AN INVESTIGATION INTO THE DETERMINANTS OF SMALL COMMUNITY POPULATION AND INCOME GROWTH IN OKLAHOMA AND ARKANSAS

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PREFACE

This study attempts to identify specific variables which are related to population and income growth in the Ozarks Region, to develop models which can be used in predicting future growth trends, and to identify variables which can be manipulated to bring about some desired growth outcome. Multivariate statistical methods are employed in analyzing Community Profile data supplied by the Ozarks Regional Commission.

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INTRODUCTION

The magnitudes of community population and income changes vary greatly within any given state. For example, the average change in population between 1960 and 1970 of all incorporated Oklahoma towns and cities with 1970 populations greater than 2500 excluding those in Tulsa and Oklahoma Counties was 25.9 percent. The average change in population between 1960 and 1970 of all towns and cities in Oklahoma with 1970 populations greater than 2500 excluding those located in counties considered to be parts of Standard Metropolitan Statistical Areas (that is, counties surrounding Oklahoma City, Tulsa, Lawton, Oklahoma, and Fort Smith, Arkansas) was 7.4 percent. During the 1960-70 period the population of Moore, Oklahoma, increased 952.2 percent while Drumright's population decreased by 32.0 percent.

Changes in median family income in Oklahoma likewise varied but according to a different pattern. The average change between 1960 and 1970 of all Oklahoma cities with 1960 and 1970 populations greater than 2500 was 64.6 percent. If cities and towns located in Tulsa and Oklahoma counties are excluded, the change was 63.8 percent. If cities located in SMSA (Standard Metropolitan Statistical Area) counties are excluded, the change was 63.0 percent. Median family income increased by 116 percent in Atoka, Oklahoma, but by only 18 percent in Nowata, Oklahoma.

Similar wide variations in income and population changes are to be found in many states.

The Investigation

There are two broad reasons for investigating why communities grow or decline and why incomes change: for explanatory purposes and for predictive purposes. If we could discover a set of variables which could be shown to cause population change, we could categorize them into two groups. The first group of instrumental variables would contain the subset which leaders within a community or government officials at the multi-county planning district, state, regional or national levels could manipulate to bring about some desired change in community population. Selection of the variable from this subset to be manipulated could be determined at the community level, and different instruments could be used in different communities, depending on the existing complement of resources and desired outcomes. If a sufficient level of quantification could be attained, community leaders could compare the cost of employing one instrument versus another and could then select the one(s) most cost-effective for their particular situation.

A second subset of variables would be those which influenced growth, but which could not be manipulated, or at least could not be manipulated at the community or multi-county level. Related to the second subset is the set of variables which can be manipulated locally but which have no effect on growth. If there is no policy which a community can adopt to achieve a desired outcome, then that knowledge is valuable to local decision-makers who strive for a higher level of community utility. If it were shown that investment in, say, an industrial park is not effective in inducing industry to locate in a community when the desired outcome is population or income growth, then those public dollars might be better spent for parks or libraries to improve the quality of life for citizens already living in the community, or the money might be retained by the people through lower tax rates.

Why do we need to predict growth? If leaders know that certain conditions exist within their community which, if left unaltered, will result in changes of the population and income structure of the community, then they can more efficiently plan for the future provision of public services (education, water services, recreational facilities, etc.). Through organizations such as the local chambers of commerce and civic clubs, information can be relayed to the private sector to assist existing merchants and prospective entrepreneurs in planning additions or new businesses to serve the needs of a different population. If growth is foreseen, the community may want to enact or amend zoning ordinances to retain the town's character, protect the environment, and ensure orderly expansion (Tweeten and Brinkman, 1976).

Since the age of the Mercantilists, economists have been concerned with economic growth. An extensive body of literature on "economic growth," as the term is broadly applied to include the growth of nations and their economies as well as of smaller political subdivisions, is available. Traditional neoclassical economic theory, location theory, and central place theory are especially useful in formulating hypotheses about community growth. In addition, comprehensive theories of social systems which integrate current economic, sociological, political, anthropological, and psychological theories, and the present state of technology are now being developed and are useful in understanding the diversity of phenomena which affect societies (Isard, 1969). Theory and recent economic research relevant to the study of community growth are discussed in Chapter II.

Econometric techniques are used in this study to ferret out relationships between growth and the structure of an economy. Such techniques provide a method for generalizing findings. We know that it is often possible to visit any community and discover what is causing the community to grow or decline. Businessmen and elected officials may tell us that the XYZ Manufacturing Company located there because skilled labor was readily available at a wage acceptable to both employer and worker and that their community was near a major widget market. Or they may tell us that the ABC Natural Resource Company left because a natural resource once found in the area had been depleted. It is usually not difficult to assess why a particular community has grown or declined and to descriptively explain the processes involved. What is difficult is to say why growth has occurred in one community while another community with similar attributes is stagnant and to discover general principles governing community growth without physically examining each city. Econometric techniques can help us accomplish this.

The results generated in an investigation such as this can furnish information to local public officials useful in planning future government activities; to the private sector for use in formulating investment plans for new or expanded plants and changes in resource input combinations; and to public officials at state and national levels for estimating the effect of alternative resource allocations among competing towns and for aggregative studies of the effects of alternative policies.

Objectives

The objectives of this study are to identify factors which affect income and population growth in Oklahoma and Arkansas, and to develop models which can be used to predict future growth in these areas. Tests are performed to determine if the economic structure of one area is significantly different from that of another and to determine if the same variables are statistically significant in each area.

Ordinary least-squares regression, principal components, and discriminant analysis are used to identify explanatory variables. Simple regression models are developed which are helpful in predicting future growth. Ideally a simultaneous equation model could be developed, but the data base is not extensive enough for such an approach. The computer package used in the study is the Statistical Analysis System, or SAS (Barr, Goodnight, Sall and Helwig, 1976).

The Study Area

Economic growth and development was examined by obtaining detailed data from over 150 communities with 1970 populations greater than 2500 in Oklahoma, Arkansas, and southern Missouri. This area was chosen for several reasons. In 1970 the Ozarks Regional Commission, headquartered at Little Rock, Arkansas, installed the Community Development Profile System, a component of the broader Regional Resources Management Information System developed in the mid-1960's at East Carolina University (Willis and Associates, 1970). The information obtained by this researcher from that system provides a rich and unique data base for investigating the growth process. The Community Development Profile System and the data obtained from it will be further discussed in Chapter III. Whenever possible, data missing from the community profiles were obtained directly from state agency offices in the state capitols or indirectly from state agency publications. Additional data were obtained from standard U. S. Bureau of the Census publications.

A second reason for choosing this area was the desirable degree of heterogeneity exhibited by the economic and demographic structures of the communities therein. No general criterion exists for determining whether the observational units for a study are sufficiently homogenous or heterogeneous. However, one should make sure that they are heterogeneous enough to allow for variations which trace out a distinct least-squares hyperplane but homogenous enough so that the variations which occur can be attributed to the variables for which data can be obtained. The degree of differences found among such areas as the Oklahoma Panhandle, the Ozarks Plateau, the Mississippi River Delta, and the forested areas of southeastern Oklahoma and southwestern Arkansas seem to embody these characteristics.

Thirdly, the Ozarks Plateau, southeastern Oklahoma, and the Mississippi River Delta section of Arkansas are economically lagging regions. Supplemental assistance designed to stimulate their economies has been provided by the federal government through the Ozarks Regional Commission and the Economic Development Administration. Of particular interest to researchers and administrators is an understanding of the growth processes found in declining areas such as these.

The researchers' familiarity with the area provided a fourth reason for its selection. In a study where one must apply available techniques and theory to real-world problems, application of first-hand knowledge and common sense can often detect obvious deficiencies in data and can suggest additional variables which should be included in or deleted from the analysis. Familiarity with the area can be substituted for computer usage in the initial screening and developmental phases of a project.

Organization of Study

The following chapter includes a brief review of growth theory and a summary of recent work relative to small community growth. A description of the study area, data, data sources, and statistical methodology are presented in Chapter III. Hypotheses and models are also developed in Chapter III. The results--i.e., the tests of the explanatory hypotheses through use of regression, discriminant and principal components--are presented in Chapters IV through VI. Conclusions, implications, and suggested departure points for future investigations are found in Chapter VII.

CHAPTER II

REVIEW OF LITERATURE

Theories of Economic Growth

The body of economic literature dealing with economic growth theories can be divided according to many schemes. Macroeconomic theories of growth deal with national economies. Regional growth theories are concerned with differential growth rates within a nation. Linkages between the two exist, but the treatment of each is generally distinct (Keeble, 1967).

Macroeconomic Growth Theories

The seventeenth century Mercantilists and the eighteenth century Physiocrats theorized about the sources of economic growth. The Mercantilists developed a crude trade theory emphasizing the accumulation of precious metals as a prerequisite for growth. The Physiocrats, emphasizing the agricultural and extractive sectors, tended toward a primitive resource or capital theory (Haney, 1910).

Ricardo, the forerunner of modern growth theory, ascribed to a labor theory of value and assumed that goods within a country traded in proportion to the amount of labor embodied in them. Since resource endowments differed among countries, he reasoned that each country had comparative advantages in the production of certain items. Therefore, trade is beneficial and the level of development which a country attains in relation to other countries (exclusive of technological change, wars, disasters, and acts of God) is a function of comparative advantages possessed by each country (Ricardo, 1911). John Stuart Mill (1904), Karl Marx (1907), and others contributed to the capital theories which were begun by Smith (1937) and Ricardo (1911).

The neoclassicists implied that the maintenance of a competitive system characterized by flexibility of prices, wages, and interest rates, and unrestrained international trade would provide sustained economic growth consistent with technology changes (Marshall, 1948).

Keynes (1936) criticized neoclassical economists for failing to deal realistically with the problems of maintaining full employment and high aggregate demand for goods and services. The Keynesian model attempts to relate growth to net investment and implies a long-run decrease in the growth rate of a given national economy. Keynes' work provides the basis for many western growth theories.

A familiar growth model which considers considers capital to be the sole source of increased production and ignores changes in the size of the labor force was developed by Harrod (1939) and Domar (1946). The model, representative of neoclassical analysis, introduces a dynamic factor--time--into the static Keynesian model. Briefly, the Harrod-Domar model seeks to explain the rate at which demand must grow to assure the use of new capacity and maintain full employment by postulating a set of relationships between the propensity to save, the capital-output ratio, and income (Tweeten and Brinkman, 1976).

Many factors other than capital seem to affect the growth rate of a national economy. Solow (1956) showed that the size of the labor force was relevant to the growth process. Hagen (1962) and Galbraith

(1958) discussed the role of social values in influencing the growth process. Kuznets (1961) examined the effect of alternative income distributions. Schultz (1961), Caine (1964), Harris (1965), and Becker (1964) emphasized investment in human capital.

Another branch of macroeconomic growth theory deals primarily with the problems of underdeveloped countries (Enke, 1963). Works in this area are readily distinguished from those mentioned in previous portions of this section which pertain primarily to developed nations.

Regional Growth Theories

Examination of regional growth theories is more useful in developing hypotheses about community growth than is macroeconomic theory because the effects of externalities created by intra-regional activity on outside regions are usually ignored. A number of schemes have been devised for classifying regional growth theories. Two commonly accepted are of Berry (1967) and Tweeten (1970).

Berry acknowledges three regional growth theories--trade theory, location theory, and export or staple theory. Trade theory had its beginnings with the Mercantilists and with Ricardo. Initially trade theory dealt with movements of goods among nations. It has been adapted to explain similar movements among regions using the concept of comparative advantage. Heckscher (1949) and Ohlin (1933) both applied trade theory in the regional context, investigating the effects of regional differences that are due to variations in the level of initial factor endowments.

Location theories seek to explain the location of individual firms in space, the competitive locational equilibrium of sets of firms, and, consequently, the character of the activities existing within a region by the consideration of spatial factors. Pioneers in the field of location theory include von Thünen (1966), Weber (1929), Lösch (1954), Hoover (1948), Christaller (1966) and Perroux (1955).

Export or staple theory assumes that growth in an unsettled region can be explained in terms of the region's main export commodity or staple. Migration of factors of production is emphasized. In accordance with neoclassical theory, factors flow to a region in response to high returns offered by a staple export; growth occurs when advancing technology reduces unit costs or when expanding demand increases rates of return (Richardson, 1969).

Tweeten's (1970) classification includes five growth theories--the basic resources theory, the internal combustion theory, the external combustion theory, the settlement pattern hypothesis, and the matrix-location hypothesis. The basic resources theory implies that economic growth depends on the presence and development of indigenous natural resources. Perloff and Wingo (1961) note that regional growth has typically been promoted by the ability of a region to produce goods and services demanded by the national economy and to export them at a comparative advantage relative to other regions. Examples of such activity include the leverage of minerals in the growth of the Rocky Mountain states, of petroleum and natural gas in the Southwest, and of favorable climatic conditions in Florida.

The internal combustion growth theory suggests that economic growth can be generated internally by technology, specialization, division of labor, economies of scale, and a well-developed infrastructure rather than by the presence of basic resources. Examples of advances attributed to internal forces are the technology-oriented electronics industries of California and New England.

The external combustion theory places the stimuli for growth outside the natural resources or man-made efforts of the region. Growth may be due to luck or to an increase in the demand for products of the region by those outside the region. The location of a large military complex in a region is an example of growth due to external combustion.

The settlement pattern hypothesis focuses on historical patterns of area settlement as a determinant of the directions of growth. For example, coal mining activity in the United States might today be centered in Wyoming and Montana rather than in the Appalachians had European settlers arrived via the Pacific Ocean rather than the Atlantic Ocean. Caudill (1965) emphasized the skills and attitudes of American pioneers as determinants of growth while Galbraith (1958) stressed early institutions such as the Homestead Act.

