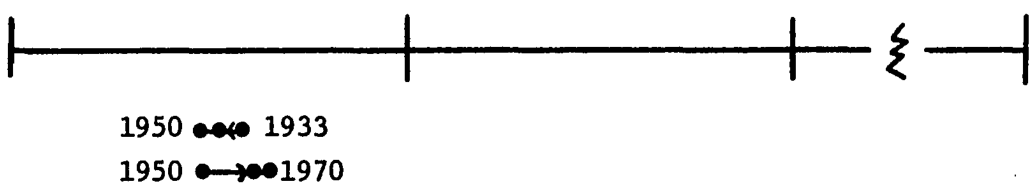
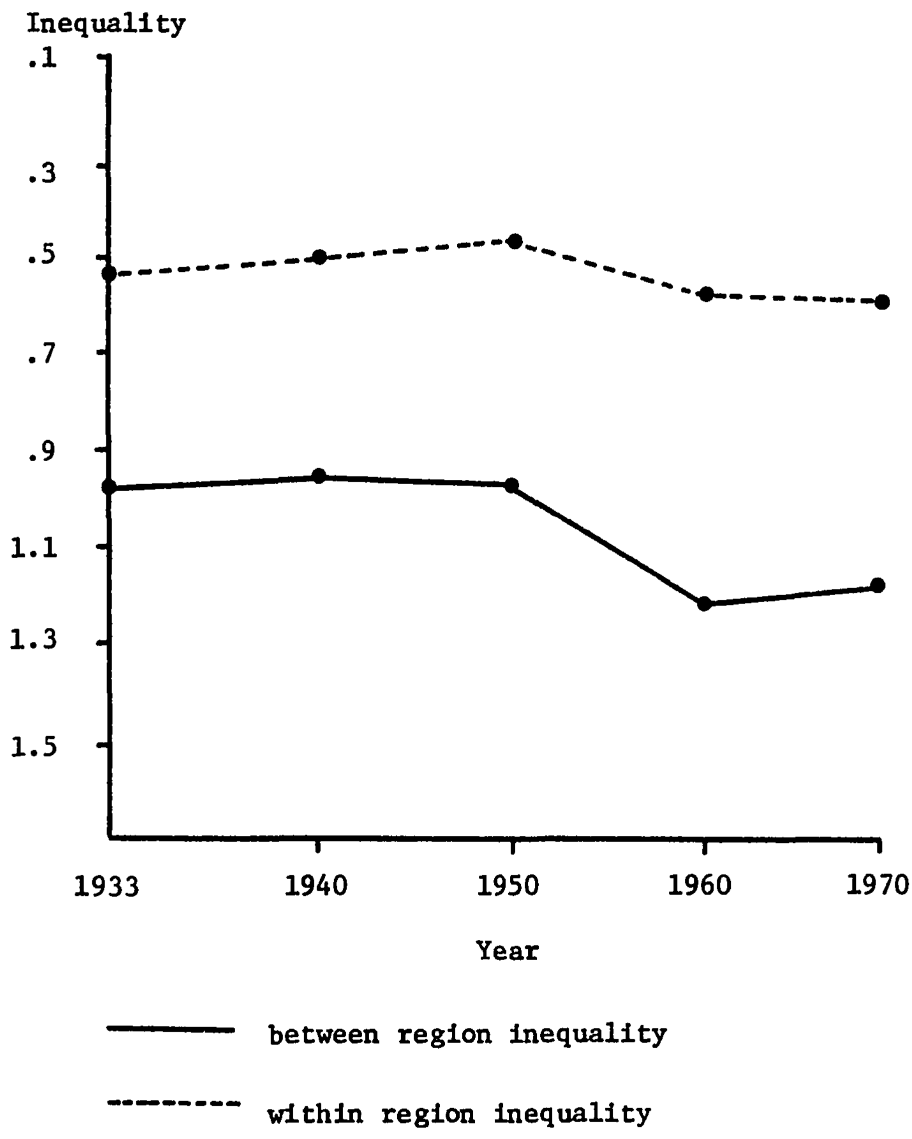