The matrix-location hypothesis as posited by Schultz (1953) suggests that economic development takes place within a specific locational matrix, that these locational matrices are at the center primarily urban and industrial in composition, and that the forces of economic development operate best near the center. Fox and Kumar (1966) modified Schultz's theory for use in an investigation of development in rural settings such as Iowa. They postulated that functional economic areas (FEA's) exist in space. A functional economic area is a set of substantially independent local communities which is relatively independent of other FEA's with respect to labor markets, availability of consumer goods and services, and availability of government services. They concluded that the FEA concept should be used as the major sub-national building block. The FEA concept is closely related to growth center theory which is discussed later.

Community Growth Theory

In this study the term "community" is used to denote incorporated political subdivisions such as town, villages, and cities. The population and income growth of communities are in part dependent upon the activities occurring in the land area surrounding them. Thus, much of the regional theory mentioned in the previous section is directly applicable to the formulation of hypotheses about community growth. A limited amount of research has been published recently dealing explicitly with the theory of growth of towns and cities, though most of this work is directed toward large cities with populations greater than 100,000.

Evans (1972) and Tolley (1971) present models of city size based on traditional marginal analysis and show theoretically why a certain level and mix of economic activities occur with a city. Hoch (1972) analyzes the relationship between income and city size. He concludes that large cities have become large because they have natural comparative advantages; labor is attracted to exploit those advantages. He finds that money per capita income tends to increase with city size, but this is primarily because the cost of living is higher in larger cities. Again, Hoch's analysis follows the neoclassical paradigm.

Much of the current research about the theory of city size and development and the subsequent formulation and implementation of public growth policy in the United States is centered around or based on growth center theory. The discussion which follows presents a generally accepted synopsis of the state of community growth center theory today. Growth center theory is inadequate in that it does not explicitly treat the phenomena of community stagnation or decline. Nevertheless, it has been adopted by agencies such as the Economic Development Administration and the regional commissions as a framework for dealing with the problems of lagging regions (Hansen, 1970).

The Growth Center Theory

Discussions of the conditions which were to lead to the explicit statement of growth pole theory began in western Europe shortly after World War II. Growth pole theorists felt that basic economic growth had its origins in an economy's inter-industry, multipler, and accelerator linkages (Darwent, 1969). Francois Perroux, a member of the French school of space economists, laid groundwork in 1950 by defining three types of topological economic spaces: space as defined by planning; space as a homogenous aggregate; and space as a field of forces. Perroux differed from earlier space economists who were concerned with the organization of economic activities over geographic space. He favored the topological abstraction that space is a set of relationships which define an object and that the theoretical growth pole is a vector of economic forces (Lasuen, 1972).

In a subsequent paper Perroux coined the term "growth pole" and elaborated. There exist ". . . centers (poles or focii) from which centrifugal forces eminate and to which centripetal forces are attracted. Each center being a center of attraction and repulsion has its proper field which is set in the field of all other centers." He viewed growth poles literally as industries or groups of industries which generate economic development in the areas surrounding them. He argued a fundamental point that ". . . growth does not appear everywhere and all at once; it appears in points or development poles with varying intensities; it spreads along diverse channels and with varying terminal effects for the whole of the economy" (Perroux, 1955, p. 307).

Following Perroux, Boudeville noted the regional character of economic space. From a growth pole context, he argued that a region can be analyzed by examining the interdependencies existing within it. Boudeville wrote that "polarized space is closely related to the notion of an heirarchy of urban centers ranked according to the functions they perform" (Hermansen, 1972, p. 179). In recent years this notion has been further researched by, among others, Fox and Berry.

Lasuen criticized Perroux for his "inability to derive a clear analytical apparatus to describe growth pole dynamics." Perroux did not identify any "leading industry" or "industrial complex," which are popular in European circles. Later, economists in France and Belgium, including Bauchet, Derwa, Gerais, Davin, Rosenfeld, and Paelink, filled in some of the gaps in their work in Germany, France, Italy, and Venezuela (Lasuen, 1972, p. 24).

The primary American contribution to growth pole theory came from Hirschman (1958). He analyzed inter-regional transmission of growth in terms of a dichotomy between advanced and backward areas. ". . . Once growth takes a firm hold in one part of the national territory, it obviously sets in motion certain forces that act on the remaining parts." Two major effects of this process can be isolated. Favorable effects consist of the trickling down of progress from the more developed to the less developed region. An unfavorable effect is the polarization of industry to the growing centers in the more developed area.

Hirschman wrote that for a nation to rise to higher income levels it "must first develop within itself one or several regional centers of economic strength" (Hirschman, 1958, pp. 183-198).

There are many definitions of the term "growth center." The one used by the Appalachian Regional Commission is clear and especially relevant to the purpose of this paper.

> By a center or centers is meant a complex consisting of one or more communities or places which, taken together, provide or are likely to provide a large range of cultural, social, employment, trade, and service functions for itself, or its associated hinterland. Though a center may not be fully developed to provide all these functions, it should provide or potentially provide some elements of each and presently provide a sufficient range and magnitude of these functions to be readily identifiable as the logical location for service to people in the surrounding hinterland (Appalachian Regional Commission, 1972, p. 26).

Growth Policy in the United States

The Kennedy Administration recognized conditions of extreme poverty existing in many rural areas in America and sponsored several articles of legislation designed to promote the development of growth centers in lagging regions. The first four-year experiment, the Area Redevelopment Act of 1961 (ARA), attempted to alleviate chronic unemployment and underemployment through a loan program for the establishment of commercial and industrial enterprises, public facility loans and grants for infrastructural development, technical assistance to aid in local planning efforts, and training to upgrade the skills of the labor force. The ARA program was not very successful because its county-by-county approach resulted in excessive fragmentation and inability to promote regional growth centers. The Public Works Acceleration Act (PWAA) of 1962 was a two-year supplement to the ARA and suffered from the same deficiencies.

The lessons of the PWAA and ARA experiences were applied by Congress and the Administration in the formulation of the Appalachian Regional Development Act of 1965 and the Public Works Act of 1965 (which provides the present legislative base for Economic Development Administration activities). Both acts specified that development strategies would be planned and implemented on a multi-county or regional basis and stressed the necessity of coordination of project goals. In drafting these acts, government planners employed many theoretical concepts relating to growth centers developed in the 1950's. Though a critic of EDA, Niles Hansen concedes that

> EDA, in keeping with the mandate of the Act, has attempted to be like something more than an administrator of an attractive grant program on a project by project basis; it has recognized the need for, though it has not generally acted on, an organized and logical strategy as a fundamental precondition to any successful attack on the problems of lagging areas (Hansen, 1970, pp. 158-159).

Under EDA guidelines four types of areas are eligible for assistance: redevelopment areas, economic development districts, Title I areas, and economic development regions. Title I areas (defined by a formula based on unemployment rates, income levels, etc.--a short-run designation) and economic development regions (the regional commissions, e.g., Ozarks, Four Corners, New England, et al., which have thus far received only limited funding) add little to this discussion. A redevelopment area may be a county, a labor area having a population of at least 1,500, any size Indian reservation, or a municipality with a population of under 250,000 characterized by conditions of unemployment and low per capita income that reflect economic stress.

The multi-county economic development district is the primary EDA organizational unit for policy implementation. EDA has encouraged sets of counties containing two or more redevelopment areas to pool their resources for planning and administrative purposes. Within the development district the counties (as represented by the district's board of directors) must designate an economic development center which, in theory, is the hub for multi-county development. The enabling legislation limits designation of development centers to a city or group of cities (the cities being in close proximity) with a population of less than 250,000. As of September, 1968, there were 52 designated economic development districts and 80 development centers. Mean population of the centers was 38,192; median population was 24,145. The 80-plus redevelopment centers (different from a development center) averaged about 10,000. Economic development centers are considered growth centers by EDA while redevelopment areas are depressed, lower-income communities where projects are initiated to stimulate the local economy. This is an example of the interaction of the economic and political dimensions of growth center policy, which will be discussed in more detail later.

EDA funding for growth centers had traditionally been directed at construction of industrial parks, sewage treatment systems, roads, and centers for occupational training programs. However, in practice EDA appropriations have been small and the agency has not been able to provide the massive funding which theory suggests is necessary in any one growth center.

The Appalachian Regional Development Commission (ARC) provides a better laboratory for examining growth center policy than EDA because more money (on a per capita basis) has been concentrated in a smaller, more readily identifiable (perhaps homogeneous) region. It was ARC's intent to identify and promote growth centers within Appalachia rather than to encourage outmigration (i.e., to promote balanced growth instead of unbalanced growth). Infrastructural improvements (excluding funding of health and training programs) in the hinterland were encouraged.

Under ARC guidelines each state designated its own growth centers and set funding priorities (though ARC was not legally bound to accept these priorities). One hundred seventy-three growth centers were identified. ARC elected to concentrate funding in centers of size 100,000-250,000 and chose to de-emphasize the large Pittsburg center.

Income and employment have increased significantly in the Appalachian region since 1965. Many have received training which has enabled them to secure jobs in industries which have recently relocated in Appalachia. Better highways have encouraged others to migrate to industrial cities such as Detroit and Cleveland.

The Controversy About the Proper Size of Growth Centers

There are two dimensions to the controversy about the proper size of growth centers. First, what population must a city or group of cities contain in order to exert a significant positive influence in reducing poverty or eliminating stagnation in the surrounding region? Second, what is the critical mass (population) at which the city's growth will become self-perpetuating? That is, how large must the city be and what forces must be present within it before continued infusion of public dollars for infrastructural development are no longer necessary for growth to continue? In examining these questions one must consider the economies of the local labor market, the existing level of technology vis-à-vis its implications for centralization or decentralization of particular activities, market economies of size and scale for firms providing supportive products and services to local businesses, input demands, the regional export base, transport economies, etc.

Economists generally agree that the maximum desirable size of growth centers is certainly less than 1,000,000 and probably less than 750,000 (USDA, 1968). When a city grows beyond this size, costs of providing services increase out of proportion to population growth. The city's economic problems are compounded as the percentage of low-income and/or minority citizens increases, the tax base is lowered, central city decay sets in, and bedroom communities develop. The intent of the federal government to discourage further migration of the rural poor is continually seen in Congressional legislation and agency funding requests.

The 1970 report of the President's National Goals Center Research Staff (NGCRS), chaired by Leonard Garment, stated that ". . . the problem of distribution of our population . . . may be more readily susceptible to policy influence than growth itself." In analyzing alternative future migratory patterns (industrialization in rural areas, new towns, megapoli, and lesser-sized cities), NGCRS favored a growth center policy based on "middle-sized communities (usually upwards of 50,000--but as small as 25,000) which are growing or have potential for self-sustained growth."

Some feel that even smaller places may function as growth centers. The 1968 Manpower Report to the President suggested that 10,000 to 50,000 might be an adequate population (U. S. Department of Labor, 1968). Others point out that during the 1950's 75 percent of all nonmetropolitan places with population between 2,500 and 25,000 grew and that the average growth over the decade of these places was 21 percent (Kuehn and Bender, 1970).

Cameron (1970) reported the results of an Indian study and an Italian study to determine optimal growth center size. In the 1968 Indian study of five cities (population range: 48,000 to 1,070,000) it was found that urban infrastructural costs were more favorable in the smaller cities. The 1967 Italian study showed that costs were minimized in the 30,000 to 250,000 population range and were maximized when population was less than 5,000 or greater than 250,000.

Robinson (1969) addresses the question in his report of the 1968 Conference of the International Economic Association. Conference participants felt that the necessary size was nearer 100,000 than 10,000 and that 100,000 was likely low.

The opinions presented thus far in this section have had little impact in shaping U. S. growth center policy or in adding to the body of knowledge in growth pole theory. Inferences are drawn from isolated and limited studies, observations unsupported by research are expressed, and politically expedient statements are made. The issues as they affect U. S. strategy and spending seem to revolve around Hansen's research and EDA/ARC activities.

Hansen (1973) argues that infrastructural investment in small growth centers (less than 200,000) in lagging regions is inefficient because few external economies are generated which promote development in the hinterland. He favors a national policy which will subsidize migration to growth centers with population between 250,000 and 750,000 in non-lagging regions. However, EDA cannot fund projects in cities over 250,000. But several studies (Isard, 1956; Clark, 1945; and Klaassen, 1965) have suggested that growth in cities of this size is self-perpetuating and no external public investment is required. That is, private industries and businesses provide a sufficient tax base from which funds can be drawn for public investment projects and generate external economies which assure growth in the hinterland. Therefore, Hansen maintains that federal funds would be most wisely spent by making investments in cities near his critical population size for sustained growth (in the neighborhood of 250,000) on the assumption that support can be withdrawn after a few years because the self-generating stage will have been reached.

There are several arguments why a city with a population substantially less than 250,000 cannot function as a growth center. First, a smaller city does not have a sufficient labor market either from a supply or a demand side. Workers have too few (often only one) outlet for their skills and intra-city job mobility is low. Likewise, a firm demanding applicants with unusual skills may not be able to recruit them in the local marketplace. Second, a complete range of public services which are prerequisites for sustained growth cannot be offered in a smaller city. Third, the activities in a smaller city have little effect on the economy of the surrounding region.

Hansen bases much of his theory against smaller cities as growth centers on work down by Berry. In studying the community patterns of

American workers (using census data from every county) he found that

> . . . the degree of metropolitan labor market participation is the key variable in the 'regional welfare syndrome,' indexing the gradient of urban influence on the surrounding areas. . . . The lowest levels of welfare are at the peripheries of metropolitan labor markets and in their interstices (Berry, 1970).

Berry found that few cities of less than 50,000 population exerted significant influence on commuting patterns in the rural areas surrounding them, except for those cities which were situated in relatively isolated regions. Specifically, he found that population densities of adjacent areas, median income levels, value of adjacent farm lands and buildings, the rate of population increase, and the rate of growth due to immigration varied inversely with city size. Berry concluded that

> If trickle-down from sufficiently large growth centers offers one viable strategy, retraining of those without skills, and subsidies to migrate (including travel, relocation, and income payments) appear to offer the only realistic alternative for those isolated in the peripheries of labor markets exceeding 250,000 and especially for those in the interstices (Berry, 1970, p. 10).