FIGURE B-4

INEQUALITY TRENDS



Source: Author's Computations

```
C     PROGRAM BY R.K. SEMPLE O.S.U. NOV. 1970
C     PROGRAM TO CLEAN DATA FOR INEQUALITY ANALYSIS
C     N IS THE NUMBER OF OBSERVATIONS  LIMIT 300
C     M IS THE NUMBER OF TIME PERIODS  LIMIT 30
C     MT IS THE NUMBER OF GROWTH PERIODS  LIMIT 29
C     FMT IS THE FORMAT TO READ IN DATA
C     FMGT IS THE FORMAT TO PRINT OUT DATA
C     FMTT IS THE FORMAT TO PRINT OUT ADJUSTED GROWTH DATA
C     FGT IS THE FORMAT TO PUCHH OUT ADJUSTED GROWTH DATA
      INTEGER FMT(8),FMTT(8),FMGT(8)
      COMMON TOWN(300,4),GROW(300,21),ID(300,4),N,M,NF,MT
      DIMENSION CSUM(30), X(30)
      EQUIVALENCE (CSUM,X)
C     SECTION TO READ DATA
    1 FORMAT(1H1)
  100 PRINT 1
      READ(5,10) N,M,MT,NR,MORE,IRAW
   10 FORMAT(6I5)
      READ(5,20) FMT
      READ(5,20) FMGT
      READ(5,20) FMTT
   20 FORMAT(20A4)
      WRITE(6,30)
   30 FORMAT(19X,'NAME',5X,'IDENTIFICATION',5X,'RAW DATA'//)
C     SECTION TO CALCULATE GROWTH
      DO 40 I=1,N
      READ(5,FMT) (TOWN(I,K),K=1,4), (ID(I,K),K=1,2), (X(K),K=1,M)
      WRITE(6,FMGT) (TOWN(I,K),K=1,4), (ID(I,K),K=1,2),(X(K),K=1,M)
      IF(IRAW.EQ.1) GO TO 101
      DO 40 K=1,MT
      L=K+1
      GROW(I,K)=((X(L)-X(K))/X(L))*100.0
      GO TO 40
  101 MT=M
      DO 40 J=1,MT
      GROW(I,J)=X(J)
   40 CONTINUE
      WRITE(6,45)
   45 FORMAT(1H,5X,'NAME',5X,'IDENTIFICATION',5X,'GROWTH RATE'//)
      WRITE(6,FMTT) ((TOWN(I,K),K=1,4), (ID(I,K),K=1,2),
     1(GROW(I,K), K=1,MT), I=1,N)
C     SECTION TO FIND SMALLEST GROWTH IN ANY TIME PERIOD
      XSMALL=GROW(1,1)
      DO 50 I=1,N
      DO 50 K=1,MT
      IF(GROW(I,K).GE.XSMALL) GO TO 50
      XSMALL=GROW(I,K)
   50 CONTINUE
      IF(XSMALL.GE.0.0) GO TO 65
      XSMALL=ABS(XSMALL)+1.0
      DO 55 I=1,N
      DO 55 K=1,MT
```

```
      GROW(I,K)=GROW(I,K) + XSMALL
   55 CONTINUE
      WRITE(6,60)
   60 FORMAT(1H1,5X,'NAME',5X,'IDENTIFICATION',5X,'ADJUSTED GROWTH'//)
      WRITE(6,FMTT) ((TOWN(I,K),K=1,4), (ID(I,K),K=1,2), (GROW(I,K),
     1K=1,MT),I=1,N)
   65 CONTINUE
      DO 75 K=1,MT
      CSUM(K)=0.0
      DO 75 I=1,N
      CSUM(K) = CSUM(K) + GROW(I,K)
   75 CONTINUE
      DO 85 I=1,N
      DO 85 K=1,MT
      GROW(I,K) = GROW(I,K)/CSUM(K)
   85 CONTINUE
      WRITE(6,90)
   90 FORMAT(1H1,5X,'CLEANED DATA')
      WRITE(6,FMTT) ((TOWN(I,K),K=1,4),(ID(I,K),K=1,2),(GROW(I,K),
     1K=1,MT),I=1,N)
      CALL INFO
      IF(MORE.EQ.1)GO TO 100
      STOP
      END
```

```
      SUBROUTINE INFO
C
C     PROGRAM BY R.K. SEMPLE O.S.U. NOV. 1970
C
C     PROGRAM TO CALCULATE INEQUALITY MEASURES USING INFORMATION STATS
C     N IS THE NUMBER OF OBSERVATIONS LIMIT 300
C     M IS THE NUMBER OF GROWTH PERIODS LIMIT 30
C     NR IS THE NUMBER OF REGIONS
C
C     TOWN IS THE NAME OF OBSERVATION
C     GROW IS THE INDIVIDUAL PROPORTION OF TOTAL GROWTH (ADJUSTED)
C     TENT IS THE TOTAL ENTROPY ASSOCIATED WITH EACH TIME PERIOD
C     TINE IS THE TOTAL INEQUALITY FOR EACH TIME PERIOD
C     YR   IS THE GROUP PROPORTION OF TOTAL GROWTH FOR EACH PERIOD
C     PP IS THE NUMBER OF INDIVIDUALS IN EACH REGION
C     BINE IS THE TOTAL BETWEEN REGION INEQUALITY
C     WINE IS THE TOTAL WITHIN REGION INEQUALITY
C     YRT IS THE SUBREGIONAL PROPORTION OF EACH REGION FOR EACH PERIO
C     BRS IS THE TOTAL NUMBER OF INDIVIDUALS IN EACH SUBREGION
C     NSR IS THE NUMBER OF SUBREGINNS IN EACH REGION
C BWINEIS THE BETWEEN SUBREGION INEQUALITY WITHIN REGIONS
C     WWINEIS THE WITHIN SUBREGION INEQUALITY WITH REGIONS
C     FMT IS THE FORMAT TO READ IN DATA
C     FMGT IS THE FORMAT TO PRINT OUT DATA
C     FMTT IS THE FORMAT TO PRINT OUT REGIONAL PROPORTIONS OF GROWTH
C     ID IS THE IDENTIFICATION CODE FOR EACH OBSERVATION
C
      COMMON TOWN(300,4),GROW(300,21),ID(300,4),N,M,NF,MT
      DIMENSION TENT(30),TINT(30),YR(30,30)
      DIMENSION PP(30),BINE(30),AYR(30,30),WINE(30)
      DIMENSION YRT(30,30,30),RPS(30,30),BWINE(30),WWINE(30)
      DIMENSION TINE(30),NSR(30)
```

```
C      SECTION TO READ AND WRITE DATA
C
C
C      SECTION TO CALCULATE TOTAL GROUP ENTROPIES FOR M TIME PERIODS
C
       DO 47 K=1,MT
       BINE(K)=0.0
       BWINE(K)=0.0
       WWINE(K)=0.0
    47 TENT(K)=0.0
       WRITE(6,310)
   310 FORMAT(1H1,13X,'ENTROPY',7X,'OBSERVATION',3X,'PERIOD')
       DO 50 I=1,N
       DO 48 K=1,MT
       ENTR=GROW(I,K)*(ALOG(1.0/GROW(I,K))/ALOG(2.0))
       WRITE(6,555) ENTR,I,K
   555 FORMAT (10X,F15.8,I5)
    48 TENT(K)=TENT(K) + ENTR
    50 CONTINUE
C      SECTION TO CALCULATE TOTAL GROUP INEQUALITIES FOR M TIME PERIODS
C
       R=N
       DO 58 K=1,MT
       TINE(K)=(ALOG(R)/ALOG(2.0))-TENT(K)
       IF(TINE(K).GE.0.0) GO TO 58
       TINE(K)=0.00000
    58 CONTINUE
       WRITE(6,75)
    75 FORMAT(1H1,5X,'PERIOD',5X,'TOTAL ENTROPY',5X,'TOTAL INEQUALITY'/)
       DO 81 K=1,MT
       WRITE (6,80) K,TENT(K),TINE(K)
    80 FORMAT(7X,I4,5X,F15.8,10X,F15.8)
    81 CONTINUE
C
C      SECTION TO CALCULATE BETWEEN REGIONAL GROWTH INEQUALITY
       DO 83 L=1,NR
       PP(L)=0.0
       DO 83 K=1,MT
       RRS(L,K)=0.0
    83 YR(L,K)=0.0
       L=1
       DO 90 I=1,N
       DO 85 K=1,MT
       IF(ID(I,1).EQ.L) GO TO 85
       L=L+1
    85 YR(L,K)=YR(L,K) + GROW(I,K)
       PP(L)=PP(L) + 1.0
    90 CONTINUE
       WRITE(6,311)
   311 FORMAT(1H1,13X,'OBSERVATIONS',4X,'REGIONS')
       DO 87 L=1,NR
       WRITE(6,86)PP(L),L
    86 FORMAT(1H,20X,F5.0,5X,I5,2X)
    87 CONTINUE
       WRITE(6,312)
   312 FORMAT(1H1,10X,'INEQUALITY',4X,'PERIOD')
       DO 120 L=1,NR
       DO 120 K=1,MT
       AYR(L,K)=YR(L,K)*(ALOG(YR(L,K)/(PP(L)/R))/ALOG(2.0))
       WRITE(6,556) AYR(L,K),L,K
   556 FORMAT(10X,F15.8,5X,I5,5X,I5)
       BINE(K)=BINE(K) + AYR(L,K)
   120 CONTINUE
```

```
      WRITE(6,135) BINE(K),K
  135 FORMAT(20X,F15.8,5X,I5)
  136 CONTINUE
C
C     SECTION TO CALCULATE WITHIN REGION INEQUALITIES
C
      DO 150 K=1,MT
      WINE(K)=TINE(K)-BINE(K)
  150 CONTINUE
      WRITE(6,160)
  160 FORMAT(1H1,5X,'WITHIN REGIONAL INEQUALITY',5X,'PERIOD')
      DO 166 K=1,MT
      WRITE(6,165) WINE(K),K
  165 FORMAT(20X,E15.8,9X,I5)
  166 CONTINUE
C
C     SECTION TO CALCULATE BETWEEN SUB-REGIONAL INEQUALITIES
C     WITHIN REGIONS
      DO 168 L=1,NR
      DO 168 KK=1,30
      DO 168 K=1,MT
  168 YRT(L,KK,K)=0.0
      MM=1
      L=1
      KK=1
      DO 180 I=1,N
      DO 175 K=1,MT
      IF(ID(I,1).EQ.L)GO TO 170
      KK=1
      MM=1
      L=L+1
  170 IF(ID(I,2).EQ.KK)GO TO 175
      KK=KK+1
      MM=MM+1
  175 YRT(L,KK,K)=YRT(L,KK,K)+ GROW(I,K)
      RRS(L,KK)=RRS(L,KK) + 1.0
      NSR(L)=MM
  180 CONTINUE
      KK=1
      DO 200 L=1,NR
  190 CONTINUE
      DO 195 K=1,MT
  195 YRT(L,KK,K)=YRT(L,KK,K)/YR(L,K)
      KK=KK+1
      MM=NSR(L)
      IF(KK.LE.MM) GO TO 190
      KK=1
  200 CONTINUE
      TOP=0.0
      KK=1
      WRITE(6,313)
  313 FORMAT(1H1,2X,'SUBREGION PROPORTION',14X,'REGION',6X,'SUB',5X,'PER
```

```
      DO 121 K=1,MT
      IF(BINE(K).GE.0.0) GO TO 121
      BINE(K)=0.00000
  121 CONTINUE
      WRITE(6,130)
  130 FORMAT(1H1,5X,'BETWEEN REGIONAL INEQUALITY',5X,'PERIOD'/)
      DO 136 K=1,MT
  134 CONTINUE
```

```
     1IOD')
      DO 230 L=1,NR
  210 CONTINUE
      DO 220 K=1,MT
      TOP=YR(L,K)*YRT(1,KK,K)*(ALOG(YRT(L,KK,K)/(RRS(1,KK)/PP(L)))/ALOG(
     12.0))
      WRITE(6,997) YRT(L,KK,K),L,KK,K
  997 FORMAT(10X,F12.6,15X,I5,5X,I5,5X,I5)
      WRITE(6,998) RRS(L,KK),L,KK
  998 FORMAT(10X,F12.6,15X,I5,5X,I5)
      WRITE(6,999) PP(L),L
  999 FORMAT(10X,F12.6,15X,I5)
  220 BWINE(K)=BWINE(K) + TOP
      KK=KK+1
      MM=JSR(L)
      IF(KK.LE.MM)GO TO 120
      KK=1
  230 CONTINUE
      DO 231 K=1,MT
      IF(BWINE(K).GE.0.0) GO TO 231
      BWINE(K)=0.00000
  231 CONTINUE
      WRITE(6,250)
  250 FORMAT(1H1,5X,'BETWEEN SUBREGIONAL INEQUALITY WITHIN REGIONS',5X'
     1PERIOD')
      DO 256 K=1,MT
      WRITE(6,255) BWINE(K),K
  255 FORMAT(30X,E15.8,20X,I5)
  256 CONTINUE
C
C     SECTION TO CALCULATE WITHIN SUBREGIONAL INEQUALITY WITHIN REGIONS
C
      DO 300 K=1,MT
      WWINE(K)=WINE(K)-BWINE(K)
  300 CONTINUE
      WRITE(6,350)
  350 FORMAT(1H1,5X,'WITHIN SUBREGIONAL INEQUALITY WITHIN REGIONS',5X,'P
     1ERIOD')
      DO 356 K=1,MT
      WRITE(6,355) WWINE(K),K
  355 FORMAT(30X,F15.8,20X,I5)
  356 CONTINUE
      WRITE(6,400)
  400 FORMAT(1H1,25X,'SUMMARY TABLE OF INEQUALITY'/10X,'TOTAL',10X,'BETW
     1EEN REGION',5X,'BETWEEN SUBREGION',5X,'WITHIN SUBREGION')
      DO 402 K=1,MT
      WRITE(6,401) TINE(K),BINE(K),BWINE(K),WWINE(K)
  401 FORMAT(5X,E15.8,5X,E15.8,5X,E15.8,5X,E15.8)
  402 CONTINUE
      WRITE(6,403)
  403 FORMAT(1H1,20X,'SUMMARY TABLE OF INEQUALITY PROPORTIONS'/10X,'TOTA
     1L',10X,'BETWEEN REGION',5X,'BETWEEN SUBREGION',5X,'WITHIN SUBREGIO
```

```
     1H')
      DO 404 K=1,MT
      IF(TINE(K).LT.0.0)GO TO 404
      BINE(K)=BINE(K)/TINE(K)
      BWINE(K)=BWINE(K)/TINE(K)
      WWINE(K)=WWINE(K)/TINE(K)
      WRITE(6,405) TINE(K),BINE(K),BWINE(K),WWINE(K)
  405 FORMAT(7X,F10.5,10X,F10.5,8X,F10.5,8X,F10.5)
  404 CONTINUE
      RETURN
      END
```