Hansen (1973) also contends that people prefer to migrate to intermediate-sized cities outside the lagging region rather than remain in their own communities or migrate to larger cities. A survey conducted among high school seniors in lagging areas (American Indian communities, Chicano communities, Appalachia, and Mississippi) revealed a desire among respondents to seek employment outside of the region. However, Tweeten (1975) maintains that the survey questionnaires were biased to elicit a response desired by the researcher by offering relatively unattractive choices in the lagging region and attractive situations in the intermediate-sized cities.

Morrill refutes Hansen's and Berry's contentions by identifying the export base of the city rather than population as the primary determinant of a city's ability to function as a growth center. He maintains that growth centers exist in Sweden and West Germany as cities of as few as a thousand persons because they produce products which are highly in demand elsewhere. He feels that advanced technologies, especially in the computer, communications, and transportation industries, are making it possible for a full range of business-supportive services to be offered in progressively smaller cities (decentralization). Twenty-three of 87 SMSA's whose urbanized areas exceeded 200,000 in 1960 had a negative net migration during the decade while 88 of 169 SMSA's of 50,000 to 200,000 population had a positive net migration. He concludes that

> The failure of growth-center-oriented development programs should not be interpreted as evidence that only metropolises over 250,000 can be successful, but that we have not concentrated on what really matters--employment and export activities (Morrill, 1972).

Collier concludes that Morrill and Hansen are discussing two different types of growth centers. Morrill appears to be examining induced growth centers (those in which outside public investment is made) while Hansen is concerned with spontaneous growth centers (Collier, 1973). However, Hansen explicitly states that government should channel aid into growth centers of a given size and development potential (250,000-plus) until such time as they become self-generating. Spontaneity can come at any point along a continuum of city sizes, but government investment can bring the city to that size.

Related Research

Over the past 20 years much applied research has been directed toward identifying patterns and determining causes of community population and income change. As new econometric techniques have evolved and as electronic computer technology has advanced, the analyses have become increasingly complex. Studies undertaken during this period can be divided into three categories--those which are principally descriptive; those which test hypotheses that only a few (usually less than five) variables affect growth; and those which, like this study, examine a large number of variables in an effort to grasp a more complete understanding of the total growth process. Studies falling into the first two categories will be mentioned briefly. Those in the third category have more relevance to the problems dealt with herein since more meaningful comparisons of results can be made because of the similarity of research techniques used.

Most of the applied studies carried out by regional economists test a hypothesis that some characteristic of the economy has an effect on the development of that economy. Measures of the state of development of an economy may be population, population change, regional income, per capita income, etc., but the measures of development are decidedly endogenous to the system. It would be ideal if a large number of characteristics of an economy existed and could be measured which were completely exogenous, such as community location, natural resource endowments, and transportation networks. In theory if the proper endogenous and exogenous variables were specified, then the workings of the economy could be described through a properly identified simultaneous equation system. In practice the data are not available and the problem of specifying such a system is moot. In practice most studies examine the effects of several preselected independent, but not completely exogenous, variables upon some dependent measure of growth.

Typical of the descriptive studies is one by Beale and Bogue (1963) in which 1950-60 city population change is examined over the entire United States. Cited as causes of basic population trends during this period were changes in natality and mortality, immigration and migration patterns, metropolitan decentralization, government spending (especially military), changes in agricultural technology, changes in the structure of business, a preference for a warmer climate, mining, changes in life styles, and changes in the economic and social status of Negroes. Of general interest is the shift in population composition by city size between 1950 and 1960 which is presented in Table I. Many more descriptive studies exist. Extensive descriptive studies on population trends in the United States were compiled by the U. S. Commission on Population Growth and the American Future (1972).

Much research has been published relating the effect of a specific variable to population or income change. Bennet (1970) looked at the expansion which has occurred in the Ozarks, Ouachitas, and the Rockies because of the availability of recreational opportunities. Bohm and Patterson (no date), Dodgson (1975), and Peaker (1976) have examined the impact of highways on growth. Hassinger (1957), Brush and Bracey (1955), Butler and Fuguitt (1970), and Rikkinen (1970) investigated the relationship between small-town population change and distance to larger towns. Mayo (1947), Fanelli and Pederson (1956), and Fuguitt (1965) have tested the hypothesis that county seat status influences population change. Darcoff and Macy (1968) and Menegokis (1970) looked

TABLE I

POPULATION IN GROUPS OF PLACES CLASSIFIED ACCORDING TO SIZE: 1960 and 1950

Size of place	Percentage distribution 1960	1950	Percent change in population 1950-1960
Total U. S. population	100.0	100.0	18.5
Total, all places	70.2	66.1	25.7
1,000,000 or more	9.8	11.5	0.5
100,000 - 1,000,000	18.7	17.9	23.5
50,000 - 100,000	7.7	5.9	54.9
25,000 - 50,000	8.3	5.8	69.2
10,000 - 25,000	9.8	7.8	47.9
5,000 - 10,000	5.5	5.4	19.4
2,500 - 5,000	5.3	5.6	14.0
Under 2,000	5.1	6.1	-1.9

Source: Beale and Bogue (1963).

at the effect of federal defense spending. The Center for Political Research (1970), under contract with the Economic Development Administration, studied the impact of all federal expenditures. Many more examples abound.

In many reviews of literature researchers organize according to variables under investigation and cite different works relevant to each variable. Because this study contains hypotheses about more than 100 variables, a traditional organization would be unwieldy and illogical. Therefore, nine studies will be reviewed individually and related to the problems at hand.

Oklahoma

Tarver and Urbon (1963) hypothesized that mobility was a significant factor affecting small community population growth. Using data collected from all incorporated places in Oklahoma they employed analysis of variance to test whether proxies for mobility--type of road on which the town is situated and distance to the nearest place of 2,500 population or greater--as well as size of place, past population trends, county seat status of the community, Negro population, soil type, and predominant economic activity influenced population growth.

Tarver and Urbon found that:

1. Size of place had a significant and positive effect on population growth.
2. County seats grew faster than towns that were not county seats.
3. Towns located on better roads grew faster.
4. Distance to a town of 2,500 population or greater was not significant.

5. Towns grew faster between 1940 and 1950 than between 1930 and 1940, but no significant difference was detected between the 1950-60 growth rate and the growth rates of the two previous decades.

Indiana

Using data collected from 59 communities with populations ranging from 2,500 to 20,000, Debertin and Huie (no date) constructed single-equation regression models which helped identify determinants of economic growth in Indiana. In their work they emphasized the role of central place theory and Schultz's matrix location hypothesis. Eight dependent variables were specified and a regression equation was estimated for each dependent variable. The dependent variables were percent change in total community population, 1960-1970; percent change in family income, 1960-70; actual change in per family income, 1960-70; percent change in total employment, 1960-70; percent change in manufacturing employment, 1960-70; percent change in professional and related services employment, 1960-70; percent change in employment in wholesale and retail trades, 1960-70; and percent change in retail sales, 1960-70. Seventeen independent variables were included in each regression. They were distance to a city with population greater than 200,000; number of towns in the area; distance to a larger town; number of roads serving towns carrying more than 5,000 vehicles per day; number of roads carrying 2,500 to 5,000 vehicles per day; proximity to an interstate highway; climate (temperature); 1960 median education of adults 25 years and over; 1960 median family income; 1960 average family size; 1960 population; percent of population 65 and over, 1960;

agricultural productivity of county land; 1960 population density; 1960 tax rate; whether an industrial development organization existed in the community; and, if an industrial development group did exist, how active it was.

Debertin and Huie found that total population grew fastest in towns located along interstate highways. Rapid population growth was also associated with communities with high initial income levels, large average family sizes, and a high proportion of the population in the 20-40 age group.

The most rapid increases in family income levels occurred in towns with populations of from 2,500 to 5,000 people rather than in small cities of 10,000 to 20,000 people. Percent increases in family income were greatest in communities with low incomes. Location of the town on a well-traveled road was positively associated with income gains. Communities with higher population densities tended to have less increase in family income.

Debertin and Huie found no evidence that geographic relationship of an Indiana community to other towns and cities influenced growth and development between 1960 and 1970. Educational levels were found to be insignificant in all the models estimated.

Pennsylvania

Forsht and Jansma (1975) investigated population and employment growth between 1960 and 1970 in 177 Pennsylvania communities with 1960 populations greater than 1,000. Regression models were developed using the stepwise technique for percent change in population for cities falling into the following size categories: 1,000 and over;

1,000 to 25,000; 1,000 to 5,000; and 1,000 to 2,500. The population model for cities 1,000 and over was run using variables #1 through #25 in Table II as candidates. Models were developed for the 1,000-2,500, 1,000-5,000, and 1,000-25,000 categories using variables #1 through #38 as candidates.

The stepwise regression algorithm returned ten significant variables for the set of 177 cities with 1960 population greater than 1,000. Growth was negatively associated with the log of total city population, the log of the distance to the nearest SMSA city, the percent change in total city population between 1940 and 1950, the percent of the labor force employed as operatives, and the percent of the labor force employed as laborers. Population growth was positively associated with the percent of the labor force employed in agriculture, in construction, in the manufacturing of durable goods, in the manufacturing of non-durables, and in government. The above variables were significant at the .05 level or greater and the R^2 for the equation was .60.

Eight variables were returned by the stepwise regression procedure for the set of 160 cities with populations of 1,000 to 25,000. Population growth was negatively related to 1960 median education of those 25 and older, the log of 1960 city population, the percent of the labor force employed in mining, the percent of the labor force employed as laborers, and the percent change in employment in manufacturing durable goods, 1960-66. Growth was positively related to the percent change in total population between 1940 and 1950, the percent of the labor force employed as craftsmen in 1960 and the percent of the labor force employed in government. R^2 for the model was .62.

TABLE II

CANDIDATE VARIABLES FOR FORSHT-JANSMA PENNSYLVANIA POPULATION GROWTH MODEL

1. Median School Years Completed, 1960
2. Median Income of Families, 1960
3. Average Per Capita Personal Income, 1963
4. Log of Total Central Place Population, 1960
5. Log of Distance to Nearest SMSA
6. Percentage Change in Total Central Place Area Population, 1940-50
7. Percentage Change in Total Central Place Area Population, 1950-60
8. Percentage Employed as Professional Workers, 1960
9. Percentage Employed as Managers, 1960
10. Percentage Employed as Clerical Workers, 1960
11. Percentage Employed as Sales Workers, 1960
12. Percentage Employed as Craftsmen, 1960
13. Percentage Employed as Operators, 1960
14. Percentage Employed as Household and Service Workers, 1960
15. Percentage Employed as Laborers, 1960
16. Percentage Employed in Agriculture, 1960
17. Percentage Employed in Mining, 1960
18. Percentage Employed in Construction, 1960
19. Percentage Employed in Manufacturing Durable Goods, 1960
20. Percentage Employed in Manufacturing Nondurable Goods, 1960
21. Percentage Employed in Transportation and Public Utilities, 1960
22. Percentage Employed in Wholesale and Retail Trade, 1960
23. Percentage Employed in Services (Finance, Insurance, Services, and Real Estate), 1960

TABLE II. (Continued)

24.	Percentage Employed in Government, 1960
25.	Population Density of Central Place, 1960
26.	Change in Employment in the Furniture and Fixtures and Lumber and Wood Products Industries, 1960-66
27.	Change in Employment in the Metals Industries, 1960-66
28.	Change in Employment in the Machinery Industries, 1960-66
29.	Change in Employment in the Transportation Equipment Industries, 1960-66
30.	Change in Employment in Other Durable Goods (Stone, Clay, Glass, and Instruments) Industries, 1960-66
31.	Change in Employment in Food and Kindred Products Industries, 1960-66
32.	Change in Employment in Textile and Apparel Products Industries, 1960-66
33.	Change in Employment in the Printing and Publishing Industries, 1960-66
34.	Change in Employment in Other Nondurable Goods (Ordnance, Tobacco, Paper, Chemicals, Petroleum, Rubber and Plastic, Leather, and Miscellaneous Products) Industries, 1960-66
35.	New Employment in Durable Goods Industries, 1961-66
36.	New Employment in Nondurable Goods Industries, 1961-66
37.	Percentage Change in Employment in the Durable Goods Industries, 1960-66
38.	Percentage Change in Employment in the Nondurable Goods Industries, 1960-66

Eight variables were returned by the stepwise regression procedure as significant at the .05 level for the set of 101 cities with 1960 population between 1,000 and 5,000. Growth was negatively associated with the 1960 median educational level of those 25 and over, the log of 1960 city population, the percent of the labor force employed as laborers in 1960, the percent of the labor force employed in mining, and the percent of the labor force employed in transportation and public utilities. Growth was positively related to percent change in total population between 1940 and 1950, percent of the labor force employed in government in 1960, and the change in employment in the machinery industry between 1960 and 1966. R^2 was .61.

Eleven variables were significant at the .05 level for the set of 63 cities with populations between 1,000 and 2,500. Growth was negatively related to the log of 1960 city population, the log of distance to the nearest SMSA, the percent of the labor force employed as laborers in 1960, the percent of the labor force employed in wholesale and retail trade, and to the change in employment in the furniture and lumber industries, in transportation equipment manufacturing, and in the manufacturing of durables between 1960 and 1966. Growth was positively related to the percent change in community population between 1940 and 1950, the percent of the labor force employed as managers in 1960, the percent of the labor force employed as craftsmen, and to the change in employment in the non-durable goods manufacturing sector between 1960 and 1966. R^2 was .77.

The Forsht-Jansma analyses also indicated that smaller areas having higher rates of population growth were associated with low levels of median school years completed because they tended to attract the low-wage manufacturing industries. Conversely, the high-wage industries were less likely to locate in small rural areas.