NAME	IDENTIFICATION	RAW DATA				
CLEVELAND	11	29303.51	97616.75	409065.25	752966.00	1243651.00
GARFIELD	12	86057.56	327345.31	954633.06	1332087.00	2010074.00
OKLAHOMA	13	810264.44	2397055.00	7752682.00	14021680.00	19148672.00
TULSA	14	628176.69	2009720.00	5827336.00	11138717.00	15247466.00
WASHINGTON	15	58763.32	256291.94	540480.94	1066293.00	1346136.00
ALFALFA	21	11695.30	49612.14	142571.28	155832.13	156745.13
BEAVER	21	4002.71	17630.08	65312.67	94424.69	105115.63
BECKHAM	21	34856.45	92452.00	397355.50	425048.75	560749.50
CANADIAN	21	31792.45	93451.63	296563.50	421851.38	673443.50
CARTER	22	63508.70	189859.44	638484.44	954449.94	1371536.00
CREEK	22	66865.81	174869.94	455385.13	689736.94	1000309.31
CUSTER	22	31122.65	109976.06	318647.56	504988.31	777110.50
ELLIS	22	8715.37	24229.80	87309.38	86401.19	100050.30
GRADY	23	53596.88	145179.50	418634.56	566602.13	777270.81
HARPER	23	6866.59	19702.80	79022.63	127481.81	109119.81
JACKSON	23	36312.56	80188.94	276269.13	520479.50	739521.06
KAY	23	85570.00	302903.75	835899.81	1186178.00	1629397.00
KINGFISHER	24	16677.04	53088.20	175140.81	191128.75	379193.06
MAJOR	24	6106.24	28027.41	114519.19	108695.31	168176.38
PAYNE	24	45807.98	181089.19	609295.38	843318.19	1351792.00
PONTOTOC	24	35740.97	158723.81	383895.19	624951.88	923332.56
POTTAWATOMIE	25	63413.78	203642.06	570064.50	859986.44	1312911.00
STEPHENS	25	34274.15	132654.00	585355.44	963152.38	1218111.00
TEXAS	25	14352.12	54131.58	249113.81	316620.50	511706.44
WOODS	25	21010.56	71104.38	226673.56	255177.00	347264.75
WOODWARD	25	19024.54	60200.59	213006.81	355850.25	633390.25
BLAINE	31	18207.62	59877.99	191640.19	209237.19	309362.44
BRYAN	31	26779.76	106753.94	261790.25	381149.50	607259.31
CADDO	31	43760.44	122893.00	359514.56	449629.88	613115.88
CIMARRON	31	1938.04	11579.74	75857.56	98427.75	132802.50
COMANCHE	31	43451.40	233823.19	707882.50	1469195.00	2593808.00
COTTON	31	11404.76	35710.33	99714.06	107069.38	128225.69
CRAIG	31	11451.04	57631.41	167855.31	237002.69	378452.31
DEWEY	32	11298.29	27391.91	85034.94	94258.88	122976.31
GARVIN	32	26406.37	78464.50	444135.81	658592.75	726157.88
GRANT	32	13531.64	44414.41	120674.50	139716.63	133879.13
GREER	32	12527.02	43484.97	141566.31	149558.63	178967.13
HARMON	32	18566.70	23982.65	67604.63	110648.19	105607.31
JEFFERSON	32	17576.55	31576.33	88717.50	108562.50	127223.56
KIOWA	32	34015.02	79662.06	265212.81	289939.44	317769.25
LEFLORE	33	25858.95	94016.25	213346.25	317539.50	553808.06
LINCOLN	33	26766.06	68643.94	190387.75	270639.69	374664.56
LOGAN	33	35341.66	98132.19	256807.00	305330.50	384880.31
MCCLAIN	33	12248.67	34737.08	105571.50	148564.56	234327.81
MARSHALL	33	11014.68	36600.77	61928.30	123132.00	183423.69
MAYES	33	9369.90	37022.78	148181.06	295071.00	515754.88
MURRAY	33	13280.98	36372.32	116429.69	171803.25	261149.13
MUSKOGEE	34	93284.63	294312.25	852979.31	1198298.00	1846068.00
NOBLE	34	14815.68	52448.87	169805.25	219822.56	245719.94
NOWATA	34	13303.68	54634.68	127603.06	175945.69	148567.94
OKMULGEE	34	57600.33	192037.38	461690.69	600493.81	853763.69
OSAGE	34	40337.06	119124.81	263453.75	442056.06	437993.44
OTTAWA	34	36618.96	172868.88	377212.88	513588.44	820834.50
PAWNEE	34	15275.23	49081.29	122541.81	151832.69	214485.75
PITTSBURG	35	38199.41	150505.69	420826.63	543046.38	1014784.75
ROGER MILLS	35	7855.51	17690.06	54568.20	52315.69	55404.12
ROGERS	35	13303.16	55036.74	179687.00	283629.50	528988.94
SEMINOLE	35	63441.57	249894.31	547766.94	636201.28	655513.94
TILLMAN	35	33169.29	79192.50	219476.56	242927.94	270323.06

WASHITA	35	23011.32	53880.52	147591.19	198047.94	206126.88
ADAIR	41	6977.69	24723.59	76834.13	108787.38	186084.19
ATOKA	41	6449.90	33260.44	77715.19	104404.63	187681.19
CHEROKEE	41	9694.51	26815.82	108263.06	200545.94	441962.75
CHOCTAW	41	13287.15	63136.82	151839.38	181892.38	303105.94
COAL	42	9611.62	23829.16	50774.51	54194.64	74056.50
DELAWARE	42	3568.24	14421.06	53005.38	106528.75	250285.81
HASKELL	42	8036.25	29601.14	79218.25	101013.69	166365.63
HUGHES	42	24416.82	80133.31	169496.00	192911.31	254036.56
JOHNSTON	43	6879.45	26079.16	55215.74	79117.19	113987.06
LATIMER	43	5537.48	16753.70	49086.19	52237.27	107729.19
LOVE	43	6334.90	18372.28	40443.25	60811.76	79465.13
MCCURTAIN	43	19501.15	80982.63	183918.06	259465.44	515289.19
MCINTOSH	44	13995.31	47424.60	88554.94	149415.25	241994.31
OKFUSKEE	44	15523.55	52937.51	110453.19	116930.38	161832.75
PUSHMATAHA	44	9457.93	31563.67	72145.31	90739.06	352750.81
SEQUOYAH	45	8340.29	27454.83	93517.38	150132.81	352750.75
WAGONER	45	9637.14	27702.35	100640.38	172627.38	232958.06

ENTROPY	OBSERV	ENTROPY	OBSERV	ENTROPY	OBSERV	ENTROPY	OBSERV
0.05971873	1	0.01158262	7	0.02230442	13	0.01656099	19
0.00000000		0.00000000		0.00000000		0.00000000	
0.06110379	1	0.01504412	7	0.01965225	13	0.02219028	19
0.00000000		0.00000000		0.00000000		0.00000000	
0.07971442	1	0.01807000	7	0.02302588	13	0.02881673	19
0.00000000		0.00000000		0.00000000		0.00000000	
0.08929832	1	0.01547823	7	0.01530866	13	0.01856828	19
0.00000000		0.00000000		0.00000000		0.00000000	
0.09890699	1	0.01341214	7	0.01286197	13	0.01992083	19
0.00000000		0.00000000		0.00000000		0.00000000	
0.13553798	2	0.06943513	8	0.09531611	14	0.08455664	20
0.00000000		0.00000000		0.00000000		0.00000000	
0.15228504	2	0.05853855	8	0.08322048	14	0.09843762	20
0.00000000		0.00000000		0.00000000		0.00000000	
0.15442276	2	0.07794708	8	0.08114761	14	0.10790974	20
0.00000000		0.00000000		0.00000000		0.00000000	
0.13518029	2	0.05657040	8	0.07109749	14	0.09624898	20
0.00000000		0.00000000		0.00000000		0.00000000	
0.14108622	2	0.05328517	8	0.06892294	14	0.10531479	20
0.00000000		0.00000000		0.00000000		0.00000000	
0.49500823	3	0.06367689	9	0.01927677	15	0.06978673	21
0.00000000		0.00000000		0.00000000		0.00000000	
0.48111409	3	0.05903797	9	0.01652187	15	0.08910364	21
0.00000000		0.00000000		0.00000000		0.00000000	
0.49337980	3	0.06204370	9	0.02119179	15	0.07589650	21
0.00000000		0.00000000		0.00000000		0.00000000	
0.50955474	3	0.05623300	9	0.02121513	15	0.07650924	21
0.00000000		0.00000000		0.00000000		0.00000000	
0.50437945	3	0.06159476	9	0.01384370	15	0.07878160	21
0.00000000		0.00000000		0.00000000		0.00000000	
0.45250112	4	0.10831076	10	0.07065511	16	0.10818964	22
0.00000000		0.00000000		0.00000000		0.00000000	
0.45042789	4	0.10206455	10	0.05228982	16	0.10757792	22
0.00000000		0.00000000		0.00000000		0.00000000	
0.44539779	4	0.11174721	10	0.05867444	16	0.10265326	22
0.00000000		0.00000000		0.00000000		0.00000000	
0.47573841	4	0.10566288	10	0.06635404	16	0.09768552	22
0.00000000		0.00000000		0.00000000		0.00000000	
0.46919608	4	0.10646611	10	0.06629181	16	0.10303104	22
0.00000000		0.00000000		0.00000000		0.00000000	
0.10217941	5	0.11255550	11	0.13496774	17	0.06754011	23
0.00000000		0.00000000		0.00000000		0.00000000	
0.12756169	5	0.09591711	11	0.14403719	17	0.07763064	23
0.00000000		0.00000000		0.00000000		0.00000000	
0.09961022	5	0.03656281	11	0.13625818	17	0.10471594	23
0.00000000		0.00000000		0.00000000		0.00000000	
0.11477482	5	0.08255780	11	0.12433553	17	0.10638440	23
0.00000000		0.00000000		0.00000000		0.00000000	
0.10498393	5	0.08379132	11	0.12102187	17	0.09736753	23
0.00000000		0.00000000		0.00000000		0.00000000	
0.02345210	6	0.06262022	12	0.03802771	18	0.03365258	24
0.00000000		0.00000000		0.00000000		0.00000000	
0.03551586	6	0.05709844	12	0.03752674	18	0.03812424	24
0.00000000		0.00000000		0.00000000		0.00000000	
0.03448284	6	0.06564343	12	0.04075358	18	0.05405328	24
0.00000000		0.00000000		0.00000000		0.00000000	
0.02506714	6	0.06480134	12	0.02966506	18	0.04471992	24
0.00000000		0.00000000		0.00000000		0.00000000	
0.01878142	6	0.06891185	12	0.03891874	18	0.04953593	24
0.00000000		0.00000000		0.00000000		0.00000000	

0.04582293	25	0.08119315	31	0.03010555	37	0.06917775	43
0.00000000		0.00000000		0.00000000		0.00000000	
0.04750172	25	0.11922865	31	0.03189113	37	0.06135779	43
0.00000000		0.00000000		0.00000000		0.00000000	
0.05013816	25	0.12063676	31	0.03428439	37	0.05537433	43
0.00000000		0.00000000		0.00000000		0.00000000	
0.03756507	25	0.14511085	31	0.02422805	37	0.04343210	43
0.00000000		0.00000000		0.00000000		0.00000000	
0.03623594	25	0.16919357	31	0.02098250	37	0.03939098	43
0.00000000		0.00000000		0.00000000		0.00000000	
0.04230357	26	0.02786862	32	0.04143352	38	0.02955492	44
0.00000000		0.00000000		0.00000000		0.00000000	
0.04154873	26	0.02712382	32	0.01948446	38	0.02651211	44
0.00000000		0.00000000		0.00000000		0.00000000	
0.04770579	26	0.02570673	32	0.02309056	38	0.02694812	44
0.00000000		0.00000000		0.00000000		0.00000000	
0.04911053	26	0.01833518	32	0.01884736	38	0.02409443	44
0.00000000		0.00000000		0.00000000		0.00000000	
0.05868619	26	0.01586514	32	0.01346530	38	0.02624451	44
0.00000000		0.00000000		0.00000000		0.00000000	
0.04083056	27	0.02795178	33	0.03968190	39	0.02708021	45
0.00000000		0.00000000		0.00000000		0.00000000	
0.04136882	27	0.04010947	33	0.02449995	39	0.02768040	45
0.00000000		0.00000000		0.00000000		0.00000000	
0.04382359	27	0.03937630	33	0.02333396	39	0.01723057	45
0.00000000		0.00000000		0.00000000		0.00000000	
0.03195150	27	0.03537420	33	0.01854927	39	0.02060968	45
0.00000000		0.00000000		0.00000000		0.00000000	
0.03297650	27	0.03395711	33	0.01576056	39	0.02141723	45
0.00000000		0.00000000		0.00000000		0.00000000	
0.05561224	28	0.02765400	34	0.06714040	40	0.02368782	46
0.00000000		0.00000000		0.00000000		0.00000000	
0.06555426	28	0.02177060	34	0.05201603	40	0.02794318	46
0.00000000		0.00000000		0.00000000		0.00000000	
0.05622452	28	0.02252612	34	0.05580601	40	0.03558465	46
0.00000000		0.00000000		0.00000000		0.00000000	
0.05187762	28	0.01647384	34	0.04165779	40	0.04225182	46
0.00000000		0.00000000		0.00000000		0.00000000	
0.05676340	28	0.01531564	34	0.03370689	40	0.04984877	46
0.00000000		0.00000000		0.00000000		0.00000000	
0.08163726	29	0.05499623	35	0.05410560	41	0.03158380	47
0.00000000		0.00000000		0.00000000		0.00000000	
0.07316619	29	0.05139196	35	0.05931943	41	0.02753789	47
0.00000000		0.00000000		0.00000000		0.00000000	
0.07212812	29	0.08491981	35	0.04775667	41	0.02921158	47
0.00000000		0.00000000		0.00000000		0.00000000	
0.05914238	29	0.07967210	35	0.04482425	41	0.02717236	47
0.00000000		0.00000000		0.00000000		0.00000000	
0.05719643	29	0.06535149	35	0.05313839	41	0.02869793	47
0.00000000		0.00000000		0.00000000		0.00000000	
0.00621234	30	0.03207115	36	0.05558969	42	0.14367437	48
0.00000000		0.00000000		0.00000000		0.00000000	
0.01052789	30	0.03244799	36	0.04617916	42	0.14107680	48
0.00000000		0.00000000		0.00000000		0.00000000	
0.02048125	30	0.03008392	36	0.04359286	42	0.13827306	48
0.00000000		0.00000000		0.00000000		0.00000000	
0.01708456	30	0.02289687	36	0.03940076	42	0.12511331	48
0.00000000		0.00000000		0.00000000		0.00000000	
0.01634081	30	0.01645225	36	0.03854151	42	0.13263130	48
0.00000000		0.00000000		0.00000000		0.00000000	

0.03453709	49	0.07349461	55	0.01952433	61	0.02085099	67
0.00000000		0.00000000		0.00000000		0.00000000	
0.03715918	49	0.08553323	55	0.01998650	61	0.02322143	67
0.00000000		0.00000000		0.00000000		0.00000000	
0.03974628	49	0.08147448	55	0.02070110	61	0.02123552	67
0.00000000		0.00000000		0.00000000		0.00000000	
0.03326772	49	0.06859314	55	0.01858146	61	0.01746092	67
0.00000000		0.00000000		0.00000000		0.00000000	
0.02729350	49	0.08472025	55	0.02167575	61	0.01974137	67
0.00000000		0.00000000		0.00000000		0.00000000	
0.03162304	50	0.02045462	56	0.01734124	62	0.05167479	68
0.00000000		0.00000000		0.00000000		0.00000000	
0.03952542	50	0.01508732	56	0.02557705	62	0.05226095	68
0.00000000		0.00000000		0.00000000		0.00000000	
0.03149359	50	0.01553462	56	0.02039897	62	0.03968768	68
0.00000000		0.00000000		0.00000000		0.00000000	
0.02771151	50	0.00999570	56	0.01795167	62	0.02989217	68
0.00000000		0.00000000		0.00000000		0.00000000	
0.01795647	50	0.00775948	56	0.02183058	62	0.02805278	68
0.00000000		0.00000000		0.00000000		0.00000000	
0.10065216	51	0.03162701	57	0.02436654	63	0.01830323	69
0.00000000		0.00000000		0.00000000		0.00000000	
0.10294437	51	0.03864050	57	0.02133845	63	0.02089673	69
0.00000000		0.00000000		0.00000000		0.00000000	
0.08747840	51	0.04160614	57	0.02751365	63	0.01568992	69
0.00000000		0.00000000		0.00000000		0.00000000	
0.07417840	51	0.04092390	57	0.03085977	63	0.01421090	69
0.00000000		0.00000000		0.00000000		0.00000000	
0.07414687	51	0.05086714	57	0.04404414	63	0.01436442	69
0.00000000		0.00000000		0.00000000		0.00000000	
0.07656326	52	0.10822505	58	0.03159584	64	0.01525116	70
0.00000000		0.00000000		0.00000000		0.00000000	
0.07141560	52	0.12521672	58	0.04317579	64	0.01440977	70
0.00000000		0.00000000		0.00000000		0.00000000	
0.05650739	52	0.09961253	58	0.03629805	64	0.01420569	70
0.00000000		0.00000000		0.00000000		0.00000000	
0.05835398	52	0.07758176	58	0.02848081	64	0.00998289	70
0.00000000		0.00000000		0.00000000		0.00000000	
0.04372546	52	0.06102286	58	0.03243006	64	0.01369415	70
0.00000000		0.00000000		0.00000000		0.00000000	
0.07111907	53	0.06583005	59	0.02419367	65	0.01708104	71
0.00000000		0.00000000		0.00000000		0.00000000	
0.09508383	53	0.05177162	59	0.01938009	65	0.01557681	71
0.00000000		0.00000000		0.00000000		0.00000000	
0.07487071	53	0.04886198	59	0.01461774	65	0.01205363	71
0.00000000		0.00000000		0.00000000		0.00000000	
0.06566495	53	0.03609258	59	0.01030178	65	0.01136575	71
0.00000000		0.00000000		0.00000000		0.00000000	
0.07191509	53	0.02952449	59	0.00995374	65	0.01057174	71
0.00000000		0.00000000		0.00000000		0.00000000	
0.03540777	54	0.04923670	60	0.01050163	66	0.04315595	72
0.00000000		0.00000000		0.00000000		0.00000000	
0.03520599	54	0.03798072	60	0.01269072	66	0.05270141	72
0.00000000		0.00000000		0.00000000		0.00000000	
0.03046554	54	0.03546925	60	0.01515839	66	0.04239499	72
0.00000000		0.00000000		0.00000000		0.00000000	
0.02453303	54	0.02927145	60	0.01825753	66	0.03807673	72
0.00000000		0.00000000		0.00000000		0.00000000	
0.02439149	54	0.02360022	60	0.02771101	66	0.04981281	72
0.00000000		0.00000000		0.00000000		0.00000000	