Kansas

Johnson (1970) combined principal components analysis and regression analysis in an investigation of population and income growth in 65 Kansas communities with 1960 population greater than 2,500 (excluding Wichita and Kansas City). Data were collected on 38 variables, each of which was related to community economic base, social base, or geographic base. A principal components factor analysis was performed on the data set and twelve factors were formed--urban position, agricultural base, tax load, manufacturing base-government linkage, social structure change, economic structure change, agricultural linkage, industrial community action, retail trade base, service base, industrial location success, and educational participation. Fourteen dependent variables--each relating to some measure of population change, income change, or capital structure change--were specified and a regression equation was developed for each dependent variable with the twelve factors developed by principal components used as independent variables.

Using percentage change in city population between 1950 and 1960 as the dependent variable, Johnson found seven factors significant at the .05 level. The regression with all twelve factors explained 74 percent of the variation. Urban position (strong commercial linkages and large population), manufacturing base-government linkage, economic structure change (decreased reliance on agricultural receipts and increase in non-oil and non-gas mineral extraction), strong retail trade base, and strong service (industry) base were positively related to population growth. Agricultural linkage (again, a measure of reliance upon agriculture) and industrial community action (resulting from high factor loadings on the number of the industrial levies and the number of railroad lines serving the community) returned negative regression coefficients.

Using absolute change in per capita income between 1950 and 1960 as the dependent variable, Johnson found that five factors were significant at the .05 level. The regression including all twelve factors developed in the principal components analysis explained 62 percent of the variation in income change. Income growth was positively associated with industrial community action and industrial location success (attracting industry to the community). Regression coefficients were negative for social structure change (an increase in the extraction of non-oil and non-gas minerals and a decline in the farm level of living), economic structure change (roughly associated with the quality dimension of the social base and the land use dimension of its geographic base), and the retail trade base. Communities whose economies were strongly dependent upon retail trade in 1950 tended to show less absolute gains in income than communities which were not so strongly dependent on retail trade.

Johnson's work provides an indication of which areas communities should strengthen in order to bring about the desired economic improvement.

New York

In a study of 221 New York communities with 1950 populations greater than 2,500, Eberts and Young (1971) used factor analysis and correlation studies to investigate determinants of community growth and development. Data for fifteen variables which relate to the socio-economic structures of the community were gathered. Percent increase in community population between 1950 and 1960 was most strongly correlated with per capita flush toilets (ρ = .59), per capita in dwelling units (ρ = .65), median family income (ρ = .34), and the affluency-poverty ratio (ρ = .29). Only very weak correlations ($|\rho| < .15$) were found between population change and variables relating to the occupational structure of the labor force.

Percent increase in median family income was found to be most strongly correlated with absolute change in median family income (ρ = .44), per capita flush toilets (ρ = -.17), and a scale variable relating the quality of medical services available (ρ = .18). Income increase was weakly associated with median educational levels (ρ = .12).

Stronger correlations were found between absolute increase in median family income and the other study variables. Absolute increase in median family income was correlated with percent change in population (ρ = .29), the affluency-poverty ratio (ρ = .50), per capita flush toilets (ρ = .25), per capita dwelling units (ρ = .22), and percent managers, proprietors, and officials in the labor force (ρ = .27).

Southern States

Tarver and Beale (1968) and Tarver (1972) examined patterns of population change in southern nonmetropolitan towns during the periods 1950-1960 and 1950-1970. The 1968 study of 801 towns with population of 2,500 to 9,999 showed that size of place in 1950 was the most important variable explaining 1950-1960 population increases. Regional location (dummies for Atlantic Metropolitan Belt, Central and Eastern Upland, Southeast Coastal Plain and Piedmont, etc.) was also significant. County seat status and distance to the nearest major metropolitan area were not significant.

Tarver (1972), in a study of 789 southern nonmetropolitan towns with 1950 population between 2,500 and 9,999, concluded that a major factor influencing 1950-1970 population growth was the type of industry located within the community rather than the number of major industries. He noted the decline of resource-based industries in the South and predicted that the greatest future population growth was likely to occur in towns and cities characterized by strong tertiary activities such as employment in the professions, public administration and related services.

Ozarks Region

Using shift-share analysis Kuehn (1974) concluded that employment growth had occurred during 1960-70 in communities located in both rural and metropolitan sections of the Ozarks. A primary cause of employment growth was the shift away from agriculture to manufacturing jobs.

Western U. S.

Using multivariate regression analysis Bender (1975) developed models to predict ancillary employment (total employment minus agricultural, mining, manufacturing, and portions of transportation employment considered basic) in the Western United States. Among variables shown to be consistently significant across sub-regions of the Western region were manufacturing employment, mining employment, agricultural employment, presence of government institutions and presence of colleges and universities.

United States

Lamb (1975) developed several multiple regression models to investigate the impact of metropolitan areas on outlying rural towns and counties. A stratified random sample of 224 U. S. urban centers was examined over the periods 1950-1960 and 1960-1970. Lamb found that accessibility to metropolitan jobs in combination with superior amenity endowment (amenity in this context refers primarily to proximity to resource-based recreational areas or favorable climatic conditions) was a key factor in explaining the pattern of nonmetropolitan population change. Higher median family incomes are also associated with proximity to urban centers. Location on an interstate highway had a positive effect on the growth rates of larger nonmetropolitan counties; however, such location had only a slight or possibly a negative effect in smaller counties.

Summary

To the economist, economic growth connotes a higher level of well-being for the people living in a distinct geographic area. Economic growth is determined jointly by the level, value, or mix of economic activities, productivity, economic stability, income equality, available leisure community service improvement, and environmental protection. Much academic, industrial, and government research conducted in the United States is aimed directly at some aspect of economic growth.

At the extreme microeconomic level engineers try to develop more efficient methods of producing goods or performing service activities which are demanded by the American consumer. At the next level, businessmen experiment with alternative ways of combining existing technologies to produce and market goods and services at a level of efficiency acceptable to the firms' owners. Within government, politicians, administrators, economists, and others work to discern the best policies for stimulating economic growth consistent with the laws, mores, values, and desires of the citizenry. Within a region, officials may only be concerned with the effects on the economy of their region of policies which they adopt. However, at higher levels of government officials must be concerned not only with the impact of absolute national growth, but also with the distribution of growth among regions.

Often economists use income as a proxy for economic growth and fail to acknowledge other components of the growth process. While use of income data is practical, sometimes income increases come to be considered an end rather than a means to higher levels of well-being. Other social scientists are attempting to convey to economists that this view persists. Sociologists and anthropologists sometimes claim that economic growth is not a proper goal for a society to adopt but that it is only a means to achieving a higher level of societal development (Oberle et al., 1974). Theories of societal development seek to incorporate typically noneconomic factors which contribute to the individual or societal welfare function (e.g., security, family relationships, and personal freedom) into an analysis of group activity (Isard, 1969). Since economists often explicitly assume that various noneconomic factors are distributed randomly throughout a population these factors are often ignored in economic analyses. Yet, noneconomic factors also influence economic growth. Economists also often assume rationality. An assumption of economic rationality does not always hold, for an individual's behavior may be such that conventional utility analysis does not accurately depict his environment, desires, options, or choices. These conditions suggest consideration of political, social, and environmental factors not usually associated with economic growth studies.

Since the time of Adam Smith, philosophers have wrestled with the problem of growth. They have tried to prescribe within the context of western culture and society principles which dictate growth. Geographers look for spatial patterns of economic activity and observe migration; demographers calculate fertility and population growth rates. Historians extrapolate patterns of the past into the future. Within the last three decades, planning has been proclaimed a branch of science which seeks to synthesize applied and theoretical aspects of the social sciences, natural and biological sciences, and engineering into a body of knowledge capable of explaining and affecting economic growth (Isard, 1975).

The evidence of the concern of the professions mentioned in the preceding paragraph with the concept of growth fills professional journals, trade publications, and educational television. Growth concerns us all.

In this chapter the elements of economic growth theory most relevant to a study of small community population and income change in the U. S. have been identified. Since the federal government actively promotes and supports agencies whose explicit goals are to initiate and sustain economic growth within this country, the relationships between these agencies' policies and activities and the academic economic theory are noted.

Many economic studies can be considered to relate to growth in the sense that they attempt to specify means for reaching a higher level of community well-being. In this chapter the results of studies which analyze the effects of a large number of variables simultaneously are emphasized. This facilitates a comparison with the results of this study.

CHAPTER III

METHODOLOGY

Conceptual Approach

Data for hundreds of variables from almost every incorporated community in Oklahoma, Arkansas, and southern Missouri were assembled by accessing the Community Data Profile element of the Ozarks Regional Commission's (ORC) Regional Resources Management Information System (Willis and Associates, 1970). A partial listing of the variables for which data were collected is presented in Table III. These data were primary in the sense that they were stored by ORC on the ORC central computer in Little Rock, Arkansas, exactly as they had been received from the offices of the multi-county planning agencies in the region whose personnel collected the data. The Community Data Profile System provides a very detailed and comprehensive set of regional economic data (Ozarks Regional Commission, 1971). Shortcomings of the data will be discussed later.

An extensive description of the economic, social, and cultural characteristics of the Ozarks Region can be found in Edwards (1970). Additional information is available in the annual reports and specialized publications of the Ozarks Regional Commission.

After a decision was made by the researcher to limit the units of study to cities with 1970 populations greater than 2,500, additional

TABLE III

PARTIAL LIST OF DATA INCLUDED ON COMMUNITY DATA PROFILE QUESTIONNAIRE

I. Identification
   A. City/Town
   B. County
   C. State

II. Local Organization

III. Labor
   A. Civilian Work Force in Area
      1. Total Number of Workers in Area
      2. Number of Employed Workers
      3. Number of Unemployed Workers
   B. Employment by Classification
      1. Manufacturing
      2. Construction
      3. Transportation
      4. Trade
      5. Finance
      6. Service
      7. Government
      8. Other Non-Manufacturing
      9. Agricultural
      10. All Other Employment
   C. High School Graduates Entering Labor Force Annually
   D. Recruitable Workers for Industry Within 15 Mile Area
      1. Available Workers, Total
      2. Experienced Manufacturing Workers, Total
      3. Other Experienced Workers, Total
      4. Inexperienced But Referable and Trainable, Total
   E. Annual Average Weekly Earnings Covered Employment
      1. For All Non-Manufacturing Jobs
      2. For Manufacturing
      3. For All Industries

IV. Transportation
   A. Railroad Transportation
      1. Freight Service in 15 Mile Area
      2. Freight Station in Area
      3. Miles to Nearest Freight Station
      4. Average Number of Freight Trains Per Day
      5. Freight Service in Community
      6. Freight Station in Community
      7. Average Number of Freight Trains Per Day
      8. Piggyback Service Available
      9. Passenger Service in 60 Mile Area
      10. Miles to Nearest Passenger Station
      11. Average Number of Passenger Trains Per Day

TABLE III (Continued)

12. Passenger Service in Community
13. Average Number of Passenger Trains Per Day
14. Number of Railroads in Community
15. Names of Railroads
16. Average Shipping Time in Days (to Various Cities)

B. Truck Transportation
1. Number of Terminals in 45 Mile Area
2. Miles to Nearest Terminal
3. Number of Motor Freight Lines Serving City
4. Average Shipping Time in Days (to Various Cities)

C. Water Transportation
1. Water Transportation in 10 Mile Area
2. Water Transportation in Community
3. Miles to Nearest Port Facility
4. Barge Companies Available, Number
5. Port Facilities Available

D. Air Transportation
1. Miles to Nearest Commercial Airport
2. Average Number of Commercial Flights Per Day
3. Length of Longest Runway
4. Charter Service Available
5. Plane Rental Available
6. Radar
7. Names of Airlines Serving Community
8. Miles to Nearest General Airport
9. Facilities Available at General Airport
10. Miles to Nearest Private Airport
11. Facilities Available at Private Airport

E. Highway Transportation
1. Miles to Nearest Interstate Highway
2. Interstate Bus Service
3. Local Bus Service
4. Taxi Service
5. Car Rental Service
6. Auto Registration in Community
7. Truck Registration in Community
8. Boat Registration in Community

V. Communication

A. Classification of Post Office
1. Postal Receipts

B. Telephone Company Serving Community, Name
1. Capacity of System
2. Number of Customers on System
3. Special Services Available

C. Radio Stations

D. TV Stations Within 75 Mile Area, Number
1. Channel Affiliation
2. Miles to Nearest TV Station

TABLE III (Continued)

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3. Educational TV Station
4. Cable TV

E. Local Newspaper
1. Circulation of Each
2. Frequency of Publication

VI. Utilities

A. Water System
1. Number of Customers on System
2. Capacity
3. Peak Load Capacity
4. Storage of Entire System
5. Source of Water
6. Chemical and Physical Characteristics of Water
7. Plans to Expand Water System
8. Water Rates
9. Concessions for Large Industrial Water Consumers

B. Sewerage System
1. Number of Customers on System
2. Capacity
3. Peak Load Capacity
4. Technical Characteristics of System
5. Rates
6. Concessions for Large Users
7. Plans to Expand System

C. Electrical Utilities
1. Suppliers Interconnected

D. Natural Gas
1. Industrial Rates
2. Main Pipeline Diameter
3. Non-Interruptable Contract Possible

E. Fuel Oil in County
1. Rates

F. Industrial Stoker Coal Available in County
1. Rates

G. Trash Disposal Service Available in County
1. Rates

VII. Established Industries

A. Number of Industries in County
1. Employment

B. Number of Industries in Community
1. Employment

C. Number of Unions in Community

D. Detailed Information on Each Industry with 50 or More Employees
1. Name
2. SIC Code
3. Products
4. Annual Production

TABLE III (Continued)

- 5. Years in Community
- 6. Seasonal
- 7. Employment
- 8. Union Affiliation
  - a. Strike Record