0.03296740	73
0.00000000	
0.03423399	73
0.00000000	
0.02329844	73
0.00000000	
0.02420879	73
0.00000000	
0.02695160	73
0.00000000	
0.03537577	74
0.00000000	
0.03744014	74
0.00000000	
0.02797162	74
0.00000000	
0.01973875	74
0.00000000	
0.01929046	74
0.00000000	
0.02387248	75
0.00000000	
0.02449181	75
0.00000000	
0.01964035	75
0.00000000	
0.01595424	75
0.00000000	
0.03670085	75
0.00000000	
0.02150223	76
0.00000000	
0.02181224	76
0.00000000	
0.02437671	76
0.00000000	
0.02430528	76
0.00000000	
0.03670085	76
0.00000000	
0.02424693	77
0.00000000	
0.02197586	77
0.00000000	
0.02590404	77
0.00000000	
0.02727984	77
0.00000000	
0.02611767	77
0.00000000	

PERIOD	TOTAL ENTROPY	TOTAL INEQUALITY
1	4.72763920	1.53914642
2	4.80507946	1.46170616
3	4.75365162	1.51313400
4	4.43684864	1.82993698
5	4.51020241	1.75658321

OBSERVATIONS	REGIONS
5.	1
21.	2
34.	3
17.	4

INEQUALITY	PERIOD	
1.38737106	1	1
1.33580780	1	2
1.38421822	1	3
1.66400909	1	4
1.58669376	1	5
-0.08340764	2	1
-0.08285183	2	2
-0.06749946	2	3
-0.09270209	2	4
-0.09930415	2	5
-0.19817168	3	1
-0.19350398	3	2
-0.20428973	3	3
-0.22183377	3	4
-0.22123009	3	5
-0.10398751	4	1
-0.11164075	4	2
-0.10585660	4	3
-0.10041088	4	4
-0.10984409	4	5

BETWEEN REGIONAL INEQUALITY	PERIOD
0.99680263	1
0.94781035	2
1.00657082	3
1.24906063	4
1.16631413	5

WITHIN REGIONAL INEQUALITY	PERIOD
0.54234380E 00	1
0.51389581E 00	2
0.50656319E 00	3
0.58087635E 00	4
0.59026909E 00	5

A P P E N D I X C

DATA SOURCES FOR CHAPTER IV

DATA	BASIC DATA SOURCE*
1. Sales Tax Revenues	Oklahoma Tax Commission. *Oklahoma Sales Tax and Use Tax.*
2. Per Capita Income	U.S. Bureau of the Census. *General Social and Economic Characteristics: Oklahoma.* PC(1)-C38, 1970.
3. Education	U.S. Bureau of the Census. *Census of Population.* V.II, Part 5, 1940, 1950, 1960, 1970.
4. Housing	U.S. Bureau of the Census. *Housing.* V. II, Table 22, 1940.
	U.S. Bureau of the Census. *City and County Data Book.* 1952, 1962.
	U.S. Bureau of the Census. *Census of Housing, Detailed Characteristics, Oklahoma.* 1970.
5. Infant Mortality	U.S. Bureau of the Census. *Vital Statistics of the U.S.* 1940, Part I, 1950, V.II. 1960, V.II 1970, V.II.
6. Divorce	U.S. Bureau of the Census. *Vital Statistics of the U.S.* V.II, Part 2, 1950. V.III, 1960, V.III, 1970.
7. Migration	U.S. Bureau of the Census. *Vital Statistics of the U.S.* 1930, Part II, "By Place of Residence". 1940, Part II, 1950, Part II, 1960, Part II, 1970, Part II.

---

*These are the sources of the basic data. In most cases, the data were re-calculated and used in a form other than that in which it was reported.

A P P E N D I X D

METHOD OF APPROACH FOR UPDATING OKLAHOMA'S COUNTY PERSONAL INCOME

The method of approach used in updating county personal income for Oklahoma is similar to that used for the previous estimates for the 1950–62 period. This section briefly describes the method used for arriving at the estimates for 1960–68. In order to simplify the presentation and make it more precise, some mathematical equations are used. For further background, the reader is referred to Chapter II of Peach, et. al., *County Building Block Data for Regional Analysis: Oklahoma*, Research Foundation, Oklahoma State University, Stillwater, 1965.

The technique employed involves using the annual state estimates of personal income prepared by the National Income Division (NID) of the U.S. Department of Commerce, and locating direct information on each of the specific components to be disaggregated to the county level. In other words, the problem is to construct a series of allocators by means of which state totals for various components of personal income can be allocated to counties.

In the construction of allocators for these components of personal income, it is necessary to use data that have a direct and reliable relationship to the particular income component being allocated to the counties. The final estimate of personal income in each county is obtained from a summation of county totals for each of these components of personal income.

By definition, county personal income is the sum of wages and salary disbursements, other labor income, proprietors' income, property income, transfer payments, less personal contributions for Social Security. In a mathematical form, the relation is:

$$Y_i = W_i + L_i + P_i + C_i + T_i - S_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where Y_i = personal income in county i.

W_i = wages and salaries paid in county i.

L_i = other labor income paid in county i.

P_i = proprietors' income paid in county i.

C_i = property income paid in county i.

T_i = transfer payments paid in county i.

S_i = personal contributions for Social Security in county i.

The procedures for estimating the variables in Eq. (1) can be explained as follows:

I. Wage and Salary Disbursements[1] (W_i)

A. Total wage and salary disbursements are computed by using the following technique:

1. Farm Wages ($W_{1,i}$):

$$W_{1,i} = \frac{w_i^*}{\sum_{i=1}^{77} w_i^*}$$

$$i = 1,2,\ldots,77.$$

where w_i^* = wages paid hired farm workers (data from the U.S. Bureau of the Census, *Census of Agriculture).* [2]

$W_{1,s}$ = NID state total of farm wages for Oklahoma.

[1] Total wage and salary disbursements consist of wages and salaries paid in the following sectors: farm, mining, construction, manufacturing, trade, finance, transportation, service, government, and other industries.

[2] The census of agriculture is taken every five years. The *Census of Agriculture* put out by the Bureau of the Census for 1959 and 1964 were used. Allocators for 1962 and 1963 were derived through interpolation, and 1964 allocators were used for 1965–68.

2. Wages and salaries for mining ($W_{2,i}$)
   Construction ($W_{3,i}$)
   Manufacturing ($W_{4,i}$)
   Trade ($W_{5,i}$)
   Finance, insurance and real estate ($W_{6,i}$)
   Transportation and public utilities ($W_{7,i}$)
   Service industries ($W_{8,i}$)

   (The above are derived from the same procedure. The numbers represent industry, and i, the county. The wages and salaries for these industries consist of two parts, namely, covered and non-covered wages.)

   a. Covered wages ($W^c_{k,j}$) in county j:

$$W^c_{k,j} = \frac{W_{k,j}}{\sum_{j=1}^{49} \bar{w}^c_{k,j}} \cdot \left(\bar{w}_m + \sum_{j=1}^{49} \bar{w}^c_{k,j}\right) \qquad \text{(2a)}$$

$k = 2, 3, \ldots, 8.$
$j = 1, 2, \ldots, 49.$

where $\bar{w}^c_{k,j}$ = covered wages and salaries paid in OESC selected counties.[3] (Data from OESC).

$\bar{w}_m$ = OESC covered wages and salaries paid in multicounty area.[4]

[3]There are 49 selected counties and a multi-county area which could not be classified by county in OESC's publication entitled *County Employment and Wage Data, 1967.* Industrial detail is not shown for the remaining 28 counties to avoid publishing information that would identify individual firms.

[4]This includes wages paid to statewide sales personel with no permanent place of work and other types of roving employment, and all others whose place of work could not be determined.

b. Non-covered wages ($W^{n}_{k,i}$) in county i:

$$W^{n}_{k,i} = \frac{w'_{k,i} \cdot E_{k,i}}{\sum_{i=1}^{77} w'_{k,i} \cdot E_{k,i}} \cdot (W_{k,s} - \sum_{j=1}^{49} W^{c}_{k,j}) \quad \ldots . (2b)$$

$k = 2,3,\ldots,8.$
$j = 1,2,\ldots,49.$
$i = 1,2,\ldots,77.$

where $w'_{k,i}$ = computed annual average wages for industry k. (Data from the U.S. Department of Commerce, *County Business Patterns* (CBP).

$E_{k,i}$ = CBP number of reporting units by employment-size "1 to 3" *times* 2 (the mid-point) for industry k in county i.

$W_{k,s}$ = NID state industry wage and salary totals for industry k in Oklahoma.

c. Wages and salaries for mining, construction, manufacturing, trade, finance, insurance and real estate, transportation and public utilities, and service industries are equal to the sum of (2a) and (2b):

$$W_{k,i} = W^{c}_{k,j} + W^{n}_{k,i} \quad \ldots\ldots (2c)$$

$k = 2,3,\ldots,8.$
$j = 1,2,\ldots,49.$
$i = 1,2,\ldots,77.$

3. Wages and salaries paid in the government sector[5] ($W_{9,i}$):

a. Federal civilian ($W^{v}_{9,i}$):

[5] Total government wages and salaries consist of three parts: federal civilian, federal military, and state and local government.

$$W^{v}_{9,i} = \frac{G_i}{\sum_{i=1}^{77} G_i} \cdot W^{v}_{9,s} \quad \text{(3a)}$$

$i = 1,2,\ldots,77.$

where G = OESC civilian federal wages (unpublished data).

$W^{v}_{9,j}$ = NID state total for federal civilian wages for Oklahoma.

b. Federal military ($W^{m}_{9,i}$):

$$W^{m}_{9,j} = \frac{E^{m}_{j}}{\sum_{j=1}^{6} E^{m}_{j}} \cdot W^{m}_{9,s} \quad \text{(3b)}$$

where j = the number of counties where military bases are located.[6]

E^{m}_{j} = military employment in county j where the military bases are located (unpublished data from the Department of Defense).

$W^{m}_{9,s}$ = NID state total of military wages for Oklahoma.

c. State and local ($W^{s}_{9,s}$):

$$W^{s}_{9,i} = \frac{E^{s}_{i}}{\sum_{i=1}^{77} E^{s}_{i}} \cdot W^{s}_{9,s} \quad \text{(3c).}$$

$i = 1,2,\ldots,77.$

Where E^{s}_{i} = state and local government employment in county i (unpublished data from OESC).

$W^{s}_{9,s}$ = NID state total of state and local government wages for Oklahoma.

[6]There are a few counties with military employment. In 1967, for example, only Comanche, Pittsburg, Jackson, Washita, Oklahoma and Garfield counties fell into this group.

d. Total government wages and salaries ($W_{9,i}$) are obtained by adding (3a), (3b), and (3c):

$$W_{9,i} = W^{v}_{9,i} + W^{m}_{9,j} + W^{s}_{9,i} \quad \text{.............................. (3d)}$$

i = 1,2, . . ., 77.
j = number of counties with military bases.

4. Wages and salaries for other industries ($W_{10,i}$):

$$W_{10,i} = \frac{\bar{w}^{c}_{i}}{\sum_{i=1}^{77} \bar{w}^{c}_{i}} \cdot W_{10,s} \quad \text{....................... (4a)}$$

i = 1,2, . . ., 77.

where $\bar{w}^{c}_{i}$ = total covered wages for county i (data from OESC).

$W_{10,s}$ = NID state total for other industries for Oklahoma.

B. Total wages and salaries (W_i) is obtained by adding (1a), (2c), (3d), and (4a):

$$W_i = W_{1,i} + \sum_{k=2}^{8} W_{k,i} + W_{9,i} + W_{10,i} \quad \text{....................... (5)}$$

i = 1,2, . . ., 77.

II. Other Labor Income (L_i):

$$L_i = \frac{W_i}{\sum_{i=1}^{77} W_i} \cdot L_s \quad \text{.............................. (6)}$$

where L_s = NID state total of other labor income for Oklahoma.

III. Proprietors' Income[7] **(P_i):**

A. Farm proprietors' income (P_i^f):

$$P_i^f = \frac{V_i}{\sum_{i=1}^{77} V_i} \cdot P_s^f \quad \text{.................................} \quad (7a)$$

$i = 1,2,\ldots,77.$

where V_i = value of the farm product sold in county i (data from the Bureau of the Census).[8]

P_s^f = NID state total of farm proprietors' income.

B. Nonfarm proprietors' income (P_i^{nf}):

$$P_i^{nf} = \frac{Q_i}{\sum_{i=1}^{77} Q_i} \cdot P_s^{nf} \quad \text{.................................} \quad (7b)$$

$i = 1,2,\ldots,77.$

where Q_i = sales taxes paid in county i (data from Oklahoma Tax Commission).

P_s^{nf} = NID state total of nonfarm proprietors' income for Oklahoma.

C. Total proprietors' income for county i (P_i) is the sum of (7a) and (7b):

$$P_i = P_i^f + P_i^{nf} \quad \text{.....................................} \quad (8)$$

$i = 1,2,\ldots,77.$

[7]Total proprietors' income includes that of farm proprietors and nonfarm proprietors.

[8]1962 and 1963 allocators were obtained by interpolating the census figures of 1959 and 1964. For the 1965–68 period, 1964 allocators were used.

IV. **Property Income** (C_i):

$$C_i = \frac{D_i}{\sum_{i=1}^{77} D_i} \cdot C_s \quad \text{.......... (9)}$$

$i = 1,2,\ldots,77.$

where D_i = total bank deposits in county i (data from the Federal Deposit Insurance Corporation (FDIC).[9]

C_s = NID state total property income for Oklahoma.

V. **Transfer Payments** (T_i):

The NID subcomponents of total transfer payments for Oklahoma are grouped into six categories and allocated to counties in the following manner:

A. OASDI (I_i):

$$I_i = \frac{I_i^*}{\sum_{i=1}^{77} I_i^*} \cdot I_s \quad \text{.......... (10a)}$$

$i = 1,2,\ldots,77.$

where I_i^* = annual OASDI payments in county i (data from the Social Security Administration).

I_s = NID state total of OASDI for Oklahoma.

B. Veterans benefits (B_i):

$$B_i = \frac{N_i}{\sum_{i=1}^{77} N_i} \cdot B_s \quad \text{.......... (10b)}$$

$i = 1,2,\ldots,77.$

[9]Federal Deposit Insurance Corporation data are available for every two years. The intervening years were obtained by interpolation.

where N_i = number of county residents of veterans in county i (data from the Veterans Administration).

B_s = NID state total of veterans benefits for Oklahoma.

C. State unemployment insurance benefits (U_i) :

$$U_i = \frac{\bar{u}_i}{\sum_{i=1}^{77} \bar{u}_i} \cdot U_s \qquad \text{(10c)}$$

$i = 1,2,\ldots,77.$

where $\bar{u}$ = state unemployment insurance payments in county i (data from OESC).

U_s = NID state total of state unemployment insurance benefits for Oklahoma.

D. Medicare (M_i) :

$$M_i = \frac{m_i}{\sum_{i=1}^{77} m_i} \cdot M_s \qquad \text{(10d)}$$

$i = 1,2,\ldots,77.$

where m_i = number of persons enrolled in both the hospital and the medical benefits programs in county i (data from the U.S. Department of Health, Education, and Welfare).

M_s = NID state total of Medicare for Oklahoma.

E. State and local direct relief (R_i) :

$$R_i = \frac{A_i}{\sum_{i=1}^{77} A_i} \cdot R_i \qquad \text{(10e)}$$

$i = 1,2,\ldots,77.$

where A_i = total payments of public assistance in county i (data from Oklahoma Department of Public Welfare).

R_s = NID state total of state and local direct relief for Oklahoma.

F. Other – i.e., the remaining components of transfer payments– (X_i) :

$$X_i = \frac{H_i}{\sum_{i=1}^{77} H_i} \cdot (T_s - I_s - B_s - U_s - M_s - R_s) \qquad (10f)$$

$i = 1,2,\ldots,77.$

where X_i = population in county i.

G. Total transfer payments is the sum of (10a), (10b), (10c), (10d), (10e), and (10f):

$$T_i = I_i + B_i + U_i + M_i + R_i + X_i \qquad (10g)$$

$i = 1,2,\ldots,77.$

VI. **Personal Contributions for Social Insurance (S_i) :**

$$S_i = \frac{w_i^t}{\sum_{i=1}^{77} w_i^t} \cdot S_i \qquad (11)$$

$i = 1,2,\ldots,77.$

where w_i^t = taxable payrolls of county i (data from CBP).