VIII. Local Financing
- A. Commercial Banks in Community
  - 1. Deposits
  - 2. Assets
  - 3. Number of Branches in County
- B. Savings and Loan Associations in Community, Number
  - 1. Deposits
  - 2. Assets
  - 3. Branches
- C. Local Development Corporation in Community
  - 1. Capitalization

IX. Government, County and Community
- A. County
  - 1. County Planning Commission
  - 2. County Zoning Ordinance
  - 3. Last Adopted County Operating Budget
  - 4. Last Adopted County Improvement Budget
  - 5. Bonded Indebtedness of County
- B. City
  - 1. Last Adopted City Operating Budget
  - 2. Last Adopted City Capital Improvement Budget
  - 3. Bonded Indebtedness of City
  - 4. Form of City/Town Government
  - 5. City Planning Commission
  - 6. City Codes-Building, Plumbing, Electrical Housing & Fire
  - 7. Zoning Ordinance
  - 8. Number of Municipal Employees
  - 9. Taxes, Rates
  - 10. Miles to Nearest Hydrants in Community System
  - 11. Number of Fire Hydrants in Community System
  - 12. Number of Stations
  - 13. Rescue Squads in Area
  - 14. Total Number of Policemen
  - 15. Total Policy Department Budgets
  - 16. Number of Sheriff's Deputies
  - 17. Total Sheriff's Department Budget

X. Social and Cultural Environment
- A. County Population, 1970
  - 1. Change, from Last Census Report
  - 2. Age Distribution
- B. City Population

TABLE III (Continued)

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1. Change, from Last Census Report
2. Age Distribution

C. Per Capita Income
D. Housing
    1. Rents
    2. Units Available
E. Lodging
    1. Number of Hotels and Rooms
    2. Number of Motels and Rooms
F. Medical Facilities
    1. Hospitals in Community
        a. Number
        b. Number of Beds
    2. Miles to Nearest Hospital
    3. Physicians in Area
        a. Number
        b. Average Age
    4. Dentists in Area
        a. Number
        b. Age
    5. Clinics in Area
    6. Nursing Homes in Area
    7. County Mental Health Department
    8. County Health Department
    9. County Welfare Department
    10. Rehabilitation Centers
G. Educational Facilities
    1. Private Schools
    2. Parochial Schools
    3. Public Schools
    4. Accreditation Status
    5. Enrollment
    6. High School Graduates in County Last Year
    7. Percent County High School Graduates Entering College Last Year
    8. High School Vocational Education Program
    9. Miles to Nearest Industrial Education Center
    10. Miles to Nearest Junior College
    11. Miles to Nearest 4 Year College
    12. Miles to Nearest University
H. Churches in Area
I. Civic Clubs in Community
J. Public Parks
K. Community Library
L. Outdoor Recreation Area in 30 Mile Area
M. Indoor Recreation Facilities in Community
N. Public Recreation Program in Community
O. Performing Arts in Community

TABLE III (Continued)

	P. Country Club in Community
	R. Golf Courses in Community
XI.	Physical Environment
	A. Temperatures
	B. Precipitation
	C. Winds
XII.	Buildings Available for Industrial Purposes
	A. Detailed Data on Each Available Building

data were obtained from widely available federal and state secondary sources. The study was limited to these communities because published reports of community demographic characteristics are generally unavailable for cities with populations less than 2,500. Baseline data on labor force, educational, and social characteristics were collected for use as independent or explanatory variables in the models to be constructed. Time-series data on community population and income used for dependent variables were obtained from U. S. Department of the Treasury and Bureau of the Census sources.

The Community Data Profile System was implemented by the Ozarks Regional Commission to supply raw economic data for making industrial plant location decisions and for researching growth processes in the Ozarks Region. This study relates a significant portion of the data collected by ORC in the 1970-72 period to community population and income growth.

Although providing a uniquely detailed foundation for predicting city population and income growth, the data constitute an embarrassment of riches. Many, perhaps most, economic phenomena are influenced by more variables than can be successfully accommodated in least squares regression equations. Various procedures exist which reduce variables to a manageable subset including weeding out of variables by use of economic theory, prior estimates of coefficients or by principal components.

A priori coefficients were unavailable and principal component analysis does not allow identification of the impact of specific variables on growth rates. As an alternative to these unacceptable alternatives, liberal use was made of stepwise regression, selecting those variables for inclusion in the regression equation that had coefficients significantly different from zero at the .10 probability level or better. Stepwise regression biases results toward reporting significant associations between the dependent and independent variables even when none exists. While this procedure distorts significance tests used in statistical inferences, it was selected nevertheless because other approaches posed even greater shortcomings. Structural validity is at least somewhat preserved by grouping the independent variables into logically related subsets for labor force, political-governmental, natural resources, socio-demographic, spatial and occupational structure dimensions. Variables with significant coefficients in the submodels were then "forced" into a final equation explaining population and per capita income growth.

The limitations and caveats of stepwise procedures are acknowledged and have been documented elsewhere (Wallace, 1977). However, in this study the value of stepwise regression techniques to examine a great amount of data outweighed the principal disadvantage of possibly obtaining spuriously significant results. Principal components analysis and discriminant analysis were used to confirm the validity of the regression findings as well as to lend further insight into the growth processes.

The process followed in selecting the observational units (communities) and relevant variables to be included in the analysis is depicted in Figure 1. Though data were available for five states, an initial decision to limit the study area to Oklahoma, Arkansas and the southern Missouri counties included in the Ozarks Regional Commission service area was made at the beginning of the study. Because Missouri

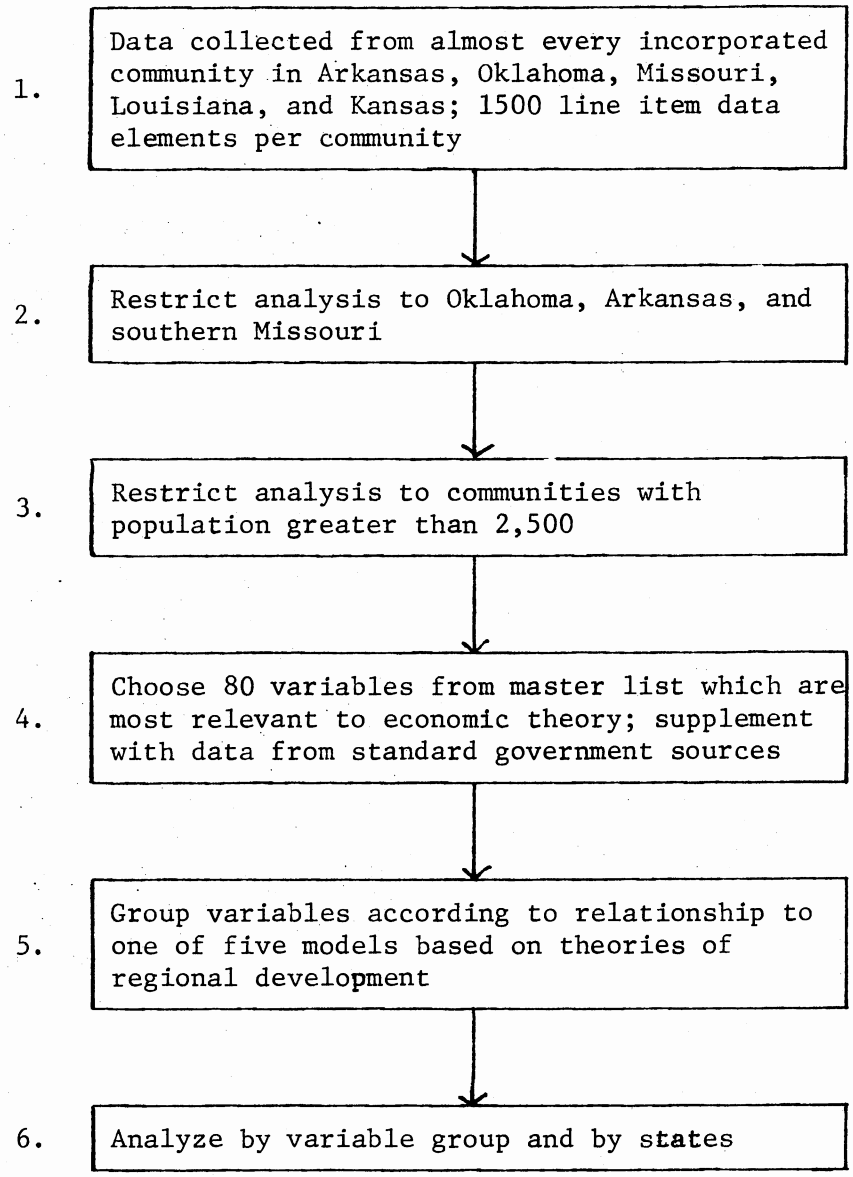

Figure 1. Stages in Choosing Variables for Analysis

investigators interpreted many of the questionnaire line items differently than did Oklahoma and Arkansas investigators, the Missouri communities were deleted from the study. The characteristics of the Oklahoma-Arkansas area should be sufficiently diverse to allow for an econometric identification of determinants of community growth processes. The area is also sufficiently homogenous to represent a manageable structure for multivariate statistical techniques.

After obtaining the Community Data Profile computer tapes from ORC, the data were dumped from the tapes and examined visually for completeness. The decision to limit the study to communities with 1970 populations greater than 2,500 was reinforced because considerable data were missing from the profiles of smaller communities.

Approximately 1500 data line items are included in the Community Data Profile questionnaire which was to be compiled and periodically updated by ORC for each community. A partial listing of the data line items is presented in Table III. Many items were initially deleted from further consideration because they had little relevance to economic growth theory or because they were primarily of a technical nature of interest only to engineers or businessmen designing plants or planning for the delivery of community services. After reducing the list of candidate explanatory or predictive variables to a more manageable 111, statistical analyses were begun.

The technique relied upon most heavily in this study was stepwise regression analysis. Initially each candidate variable was assigned to one of six categories which reflect the traits of generally recognized theories of economic development (Tweeten, 1970). The assignment scheme as well as descriptive statistics are presented in

Tables V through X. Descriptive statistics for dependent variables used in the analysis appear in Table IV. These data are necessary to interpret standardized regression coefficients reported in the next chapter. A discussion of the candidate variables is included in a later section of this chapter. A stepwise regression analysis was performed for each dependent variable in each category across all models. Results are reported in Chapter IV. The results of selected analyses were checked by performing discriminant analyses using the variables found to be significant in the corresponding regression analyses as independent variables in the formulation of the discriminant classification rules and are found in Chapter V. Principal components analysis was also used. The results are reported in Chapter VI.

Sub-Models

Natural Resource Variables

1. Recreational opportunities. In Arkansas and Oklahoma regional population growth has been linked to the recent development of retirement and resource communities in the Ozark Mountains and with tourism related to exploitation of the region's natural beauty and man-made lakes and reservoirs. Effects of such developments vis-à-vis income are difficult to predict since retirees may draw living expenses from previous savings, investments, and pensions which may not be classed as current per capita income. Retirees' spending patterns differ from those of typical families since there are usually no children to support or educate and higher expenditures for medical care. The seasonality of the tourism industry further confounds efforts to make

TABLE IV

SUMMARY OF DEPENDENT VARIABLES USED IN EACH MODEL

Variable Description	Variable Symbol	Oklahoma Mean	Oklahoma Standard Deviation	Arkansas Mean	Arkansas Standard Deviation
Percent change in city population, 1970-1973	TNDEP1	4.3	14.6	3.8	13.7
Percent change in city per capita income, 1969-1972 (constant dollars)	TNDEP2A	8.8	4.4	10.2	4.5
Percent change in city population, 1970-1975	TNDEP175	6.0	17.4	7.8	15.6
Percent change in city per capita income, 1969-1972 (money dollars)	TNDEP272	24.0	5.0	25.4	5.0
Percent change in city per capita income, 1969-1974 (money dollars)	TNDEP275	50.7	6.2	57.1	10.7
Absolute change in city per capita income, 1969-1972 (money dollars)	GROWTH72	592	128	564	103
Absolute change in city per capita income, 1969-1974 (money dollars)	GROW74	1260	223	1274	242

TABLE V

SUMMARY OF INDEPENDENT VARIABLES CONSIDERED AND DATA USED IN THE SOCIO-DEMOGRAPHIC MODELS

Variable Description	Variable Symbol	Oklahoma		Arkansas	
		Mean	Standard Deviation	Mean	Standard Deviation
City population, 1970	POP70	10457.742	12075.044	10808.640	12497.063
(City population, 1970)^2	SQUARE70	2.53×10^8	7.08×10^8	2.71×10^8	7.27×10^8
Percentage of county population with income at poverty level or below	POVERTY	17.44	7.15	25.85	7.73
County rural non-farm population as percentage of total county population, 1970	RURNOFM	31.0	19.1	42.5	11.6
County rural farm population as percentage of total county population, 1970	RURFARM	11.0	7.4	11.2	06.3
County school dropout rate	DROPOUT	.0148	.0452	.0359	.0144
County white population as percentage of county population, 1970	ETHNIC1	90.1	5.9	78.9	29.0
County Indian population as percentage of county population, 1970	ETHNIC3	4.2	3.4	0.0	0.0
County school enrollment, grades 1-12 as percentage of total county population, 1970	SKLENR2	24.8	2.4	23.3	3.5
Residents of county enrolled in college as percentage total county population, 1970	COLLEGE2	3.5	1.1	2.0	3.0
Percentage of children, ages 5-16 enrolled in school, 1970	AMEN_SH	92.113	4.410	89.267	3.560
County population, 1940	CO_POP40	42191.6	43537.4	35673.7	28143.2
County population, 1950	CO_POP50	43061.9	58538.3	36759.6	36323.6
County population, 1960	CO_POP60	48202.4	82860.9	36191.6	45296.4
County population, 1970	CO_POP70	53637.9	96467.2	39532.1	53879.2
Physicians per 1000 county population	PCCO_MD	0.001	0.000	0.001	0.001
Dentists per 1000 county population	PCCO_DDS	0.001	0.000	0.001	0.000
Hospital beds per 1000 county population	PCHOSBED	0.005	0.003	0.005	0.004
City per capita income, 1969 (dollar)	CTY_Y69	2606.495	791.022	2247.600	333.005
County dependency rate, 1970	DEPENDRA	.4723	.0307	.4775	.0346