S_i = NID state total of personal contributions for social insurance.

VII. **Total Personal Income:**

The sum of (5), (6), (8), (9), and (10g) minus (11) will yield (1), the equation for total personal income for each county of Oklahoma.

A P P E N D I X E

NET MIGRATION DATA

Net Migration

Region	1930-1940	1940-1950	1950-1960	1960-1970
I	4999	73110	63491	41738
II	-114615	-112672	-79280	-18328
III	-172257	-239418	-144611	-45639
IV	-9244	-135799	-77015	13384

Population

Region	1930	1940	1950	1960
I	507625	541294	721394	928466
II	606003	549926	704181	490514
III	958789	887740	507951	694645
IV	323623	357474	268217	214679

Percent Gain or Loss

Region	1930-40	1940-50	1950-60	1960-70
I	.01	.13	.08	.04
II	-.18	-.20	-.11	-.03
III	-.17	-.26	-.28	-.06
IV	-.02	-.37	-.28	-.06

Source: Author's Computations.
U.S. Bureau of The Census. Census of Population, General Population Characteristics, Oklahoma, 1970.

BIBLIOGRAPHY

Public Documents, Discussion Papers, and Other

Bureau of Business Research, University of Oklahoma. County Personal Income in Oklahoma 1960-1970. Norman, Oklahoma: University of Oklahoma, 1971.

DiLisio, James E. "The Spatial Structure of Socio-Economic Differences: A Factorial Ecology of Okalhoma." Unpublished paper, May 1973.

Griffin, J. M. and Semple, R. K. An Information Analysis of Trends in Urban Growth Inequality in Canada. Department of Geography, Ohio State University: Discussion Paper Number 19, April, 1971.

Hagle, Paul. Housing and People in Oklahoma: A Study of County Housing Conditions and Characteristics. Stillwater, Oklahoma: Department of Geography Extension Program, 1972.

Hagle, P., Schreiner, D., Warner, L., and Watson, R. Basic Data and Projections for the Oklahoma Economy by Planning Districts. Stillwater, Oklahoma: Oklahoma State University Research Foundation, 1973.

Oklahoma Industrial Development and Parks Department. Oklahoma Directory of Manufactures and Products, 1972. Oklahoma City: State of Oklahoma, 1972.

President's National Advisory Commission on Rural Poverty. The People Left Behind. Washington D.C.: Government Printing Office, 1967.

State Planning Coordination Office, Office of Community Affairs and Planning. Substate Planning Districts in Oklahoma. Oklahoma City: Cimarron Data Services, Ltd., 1972.

Statistical Abstract of Oklahoma, 1974. Norman, Oklahoma: Bureau of Business and Economic Research, University of Oklahoma, 1972.

Stöhr, W. B. Interurban Systems and Regional Economic Development. Association of American Geographers, Washington D.C.: Commission on College Geography Resource Paper Number 26, 1974.

University of Chicago. Essays on Geography and Economic Development. Chicago: Department of Geography Research Paper Number 62, University of Chicago Press, 1960.

Wilbanks, T. J. "Regional Equality and the Evolution of Income Surfaces." Unpublished paper presented at the 62nd annual meeting of the Oklahoma Academy of Science, Oklahoma City, November 16, 1973.

Books

Bauer, Raymond A. Social Indicators. Cambridge: M.I.T. Press, 1966.

Berry, B. J. L., (Guest editor). "Comparative Factorial Ecology," Economic Geography, Vol. 47, No. 2 (June 1971) supplement issue.

Blalock, Hubert M., Jr. and Blalock, Ann B. Methodology in Social Research. New York: McGraw-Hill, 1968.

Denzin, Norman K. (editor). Sociological Methods: A Sourcebook. New York: Aldine Publishing Company, 1970.

Friedmann, John. Regional Development Policy. Cambridge: M.I.T. Press, 1966.

Galbraith, John Kenneth. Economic Development. Boston: Houghton-Mifflin, 1962.

Hamilton, David. A Primer on the Economies of Poverty. New York: Random House, 1968.

Harlow, Victor. Harlow's Oklahoman History. Norman, Oklahoma: Harlow Publishing Company, 1967.

Harries, Keith D. The Geography of Crime and Justice. New York: McGraw-Hill, 1974.

Heilbroner, Robert L. The Great Ascent: The Struggle for Economic Development in Our Time. New York: Harper and Row, 1963.

Hicks, J. R. Essays in World Economics. Oxford, Claredon Press, 1959.

Higgins, Benjamin. Economic Development. New York: W. W. Norton & Company, 1968.

Hoover, Edgar. An Introduction to Regional Economics. New York: A. A. Knopf, Inc., 1971.

Hurry, Jamieson. Poverty and Its Viscous Circles. London: J. and A. Churchill, 1921.

Hurst, M. E. A Geography of Economic Behavior. North Scituate, Mass.: Duxbury Press, 1972.

Johnson, E. A. J. The Organization of Space in Developing Countries. Cambridge: Harvard University Press, 1970.

Kent, Ruth. Oklahoma: A Guide to the Sooner State. Norman: University of Oklahoma Press, 1958.

Kerlinger, Fred. Foundations of Behavioral Research. New York: Holt, Rinehart, and Winston, Inc., 1973.

Kindleberger, Charles. Economic Development. New York: McGraw-Hill, 1965.

Klaassen, Leo H. Social Amenities in Area Economic Grwoth: An Analysis of Methods of Defining Needs. Paris: Organization for Economics Co-operation and Development, 1968.

Myrdal, Gunnar. Rich Lands and Poor. New York: Harper and Row, 1957.

National Bureau of Economic Research. Regional Income: Studies in Income and Wealth, Vo. 21. Princeton: Princeton University Press, 1957.

Needleman, L., (editor). Regional Analysis, Baltimore: Penguin Books, 1968.

Ornati, Oscar. Poverty Amid Affluence. New York: Twentieth Century Fund, 1966.

Richardson, Harry W. Elements of Regional Economics. Baltimore: Penguin Books, 1969.

Richardson, Harry W. Regional Economics: Location Theory, Urban Structure, and Regional Change. New York: Praeger, 1969.

Richardson, Harry W. Regional Economics: A Reader. New York: St. Martin's Press, 1970.

Shannon, Gary W., and Dever, G. E. Alan. Health Care Delivery: Spatial Perspectives. New York: McGraw-Hill, 1974.

Smith, David. The Geography of Social Well-Being. New York: McGraw-Hill, 1973.

Stöhr, W. B. Regional Development, Experiences and Prospects in Latin America. The Hague: Mouton, 1973.

Theil, H. Economics and Information Theory. New York: Rand-McNally, 1967.

Theodorson, George A., (editor). Studies in Human Ecology. Evanston: Row, Peterson, and Co., 1961.

Whyte, William F. and Williams, Lawrence. Toward an Integrated Theory of Development. New York: Cornell University, 1968.

Wood, W. S., and Thoman, R. S. (editors). Areas of Economic Stress in Canada. Kingston, Ontario: Queen's University Press, 1965.

Articles

Adams, Jack. "Urbanization: Economic Development in Oklahoma From 1890 to 1970." Oklahoma Business Bulletin, Vol. 39, No. 9 (June 1971), 20-27.

Adelman, Irma and Morris, Cynthia. "Analysis of World Income and Growth," Economic Development and Cultural Change, Vol. 20, No. 4 (July, 1972), 731-733.

Almeida, Andrade T. "Regional Inequality in Brazil," unpublished paper presented at the colloquium on regional inequalities of development, Rua Curitiba, 832-Belo Horizonte, M.G., Brazil, April, 1971.

Anderson, Odin W. "Infant Mortality and Social Cultural Factors, Historical Trends and Current Patterns," in Patients, Physicians and Illness, E. Gartely Jaco, ed. Glencoe: Fress Press, 1958.

Andric, S. and Peacock, A. T. "The International Distribution of Income," Journal of the Royal Statistical Society, Vol. 124, No. 2 (1961), 206-218.

Baer, W. "Regional Inequality and Economic Growth in Brazil," Economic Development and Cultural Change, Vol. 12, No. 3 (1964), 268-285.

Berry, B. J. L. "Numerical Regionalization of Political-Economic Space," Economic Regionalization and Numerical Methods. Edited by B. J. L. Berry and A. Wrobel. Warsaw: Geographic Polonia, Vol. 15 (1968), 27-36.

Berry, B. J. L. "The Factorial Ecology of Calcutta," The American Journal of Sociology, Vol. 74 (1969), 445-460.

Bertalanffy, L. Von. "An Outline of General Systems Theory," British Journal of Philosophy of Science, Vol. I (1951), 134-165.

Bohland, James. "Oklahoma Migration Patterns: A Cause For Concern," Oklahoma Business Bulletin, Vol. 42, No. 4 (April, 1974), 8-9.

Borts, G. H. "The Equalization of Returns and Regional Economic Growth," American Economic Review, Vol. 50 (1960).