TABLE VI

SUMMARY OF INDEPENDENT VARIABLES CONSIDERED AND DATA USED IN THE POLITICAL-GOVERNMENTAL MODELS

Variable Description	Variable Symbol	Oklahoma Mean	Oklahoma Standard Deviation	Arkansas Mean	Arkansas Standard Deviation
City population, 1970	POP70	10457.742	12075.044	10808.640	12497.063
$(\text{City population, 1970})^2$	SQUARE70	2.53×10^8	7.08×10^8	2.71×10^8	7.27×10^8
Is city located in county eligible for Economic Development Administration assistantce? (1 if yes, 0 if no)	EDA_AREA	0.515	0.502	0.667	0.475
Was county in original Ozarks Region? (1 if yes, 0 if no)	OZARK	0.433	0.498	0.480	0.503
Is local political culture traditionatistic? (1 if yes, 0 if no)[a]	POLCUL1	0.073	0.261	1.000	0.000
Is local political culture individualistic? (1 if yes, 0 if no)[a]	POLCUL3	0.302	0.462	0.000	0.000
Does county have a planning commission?[b] (1 if yes, 0 if no)	Q1162	0.263	0.443	0.320	0.470
Does county have zoning ordinances?[b] (1 if yes, 0 if no)	Q1163	0.171	0.379	0.107	0.311
Amount of city's bonded indebtedness (millions)[b]	Q1171	1.0675	2.4387	.9810	4.1830
Amounty of county's bonded indebtedness (millions)[b]	CO_DEBT	3.7326	7.1732	.2992	.4998
Does city have city manger form of government? (1 if yes, 0 if no)[b]	Q1173	0.539	0.502	0.107	0.311
Does city have building code?[b] (1 if yes, 0 if no)	Q1179	0.829	0.379	0.933	0.380
Does city have plumbing code?[b] (1 if yes, 0 if no)	Q1181	0.882	0.325	0.947	0.226
Does city have electrical code?[b] (1 if yes, 0 if no)	Q1183	0.842	0.367	0.907	0.293
Does city have housing code?[b] (1 if yes, 0 if no)	Q1185	0.539	0.502	0.827	0.381
Does city have fire code?[b] (1 if yes, 0 if no)	Q1187	0.816	0.390	0.827	0.381
Is there a public park in community?[b] (1 if yes, 0 if no)	Q1440	0.895	0.309	0.760	0.460
Is there a public library in community?[b] (1 if yes, 0 if no)	Q1442	0.947	0.225	0.733	0.445
Does community have a public recreation program? (1 if yes, 0 if no)[b]	Q1457	0.671	0.473	0.813	0.651
Is city an Economic Development Administration designated growth center? (1 if yes, 0 if no)	EDADUMMY	0.155	0.363	0.147	0.356
Number of city policemen per 1000 population[b]	TIGER1	0.002	0.001	0.001	0.001
Percentage of total votes received by Democratic Presidential Ticket, 1968	DEM68PC	33.420	6.617	31.080	6.303
Percentage of total votes received by Republican Presidential ticket, 1968	REP68PC	45.251	10.322	28.075	9.852

[a] As defined by Daniel Elazar in <u>America Federalism: A View from the States</u>, 1966

[b] Data from the Ozarks Regional Commission - Regional Resources Management Information System

TABLE VII

SUMMARY OF INDEPENDENT VARIABLES CONSIDERED AND DATA USED IN THE NATURAL RESOURCES MODEL

Variable Description	Variable Symbol	Oklahoma		Arkansas	
		Mean	Standard Deviation	Mean	Standard Deviation
City population, 1970	POP70	10457.742	12075.044	10808.640	12497.063
(City population, 1970)^2	SQUARE70	2.53×10^8	7.08×10^8	2.71×10^8	7.27×10^8
Is there a state park in county? (1 is yes, 0 if no)	ST_PK	0.268	0.445	0.347	0.479
County farm acreage/Total county land area	FARMDENS	75.7	19.4	56.2	24.6
Value of minerals produced in county, 1971/ Total county land area (dollars per square mile)	MINDENS1	22.233	24.943	3.330	8.271
Value of minerals produced in county, 1971 ($1000)	MINVAL71	16896.842	22320.310	2324.787	5895.713
Value of minerals produced in county, 1974 ($1000)	MINVAL74	15521.691	19020.776	3557.680	5062.995
Is water recreation available in county?	WATERREC	0.402	0.493	0.347	0.479
Irrigated farm land in county	IRR_LAND	4620.309	17194.195	20628.920	38495.558
Percentage of county labor force in mining sector	PCMIN_EM	09.8	03.6	00.6	01.2
Mean annual temperature	TEMP	60.697	1.248	62.113	1.647
Mean annual rainfall	RAINFALL	34.790	7.952	49.669	2.768

TABLE VIII

SUMMARY OF INDEPENDENT VARIABLES CONSIDERED AND DATA USED IN THE SPATIAL MODELS

Variable Description	Variable Symbol	Oklahoma Mean	Oklahoma Standard Deviation	Arkansas Mean	Arkansas Standard Deviation
City population, 1970	POP70	10457.742	12075.044	10808.640	12497.063
(City population, 1970)^2	SQUARE70	2.53×10^8	7.08×10^8	2.71×10^8	7.27×10^8
Miles to nearest railroad freight station[a]	Q99	1.150	3.745	9.200	17.909
Average number of freight trains stopping in city per day[a]	Q100	3.289	4.744	4.973	12.410
Is local piggy-back freight service available? (1 if yes, 0 if no)[a]	Q104	0.342	0.478	0.533	0.502
Number of truck terminals within 45 mile radius[a]	Q149	11.947	11.896	4.227	6.583
Number of truck lines serving community[a]	Q151	7.711	5.135	7.813	6.877
Miles to nearest commercial airport[a]	Q221	30.408	24.325	38.387	20.191
Miles to nearest general aviation airport[a]	Q269	15.658	12.014	11.650	12.715
Miles to nearest private airport[a]	Q320	8.717	3.911	9.680	3.691
Miles to nearest port[a]	Q212	109.645	83.259	74.947	68.157
Does an interstate highway pass through county? (1 if yes, 0 if no)[a]	Q380	0.605	0.492	0.467	0.502
Is interstate bus service locally available? (1 if yes, 0 if no)[a]	Q383	0.974	0.161	0.800	0.403
Is local bus service available? (1 if yes, 0 if no)[a]	Q384	0.039	0.196	0.213	0.412
Is local taxi service available? (1 if yes, 0 if no)[a]	Q385	0.658	0.478	0.640	0.483
Number of radio stations serving community[a]	Q408	10.382	9.051	11.120	8.743
Number of television stations serving community[b]	Q421	1.618	2.233	2.293	3.035
Is educational television available? (1 if yes, 0 if no)[a]	Q426	0.711	0.457	0.600	1.000
Are electricity suppliers interconnected? (1 if yes, 0 if no)[a]	Q1005	0.342	0.478	0.893	0.311
Is natural gas available in community? (1 if yes, 0 if no)[a]	Q1006	0.947	0.225	0.947	0.226
Are non-interruptable natural gas contracts possible? (1 if yes, 0 if no)[a]	Q1015	0.316	0.468	0.080	0.273
Is fuel oil available locally? (1 if yes, 0 if no)[a]	Q1016	0.447	0.501	0.387	0.490
Is stoker coal available locally? (1 is yes, 0 if no)[a]	Q1018	0.079	0.271	0.120	0.327
Miles to nearest major regional trade center city	PINK2	70.427	54.641	107.480	50.735
County population/Total county land area	POPDENS1	80.99	171.37	53.219	70.114
Number of hotel and motel rooms in community[a]	ROOMS	163.711	200.087	291.733	170.294
Is lodging available locally? (1 if yes, 0 if no)[a]	Q1309	0.750	0.520	0.707	0.458
Distance to nearest truck terminal multiplied by number of truck lines serving community[a]	INTACT2	49.316	74.762	26.560	62.659

[a]Data from Ozarks Regional Commission - Resource Management Information Systems

TABLE IX

SUMMARY OF INDEPENDENT VARIABLES CONSIDERED AND DATA USED IN THE LABOR MODELS

Variable Description	Variable Symbol	Oklahoma		Arkansas	
		Mean	Standard Deviation	Mean	Standard Deviation
City population, 1970	POP70	10457.742	12075.044	10808.640	12497.063
(City population, 1970)^2	SQUARE70	2.53×10^8	7.08×10^8	2.71×10^8	7.27×10^8
Number of high school graduates from city[a] entering labor force annually	Q61	270.500	534.848	335.347	366.381
Number of unions in community[a]	Q1028	1.105	2.716	2.893	4.425
Number of buildings currently available for industrial use?[a]	Q1479	1.355	3.127	1.413	9.108
Is there a local high school vocational education program? (1 if yes, 0 if no)[a]	Q1380	0.697	0.462	0.827	0.381
Is there an industrial education center in county? (1 if yes, 0 if no)[a]	Q1386	0.263	0.443	0.240	0.430
Percentage of county labor force employed as proprietors, 1970	PCPROP	26.7	12.8	16.7	6.5
Percentage of county labor force employed as farm proprietors, 1970	PCFRMPRO	14.3	10.0	4.6	2.8
Percentage of county labor force employed by government, 1970	PCGOVTEM	19.4	8.8	14.2	3.7
Percentage of county labor force in private non-farm wage and salary sector, 1970	PCPRNOFW	50.7	15.5	66.1	5.6
Percentage of county labor force in manufacturering	PCMFG_EM	10.7	7.4	27.3	7.3
County underemployment rate, 1960	UNDEREM	.1935	.0797	.3549	.0854
County non-worker/worker ratio, 1970	NWORK_WK	1.682	0.334	1.856	0.285
Percentage of county labor force employed outside of county	WRKOUTLO	15.878	12.785	13.812	9.634
Median years of school completed by county males over 25, 1970	ED_ML70	11.030	1.299	9.556	1.214
Median years of school completed by county females over 25, 1970	ED_FEM70	11.302	0.985	10.125	1.078
Median age of county population, 1970	MEDIANAG	32.262	4.572	29.672	4.434
County unemployment rate, 1970	UNEMP70	.0438	.0133	.0638	.0245

[a]Data from the Ozarks Regional Commission - Regional Resources Management Information System

TABLE X

SUMMARY OF INDEPENDENT VARIABLES CONSIDERED AND DATA USED IN FORSHT-JANSMA OCCUPATIONAL STRUCTURE MODEL

Variable Description	Variable Symbol	Oklahoma Mean	Oklahoma Standard Deviation	Arkansas Mean	Arkansas Standard Deviation
Median school years completed, 1970	X1_70	11.2523	1.0632	10.6378	1.3176
Median income of families, 1970	X2_70	7076.5348	1443.6057	6546.9189	1170.6006
Log of total city population, 1970	X4_70	8.7635	0.8268	8.8802	0.8202
Log of distance to nearest SMSA	X5_70	3.9756	0.8470	3.8670	0.9967
Percent change in population, 1950-60	X6_70	0.1409	0.4478	4.0404	8.3843
Percent change in population, 1960-70	X7_70	0.3666	1.6436	0.2694	0.2589
% professional workers, 1970	X8_70	0.1299	0.0430	0.1138	0.0367
% managers, 1970	X9_70	0.1050	0.0269	0.0924	0.0230
% clerical workers, 1970	X10_70	0.1549	0.0315	0.1277	0.0289
% sales workers, 1970	X11_70	0.0714	0.0187	0.0685	0.0198
% craftsmen, 1970	X12_70	0.1427	0.0362	0.1203	0.0276
% operatives, 1970	X13_70	0.1216	0.0434	0.1890	0.0501
% household and service worker, 1970	X14_70	0.1669	0.0340	0.1411	0.0332
% laborers, 1970	X15_70	0.0446	0.0153	0.0524	0.0198
% in agriculture, 1970	X16_70	0.0292	0.0280	0.0238	0.0231
% in construction, 1970	X18_70	0.0717	0.0264	0.0530	0.0219
% in manufacturing durable goods, 1970	X19_70	0.0789	0.0675	0.1003	0.0780
% in manufacturing nondurable goods, 1970	X20_70	0.0743	0.0605	0.1011	0.0679
% in transportation and utilities, 1970	X21_70	0.0680	0.0331	0.0587	0.0230
% in trade, 1970	X22_70	0.2381	0.0357	0.2055	0.0410
% in services, 1970	X23_70	0.0636	0.0179	0.0520	0.0171
% in government, 1970	X24_70	0.0667	0.0406	0.0362	0.0164
Population density of city, 1970	X25_70	1863.9340	975.6038	1611.3415	769.8432

preliminary assessments about income effects. Two variables, presence of a state park in the county in which the community is located (ST_PK) and presence of a water recreation area (WATERREC), were examined to assess the impact of recreational opportunities on development.

2. Mineral resources. The economy of Oklahoma has been strongly influenced by the petroleum industry for over 40 years. Arkansas is not as richly endowed, though mining of bauxite is a major economic activity in certain areas. The basic resources theory suggests that the economic growth of an area depends on the presence and the feasibility of exploiting endogenous natural resources (Tweeten, 1970). Three measures were specified as candidate variables in the natural resources model. Value of minerals produced in 1971 per square mile of county land area (MINDENS1) and absolute value of minerals produced in 1971 in the county in which the community is situated (MINVAL71) were introduced as a candidate variable. To check whether the Arab oil embargo of 1973 which quadrupled the wellhead price of crude oil had an effect on the growth of the Oklahoma economy, value of minerals produced in the community's county in 1974 (MINVAL 74) was introduced as a candidate variable. The last variable--percentage of the county labor force employed in mining (PCMIN_EM)--was previously found to be inversely related to small-community growth in Pennsylvania (Forsht and Jansma, 1975).