Bowsher, N. N., Daane, J. D., and Einzig, R. "The Flow of Funds Between Regions of the United States," Papers and Proceedings of the Regional Science Association, Vol. 3 (1957).

Chinitz, Benjamin. "The Regional Problem in the U.S.A.," in E. A. G. Robinson (editor), Backward Areas in Advanced Countries. London: MacMillan. 1969.

Connell, John. "The Geography of Development or the Development of Geography," Antipode, Vol. 5, No. 2 (May, 1973), 27-30.

Czyz, T. "The Application of Multifactor Analysis in Economic Regionalization," Economic Regionalization and Numerical Methods. Warsaw: Geographia Polonia, Vol. 15 (1968), 115-134.

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

Easterlin, R. A. "Interregional Differences in Per Capita Income, Population, and Total Income, 1840-1950," in National Bureau of Economic Research Studies in Income and Wealth, Vol. 24, Trends in the American Economy in the Nineteenth Century. Princeton: Princeton University Press (1960), 73-140.

Easterlin, R. A. "Regional Income Trends, 1840-1950," in Seymour Hall (editor), American Economic History. New York: McGraw-Hill (1961), 525-547.

Emmer, R. E. "Influences on Regional Credit Expansion," Proceedings of the Regional Science Association, Vol. 3 (1957).

Fryer, D. W. "World Income and Types of Economies: The Pattern of World Economic Development," Economic Geography, Vol. 34, No. 4 (1958), 283-303.

Fulmer, J. L. "Factors Influencing State Per Capita Income Differentials," Southern Economic Journal, Vol. 16, No. 3 (1950), 259-278.

Graham, R. E. "Factors Underlying Changes in the Geographic Distribution of Income," Survey of Current Business, Vol. 44 (April 1964), 15-32.

Grigg, D. B. "The Logic of Regional Systems," Annals of the Association of American Geographers, Vol. 55 (1965), 465-491.

Grigg, D. B. "Regions, Models, and Classes," Models in Geography. London: Methuen (1967), 461-509.

Hackney, Sheldon. "Southern Violence," in Hugh Graham and T. R. Gurr (eds.), The History of Violence in America, New York: Frederich A. Praeger, 1969, 505-527.

Hanna, F. "Analysis of Interstate Income Differentials: Theory and Practice," Regional Income, National Bureau of Economic Research Studies in Income and Wealth, Vol. 21 (1957), 113-193.

Harries, Keith. "The Geography of American Crime, 1968." Journal of Geography, Vol. 70, No. 4 (April, 1971), 204-213.

Hartland, P. "Interregional Payments Compared with International Payments," Quarterly Journal of Economics, Vol. 63.

Hartshorn, Truman. "The Spatial Structure of Socioeconomic Development in the Southeast, 1950-1960," Geographical Review, Vol. LXI, No. 2 (April 1971), 265-283.

Hartshorn, Truman, and Stephenson, R. A. "Socioeconomic Development Axes in the Atlantic Coastal Plain," International Geography, 1972, Vol. I (1972), 229-243.

Henderson, J. M. "General Aspects of Recent Regional Development," in Melvin Greenhut (editor), Essays in Southern Economic Development. Chapel Hill: University of North Carolina Press, 1964.

Hughes, R. B. "Interregional Income Differences: Self-Perpetuation," Southern Economic Journal, Vol. 28 (1961), 41-45.

Janson, Carl Gunnar. "Some Problems of Ecological Factor Analysis," in Mattei, Dogan, and Stein Roddan (editors), Quantitative Ecological Analysis in the Social Sciences. Cambridge: M.I.T. Press, 1969.

Johnston, R. J. "Grouping and Regionalization: Some Methodological and Technical Observations," Economic Geography, Vol. 42, No. 2 (June 1970), 293-305.

Keeble, D. E. "Models of Economic Development," in Models in Geography. Peter Haggett and Richard Chorley (eds.), London: Methuen, 1968.

Kiiskinen, Auro. "Regional Problems and Policies in Finland," Papers and Proceedings of the Regional Science Association, Vol. 14 (1964), 91-105.

Klaassen, L. H., Kroft, W. C., and Voskuil, L. R. "Regional Income Differences in Holland," Papers and Proceedings of the Regional Science Association, European Congress, Vol. 10 (1963), 77-81.

Kuznets, S. "International Differences in Income Levels," Economic Development and Cultural Change, Vol. 2 (1953), 3-26.

Kuznets, S. "Economic Growth and Income Inequality," American Economic Review, Vol. 45, No. 1 (1955), 1-28.

Lance, G. N. and Williams, W. T. "Mixed Data Classificatory Programs, I, Agglomerative Systems," Australian Computer Journal, Vol. 1 (1967), 82-85.

Lasuen, J. R. "Regional Income Inequalities and the Problems of Growth in Spain," Papers and Proceedings of the Regional Science Association, European Congress, Vol. 8 (1962), 169-191.

Lee, Yuk, and Egan, Frank. "The Geography of Urban Crime: The Spatial Patterns of Serious Crime in the City of Denver," Proceedings: Association of American Geographers, 1972, 59-64.

Lottier, Stuart. "Distribution of Criminal Offenses in Sectional Regions." Journal of Criminal Law and Criminology, Vol. 29, (1938), 343.

Metwally, M., and Jensen, R. C. "A Note on the Measurement of Regional Income Dispersion," Economic Development and Cultural Change, Vol. 22, No. 1 (Oct. 1973), 135-137.

Miller, Herman P. "Annual and Lifetime Income in Relation to Education: 1939-1959." American Economic Review (Dec. 1960), 962-986.

Mohktar, M. Metwally, and Jensen, Rodney C. "A Note on the Measurement of Regional Income Dispersion," Economic Development and Cultural Change, Vol. 22 (October 1973), 135-136.

Metzler, L. A. "A Multiple Region Theory of Income and Trade," Econometrics, Vol. 18 (1950), 329-354.

Nishioka, Hisao. "On the Interregional Differential in Japan: A Comment on the Planning of Industrial Location," Papers and Proceedings of the Regional Science Association, Vol. 2 (1967), 169-180.

Okun, Bernard, and Richardson, Richard. "Regional Income Inequality and Internal Population Migration," Economic Development and Cultural Change, Vol. 9 (January 1961).

Olsen, Erling. "Regional Income Differences within a Common Market," Papers and Proceedings of the Regional Science Association, Vol. XIV (1965) 35-41.

Olson, Mancur. "Measuring Quality of Life," Resources, Washington, D. C." Resources for the Future (June 1974), 1-2.

Olsson, Gunnar. "Servitude and Inequality in Spatial Planning: Ideology and Methodology in Conflict," Antipode, Vol. 6, No. 1, (May 1974), 16-21.

Pratt, Richard T. "Regional Production Inputs and Regional Income Generation," Journal of Regional Science, Vol. 7, No. 2 (Winter 1967), 141-14 .

Ray, D. M. "The Spatial Structure of Economic and Cultural Differences: A Factorial Ecology of Canada," Papers and Proceedings of the Regional Science Association, Vol. 22.

Rummel, R. J. "Understanding Factor Analysis," Journal of Conflict Resolution, Vol. 11, No. 4 (December 1967), 444-480.

Schuessler, Karl. "Components of Variation in City Crime Rates," Social Problems, Vol. 9 (1961), 314-323.

Semple, R. K., and Gauthier, H. L. "Spatial-Temporal Trends in Income Inequalities in Brazil," Regional Analysis, Vol. 6 (1972).

Sickle, J. V. Van. "Regional Economic Adjustments: The Role of Geographical Wage Differentials," American Economic Review, Vol. 44, No. 2 (1954), 381-392.

Sisler, D. G. "Regional Differences in the Impact of Urban-Industrial Development on Farm and Non-Farm Income," Journal of Farm Economics, Vol. 41, No. 5 (1959), 1100-1113.

Smith, David M. "Social Well-Being," in Richard Peet (ed.), Geographical Perspectives on American Poverty, Worcester, Massachusetts: Antipode, 1972.

Smolensky, E. "Industrialization and Income Inequality: Recent U.S. Experience," Papers and Proceedings of the Regional Science Association, (1961) 67-88.

Swartz, C. F. and Graham, R. E. "Personal Income by States," Survey of Current Business, (September 1960).

Swartzenberg, J. E. "Three Approaches to the Mapping of Economic Development in India," Annals of the Association of American Geographers, Vol. 52 (1962), 455-468.

Sweetser, Frank. "Factorial Ecology," Demography, Vol. I (1960) 372-386.

Terris, M. and Monk, M. "Recent Trends in the Distribution of Physicians in Upstate New York," American Journal of Public Health, (May 1956), 585-591.

Usher, D. "Equalizing Differences in Income and the Interpretation of National Income Statistics," Economica, New Series, Vol. 32 (1965), 253-268.

Warner, Larkin. "Changes in Relative Income in Oklahoma," Oklahoma Business Bulletin, Vol. 41, No. 1 (January 1973), 14-18.

Williamson, J. G. "Regional Inequality and the Process of National Development: A Description of the Patterns," Economic Development and Cultural Change, Vol. 13 (1965), 3-45.