3. Agriculture. The economies of Oklahoma and Arkansas have long been dependent upon agriculture. Changes in agricultural technology and consumer demand have led to out-migration from rural areas as well as changes in the number and sizes of farms. Whether adjustments are still taking place is of interest to researchers. To determine the importance of agriculture in influencing a community's economy, the

percentage of total county land area classified as farmland (FARMDENS) was entered as a candidate variable. Because irrigation is important, especially in western Oklahoma, that too was examined (IRR_LAND).

4. Climate. Rainfall (RAINFALL) and temperature (TEMP) influence both agriculture and tourism. These factors determine what types of crops and livestock can be raised and determine the optimal land requirements and capital structure of farm units. They also determine the length of the tourist season as well as the attractiveness of the area to vacationers and retirees.

Political-Governmental Variables

1. Federal assistance. As discussed in the previous chapter, the federal government established the Economic Development Administration and the regional commission system in the 1960's to promote the development of economically depressed areas of the United States. If these agencies are having an impact (EDA_AREA and OZARK), significant coefficients confirming this should result.

The Economic Development Administration provides special financial and technical assistance to cities which it, in conjunction with state and local officials, designates as growth centers (EDADUMMY). Previous research indicates that these areas tend to exhibit more rapid development than similar areas not receiving this consideration (Economic Development Administration, 1972b).

2. Political culture. Elazar (1966) developed a concept of political culture which incorporates past voting patterns with the predominant social, economic, and moral values of the region. Other political scientists (Sharkansky, 1968) have attempted to identify

regional political characteristics associated with growth processes. Elazar defined three basic political cultures--individualistic, moralistic, and traditionalistic.

The individualistic political culture emphasizes the conception of the democratic order as a marketplace. Government is instituted strictly for utilitarian reasons--to handle those functions demanded by the people it is created to serve. In general, government action is to be restricted to those areas, primarily in the economic realm, which encourage private initiative and widespread access to the marketplace. Politics is just another means by which individuals may improve their social and economic stature.

The moralistic political culture emphasizes the commonwealth conception as the basis for democratic government. Politics is considered one of the great activities of man in his search for the good society. In the moralistic political culture individualism is tempered by a general commitment to utilizing communal--preferably nongovernmental, but governmental if necessary--power to intervene into the sphere of private activities when it is considered necessary for the public good or well-being of the community. Where the moralistic political culture is dominant today there is considerably more amateur participation in politics and less government corruption.

The traditionalistic political culture is based on an ambivalent attitude toward the marketplace coupled with a paternalistic and elitist conception of the commonwealth. Like the moralistic political culture, the traditionalistic political culture accepts government as an actor with a positive role in the community, but it tries to limit that role to securing the maintenance of the social order. Political parties are of minimal importance in the traditionalistic political culture since they encourage a degree of openness that goes against the fundamental grain of an elite-oriented political order. Where the traditionalistic political culture is dominant in the United States today, political leaders play conservative and custodial rather than initiatory roles unless strongly pressed from the outside.

Elazar classifies all of Arkansas as having a traditionalistic political culture. Western Oklahoma has an individualistic political culture. Eastern Oklahoma has a traditionalistic political culture. The central portion of Oklahoma embodies elements of both cultures. The moralistic political culture is found further north, beginning in northern Kansas and extending through much of Iowa and the Dakotas. Dummy variables are used to represent political cultures in the analysis.

3. Community foresightedness. Communities can enact laws which encourage orderly growth. Under most circumstances the enactment of zoning ordinances (Q1163), the establishment of planning commissions (Q1162), and the enactment of building (Q1179), plumbing (Q1181), electrical (Q1183), housing (Q1185), and fire (Q1187) codes might be considered a proxy for the presence of ambitious, enlightened, and forward-looking leadership within the community. Consequently, growth is expected to be positively associated with such variables. Although there seems to be a point where such institutions are used to retard growth in order to preserve a desired community atmosphere or protect the environment, policy used in this manner is more characteristic of areas in later stages of development such as the Northeast Corridor (Washington, D. C.-New York City area) or southern California rather than the less developed, more spatious areas in the American South and Southwest.

4. Municipal services. Although availability of superior municipal services may in reality be either a cause or a result of community growth, here it is hypothesized to be a cause. Taxes to support such services can have an offsetting negative effect, but this level of community services in all likelihood has not yet been reached in the study area. Development in the form of industrial location or expansion and population in-migration or lack of out-migration seems more likely to occur in areas in which are attractive to reside or invest. The existence of city parks (Q1440), public libraries (Q1442), and public recreation programs (Q1457) should provide some indicator of the quality and quantity of the complement of available municipal, leisure-related services.

The amount of city and county public bonded indebtedness (Q1171 and CO_DEBT) are measures of past investment in community infrastructure. Population and income growth might be considered returns to this investment.

5. Availability of police protection. Police per capita appear to have little impact on reducing the crime rate and hence can be taken as a proxy for problems with crime (Morris, 1973). The normal reaction of city officials to increased crime in their community is to hire more policemen (Schmidt, 1977). Here it is hypothesized that growth is more likely to occur in areas where there are fewer social problems. Since crime is an indicator of disharmony in society, economic growth would be more likely to occur in areas with lower policemen to total population ratios.

6. Political party affiliation. Certain characteristics are commonly ascribed to members of the various political parties.

Republicans tend to favor less government intervention in the marketplace and a decreased emphasis on social programs than do Democrats. Democrats are more likely to have lower incomes, work in blue-collar occupations, and be members of labor unions and minority racial groups than are Republicans. Many of the characteristics which Elazar (1966) associates with the individualistic political culture described earlier could also be attached to Republicanism and, especially in the Deep South, the traditionalistic political culture is similar to the tenets of the southern Democratic Party of the 1960's and earlier.

Couny voting patterns in the 1968 presidential election (DEM68PC and REP68PC) were selected as a measure of community party affiliation since most of the other baseline data was from 1970, since the candidates in that year, Hubert Humphrey and Richard Nixon, embodied many of the traditional ideologies of their respective parties, and since the percentage of the vote going to the third-party candidate, George Wallace, was large enough to eliminate multicollinearity problems which would have resulted had the sum of the Democratic plus the Republican vote been quite close to one hundred percent. It is hypothesized that Republican areas will be more likely to experience development largely because of the socio-economic characteristics associated with their constituencies.

Spatial Variables

As noted in the review of literature much research into economic growth processes has been centered around spatial dimensions of economic activity (see, especially, von Thünen, 1966; Weber, 1929; and Isard, 1960).

1. Availability of transportation. Proximity to a railroad freight station (Q99), to a commercial airport (Q221), to a general aviation airport (Q269), to a private airport (Q320), and to a river or ocean port (Q212) should be positively associated with community growth and development since transportation costs associated with access to these facilities are, more or less, directly related to the distance of the user from them. Greater numbers of freight trains stopping in the city daily (Q100), number of truck terminals within a forty-five mile radius (Q149), and numbers of truck lines serving the community (Q151) should promote growth because they indicate whether a community had good access to bulk and specialized freight transportation systems. Whether certain transportation services are available in a community--an interstate highway (Q380), piggyback railroad freight service (Q104), interstate bus service (Q383), local bus service (Q384), and taxi service (Q385)--should affect growth. Such services seem more likely to be present in thriving communities.

2. Communications. Availability of radio (Q408), commercial television (Q421), and educational television (Q426) should encourage community growth and development for much the same reasons cited under the municipal services section of the political-governmental variable discussion.

3. Energy. Industries desire to locate in and people desire to live in communities where there is an abundant, non-interruptible, low-cost supply of energy to run factories and to heat and cool homes. Enhanced availability of electricity (Q1105), natural gas (Q1006 and Q1015), fuel oil (Q1016), and stoker coal (Q1018) encourage growth.

A wider variety of available fuels provides consumption alternatives when the price of one rises relative to another.

4. Lodging. Availability of overnight lodging--hotels or motels--is helpful for the community desiring to prosper since industries frequently bring in related corporate personnel for short-term consultation and demonstrate their wares to potential customers at the plant site. Travelling salesmen calling on industries and local businesses also must have overnight lodging. Hotels and motels sometimes contribute to community economy if they cater to the tourist trade or if they serve as a waystation for travellers.

5. Population density. One could make a case in rural areas that higher population density is important to get adequate labor supply. For the central city this may not apply. However, Bogue and Harris (1954) found that the greater the population density of the SMSA central city, the lower rate of population growth. Thus, a negative coefficient was expected for the population density variable.

Socio-Demographic Variables

1. Income. Neoclassical economic theory suggests that workers migrate to an area when the discounted wage stream--less moving costs and less a premium for the psychic cost associated with moving--in the destination area exceeds the discounted wage stream in the original work area (Sjaastad, 1962). Thus, a population flow is expected from a low income area to a high income area as measured by the city median per capita income (CTY_Y69) and by the percentage of families living in poverty (POVERTY) in the county in which the community is located.

The effects of these variables on income change are difficult to specify beforehand. Historically, incomes have tended to increase faster on a percentage basis when the base year income is low, while incomes tend to increase faster absolutely when base year income is high.

2. Place of residence. During the 1950's an exodus began from farming areas largely because of accelerated technological change in the agricultural sector. Here it is hypothesized that residual effects of the technology boom which caused capital to be substituted for labor are still being felt in rural areas. Thus, areas with a higher proportion of farm dwellers (RURFARM) are expected to exhibit slower rates of population growth. Whether the variable rural non-farm population--that is, those people who live outside of incorporated communities with populations greater than 2,500 but who do not reside on farms (RURNOFM)--has an effect is also examined.

Although areas with a larger percentage of farmers are expected *a priori* to show less population growth, they should exhibit healthy characteristics vis-à-vis income growth since the less efficient farmers and surplus offspring of efficient farmers tend to migrate to other areas. Higher incomes may be indicative of a return from the same amount of land to fewer individuals as well.

3. Racial composition. Because large numbers of blacks in the South and Southwest were employed as farm laborers and failed to acquire for themselves or their families the skills and values which are necessary to compete within the dominant economic system and because many of those who were displaced by advancing technology moved to nearby towns and cities instead of migrating to more distant industrial centers, it is expected that communities with a high percentage of

blacks will exhibit characteristics of a lagging economy. Institutional and social barriers within American society have tended to restrict employment opportunities for minorities as well as accept the paying of wages to minorities which are less than those to whites doing similar work.

In Arkansas there are two major ethnic groups--black and white. In Oklahoma there are three major ethnic groups--white, black, and American Indian. To eliminate multicollinearity in the estimated regression equations one group, the blacks, had to be removed as a candidate variable since the sum of the three percentages in the Oklahoma, Arkansas, and the combined Oklahoma-Arkansas data sets was very nearly one hundred percent.

4. Education. Education, quite literally investment in human capital, plays a critical role in community development. Four indicators of the community commitment were examined--(1) percentage of the total county population enrolled in grades one through twelve (SKLENR2); (2) percentage of the total county population enrolled in college (COLLEGE2); (3) percentage of county children ages five through sixteen enrolled in school (AMEN_SH); and (4) county school dropout rate (DROPOUT).

5. Medical facilities and personnel. Superior medical resources should be conducive to community population growth and should be indicative of a prospering economy. Three measures were examined--(1) physicians per 1,000 population (PCCO_MD); (2) dentists per 1,000 population (PCCO_DDS): and (3) hospital beds per 1,000 population (PCHOSBED). However, consideration must be given to resource fixity as, for example, the supply of hospital beds is obviously less responsive to changes in demand than is the supply of physicians.

6. Dependency rate. A dependency rate for each community was calculated by dividing the total of those under 18 and over 65 years old by the total community population (DEPENDRA).

Labor Force Variables

1. Education. A large number of high school graduates entering the labor force (Q61) should signal a positive contribution to the economic development of the community since new industry is attracted to areas with a well-trained, plentiful labor supply. Corresponding increases in income should accrue.

A high school vocational education program (Q1380) and an industrial education center (Q1386) represent infrastructural investment and foresight on the part of community leaders. Thus, they should be suggestive of growth.

The educational level of the county population (ED_ML70 and ED_FEM70) reflects past investment in human capital and should contribute to growth.

2. Sectoral employment. It was hypothesized that variations in employment by sector could influence population and income growth. Five variables were examined: percentage of county labor force employed as (1) proprietors (PCPROP), (2) farm proprietors (PCFRMPRO), (3) government workers (PCGOVTEM), (4) private non-farm wage and salary workers (PCPRNOFW), and (5) manufacturing workers (PGMFG_EM).

3. Union activity. Some have suggested that industries tend to locate in areas where there is little labor union activity. To test this hypothesis the number of unions in the community (Q1028) was included as a candidate variable for the regression models. Data were

not available to measure the proportion of workers in labor unions.

4. Commuting. Sometimes workers are attracted to employment opportunities outside their home community but do not find it desirable to move their residence because of social, economic or kinship ties to the home community. Often small towns near major metropolitan areas become "bedroom" communities because workers either cannot afford housing in the larger community or they prefer the lifestyle of the smaller community. To see whether this phenomenon influenced growth, the percentage of the county labor force working outside the county of residence (QRKOUTLO) was tested in the models.

5. Underemployment and unemployment. Underemployment and unemployment may either by symptomatic of a depressed economy with lack of growth potential or they may signify an untapped reservoir of human talent which may attract outside investment by industry. The 1960 county underemployment rate (UNDEREM) and the 1970 county unemployment rate (UNEMP70) were examined to determine whether they affected community growth and development.

Dependent Variables

Dependent variables can be specified in various forms. Income change can be expressed either in percentage or absolute terms.[1/]

[1/] The question arises as to whether the dependent variable should be absolute change or percentage change. Let us consider measuring population change between 1970 (POP70) and 1975 (POP75).

Consider percentage change:

$$1.a \quad \frac{POP75 - POP70}{POP70} = B_b + B_2X_2 + \ldots + B_nX_n$$

Estimate this equation through regression. Multiply both sides by POP70.

States with lower base year per capita incomes have experienced greater percentage increases than states with high base incomes. However, more prosperous states generally have registered greater absolute gains in income. The dollar gap in per capita income between richer and poorer states historically has widened.

A second consideration in choosing the dependent variable is to select the most appropriate time interval over which to measure the change. The time interval should be sufficiently short to capture effects of factors within the community which influence the dependent variable; yet, the interval should be long enough to filter out random variations in change which occur. For example, a manufacturing plant might locate in a small community and cause the community population to increase by 500 during a given year. The events which culminated in the actual plant location such as the wooing of industrialists, careful planning of community services, passage of bond issues, and negotiations with local bankers might have occurred over a span of several years. A population increase of 500 for a single year may not be typical and attributable to the existing community situation but an average increase of 100 per year over a five year period might be. If

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1.b $POP75 - POP70 = B_o POP70 + B_2 X_2 \; POP60 + \ldots + B_n X_n \; POP70$

Now, consider absolute change:

2.a $POP75 - POP70 = B_0 + B_1 \; POP70 + B_2 X_2 + \ldots + B_n X_n$

Compare 1.b with 2.a. B_0 in 1.b should equal B_1 in 2.a. Empirically this has been shown to be the case in our work. When percentage change is used, the intercept picks up the effect of the denominator in the dependent variable. The included variables should be the same in both models.

so, then population change should measure over a five-year span rather than over one year.

Results for alternative specification of population and income dependent variables are presented. The tables incorporated into the next chapter are intended to present a fairly straightforward analysis of the regression results of the dissertation. The narrative accompanying the tables should be used by the reader as a guide through the tables rather than as a comprehensive analysis. To demonstrate interpretation of results, comments are made in some detail on the statistical output of each of the final regression models for one measure of population change--percent change in population, 1970-75--and one measure of income change--percent change in real per capita income, 1969-74. The discussion highlights some of the results, identifies patterns which exist throughout the regression models, and compares results of alternate models formed by inclusion of slightly different sets of candidate variables or alteration of the reference time interval. The reader may examine the tables to observe the outcome of a particular variable or area in which he has an interest.

Regression Models

Determinants of community population and income change were isolated by applying a stepwise regression technique to each set of variables contained in the five hypothesized sub-models. The FORWARD SELECTION option of the STEPWISE procedure of the Statistical Analysis System, commonly known as SAS (Barr, et al., 1976, pp. 249-253), was used in all instances where a stepwise technique was employed. Using the STEPWISE (FORWARD SELECTION) technique, the single variable model which produces the largest R^2 statistic is first found. Variables are then added one by one to the model. For each of the candidate independent variables STEPWISE calculates an F-statistic reflecting that variable's contribution to the model if it were included. If the F-statistic for one or more variables has a significance level greater than the specified "significance level for entry," then the variable with the largest F-statistic is included. The partial F-statistic calculated for each independent variable is the square of the Student's t-statistic. In this study the significance level for entry was set in all instances at .50. After a variable is added STEPWISE looks at all the variables already included in the model. Any variable not producing a partial F-statistic significant at the specified "significance level for staying in" is then deleted from the model. The significance level for staying in this study was set in all cases at .10. Only after this check is made and any required deletions accomplished can another variable be added to the regression model. The process terminates when no variable meets the conditions for inclusion in the model or when the variable added to the model is the one just deleted from it.

The structural validity of each model is at least somewhat preserved by grouping the variables into logically related subsets for labor force, political-governmental, natural resource, socio-demographic, and spatial dimensions of the economy under study (see Tables V-X). Variables with significant coefficients in the respective sub-models were then included in final equations explaining income and population growth by using the SAS SYSREG procedure and specifying that the variables returned in the stepwise sub-model would be included in a final regression model for the respective dependent variables.

In multiple linear regression the coefficients B_1, B_2, . . ., B_n of the model

$$Y_i = B_0 + B_1X_{i1} + B_2X_{in} + . . . + B_nX_{in} + r_i$$

are estimated so that the sum of the square residuals ($\sum_i \hat{r}_i^2$) is minimized. Detailed explanations of the technique are widely available (Huang, 1970).

Statistical results for each regression model reported herein include ordinary regression coefficients, standardized regression coefficients, t values, and probabilities of values greater than t if sampling from a population in which the null hypothesis $\beta_i = 0$ is true. The standardized regression coefficient is defined as $\hat{\beta}(x_{xi}/s_y)$ where s_{xi} and s_y are respectively the standard deviations of the independent and dependent variables reported in Tables IV-X. The standardized coefficient shows the increase in the dependent variable associated with one standard deviation increase in the respective independent variable. The standardized coefficient is very similar to the elasticity of response which is $\hat{\beta}(\bar{x}_i/\bar{y})$; indeed they are identical if the coefficient of variation is the same for x_i as for y.

The results of the 90 sub-model regressions are reported in summary Tables XI-XVI. The physical volume of information generated in these analyses preclude detailed reporting. Thus, only R^2's and number of significant coefficients resulting in each procedure are noted.

The variables whose coefficients were significant in the sub-model associated with each respective dependent variable were then used to develop a final regression equation. The results of these analyses are reported in detail.

TABLE XI

RESULTS OF STEPWISE REGRESSION SUB-MODELS FOR DEPENDENT VARIABLE PERCENT CHANGE IN POPULATION 1970-73

State	Model	No. of Coefficients Significant at .10	R^2
Oklahoma	Socio-Demographic	2	.1750
Oklahoma	Spatial	3	.2672
Oklahoma	Political-Governmental	3	.2834
Oklahoma	Natural Resource	1	.1671
Oklahoma	Labor Force	3	.2832
Arkansas	Socio-Demographic	3	.3430
Arkansas	Spatial	5	.2874
Arkansas	Political-Governmental	2	.2319
Arkansas	Natural Resource	3	.2135
Arkansas	Labor Force	3	.2261
Two-State	Socio-Demographic	3	.1908
Two-State	Spatial	2	.1131
Two-State	Political-Governmental	6	.2625
Two-State	Natural Resource	2	.0631
Two-State	Labor Force	2	.1301

TABLE XII

RESULTS OF STEPWISE REGRESSION SUB-MODELS FOR DEPENDENT VARIABLE PERCENT CHANGE IN POPULATION 1970-75

State	Model	No. of Coefficients Significant at .10	R^2
Oklahoma	Socio-Demographic	8	.4159
Oklahoma	Spatial	8	.4691
Oklahoma	Political-Governmental	4	.3580
Oklahoma	Natural Resource	3	.1271
Oklahoma	Labor Force	2	.2004
Oklahoma	Forsht-Jansma	8	.7215
Arkansas	Socio-Demographic	4	.5016
Arkansas	Spatial	8	.6164
Arkansas	Political-Governmental	3	.3215
Arkansas	Natural Resource	3	.2938
Arkansas	Labor Force	7	.5299
Arkansas	Forsht-Jansma	4	.6671
Two-State	Socio-Demographic	6	.3334
Two-State	Spatial	7	.2662
Two-State	Political-Governmental	5	.2230
Two-State	Natural Resource	4	.1482
Two-State	Labor Force	5	.2185
Two-State	Forsht-Jansma	11	.6621

TABLE XIII

RESULTS OF STEPWISE REGRESSION SUB-MODELS FOR DEPENDENT VARIABLE PERCENT CHANGE PER CAPITA INCOME 1969-72

State	Model	No. of Coefficients Significant at .10	R^2
Oklahoma	Socio-Demographic	5	.2875
Oklahoma	Spatial	3	.2377
Oklahoma	Political-Governmental	4	.3720
Oklahoma	Natural Resource	3	.2062
Oklahoma	Labor Force	4	.3037
Arkansas	Socio-Demographic	4	.3280
Arkansas	Spatial	4	.3515
Arkansas	Political-Governmental	2	.2758
Arkansas	Natural Resource	3	.3354
Arkansas	Labor Force	4	.3420
Two-State	Socio-Demographic	5	.1997
Two-State	Spatial	8	.2847
Two-State	Political-Governmental	5	.2264
Two-State	Natural Resource	4	.2275
Two-State	Labor Force	5	.2249

TABLE XIV

RESULTS OF STEPWISE REGRESSION SUB-MODELS FOR DEPENDENT VARIABLE PERCENT CHANGE IN PER CAPITA INCOME, 1969-74

State	Model	No. of Coefficients Significant at .10	R^2
Oklahoma	Socio-Demographic	3	.1788
Oklahoma	Spatial	5	.3324
Oklahoma	Political-Governmental	3	.2828
Oklahoma	Natural Resource	1	.0477
Oklahoma	Labor Force	2	.0871
Arkansas	Socio-Demographic	2	.2787
Arkansas	Spatial	3	.3298
Arkansas	Political-Governmental	4	.2936
Arkansas	Natural Resource	4	.3244
Arkansas	Labor Force	4	.3991
Two-State	Socio-Demographic	4	.2970
Two-State	Spatial	6	.3308
Two-State	Political-Governmental	5	.2486
Two-State	Natural Resource	6	.2811
Two-State	Labor Force	3	.2410

TABLE XV

RESULTS OF STEPWISE REGRESSION SUB-MODELS FOR DEPENDENT VARIABLE ABSOLUTE CHANGE IN INCOME 1969-72

State	Model	No. of Coefficients Significant at .10	R^2
Oklahoma	Socio-Demographic	5	.3819
Oklahoma	Spatial	3	.3338
Oklahoma	Political-Governmental	5	.4592
Oklahoma	Natural Resource	3	.2837
Oklahoma	Labor Force	4	.3882
Arkansas	Socio-Demographic	4	.2433
Arkansas	Spatial	3	.1926
Arkansas	Political-Governmental	2	.1654
Arkansas	Natural Resource	3	.2384
Arkansas	Labor Force	3	.2269
Two-State	Socio-Demographic	1	.1413
Two-State	Spatial	6	.2780
Two-State	Political-Governmental	5	.2496
Two-State	Natural Resource	3	.2184
Two-State	Labor Force	6	.2827

TABLE XVI

RESULTS OF STEPWISE REGRESSION SUB-MODELS FOR DEPENDENT VARIABLE ABSOLUTE CHANGE IN PER CAPITA INCOME, 1969-74

State	Model	No. of Coefficients Significant at .10	R^2
Oklahoma	Socio-Demographic	4	.4955
Oklahoma	Spatial	6	.6949
Oklahoma	Political-Governmental	5	.6699
Oklahoma	Natural Resource	3	.5599
Oklahoma	Labor Force	4	.5902
Oklahoma	Forsht-Jansma	5	.6070
Arkansas	Socio-Demographic	4	.3948
Arkansas	Spatial	4	.4522
Arkansas	Political-Governmental	2	.3009
Arkansas	Natural Resource	5	.4306
Arkansas	Labor Force	4	.4730
Arkansas	Forsht-Jansma	5	.4555
Two-State	Socio-Demographic	6	.4680
Two-State	Spatial	8	.5257
Two-State	Political-Governmental	6	.4324
Two-State	Natural Resource	7	.4412
Two-State	Labor Force	4	.4271
Two-State	Forsht-Jansma	8	.4423

Selection of significance levels was made in part by examining similar studies and choosing levels which would facilitate comparison. The specified level for entry was .50 and the level for staying in the model was .10. Such levels seem to be undeclared standards for recent work in regional economics.[2/]

Discriminant Analysis

Statistical methods for estimation, hypothesis testing, and confidence statements are based typically on exact specification of the response variates. In the applied sciences another kind of multivariate problem frequently occurs in which an observation must be assigned in some optimal fashion to one of several populations. Classification rules based on an index called the linear discriminant function provide a method for such assignment.

Implicit in the development of a successful classification scheme is the assumption that the variables included will in the future continue to be related as in the past. If the classification variables are merely associated with community growth (or no growth), the results can be used for prediction as long as the association among variables continues to hold. If in addition the classification variables are judged to cause community growth, the results can also be used for

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[2/] To test the algorithm as well as to demonstrate the hazards of stepwise, 5000 random numbers were generated and divided into 50 groups of 100 numbers each. Each group was treated as if it were an independent variable in a stepwise regression procedure. As expected the test repeatedly yielded 5 variables significant at the .10 level and an R^2 in the neighborhood of .40.

prescriptive purposes. Such information may be valuable to planners and government officials.

The technique of discriminant analysis is based on the assumption that a linear function $Y = B_1X_1 + B_2X_2 + . . . + B_nX_n$ exists which will distinguish between the elements of a population. The discriminant model utilizes coefficients $B_1, B_2, . . ., B_n$ chosen in such a way that the ratio of between group sum of squares is maximized. Therefore, the index Y represents the optimal discriminator between the two groups. Factors $X_1, X_2, . . ., X_n$ represent quantifiable determinants of income change.

Several computational approaches are available when using the discriminant procedure (Morrison, 1976). In this paper the classification criterion developed by the discriminant procedure is determined by a measure of the generalized square, or Mahalanobis, distance. It can be based on either the individual within-group covariance matrices or on the pooled covariance matrix. If a test for homogeneity confirms that no difference exists at the specified level between the covariance matrices of the respective samples, the pooled covariance matrix can be used to develop the classification rule.

The generalized least square distance is

$$D^2(\underset{\sim}{X}) = (\underset{\sim}{X} - \underset{\sim}{\mu}_j)' \Sigma_j^{-1} (\underset{\sim}{X} - \underset{\sim}{\mu}_j) + \ln|\Sigma_j|$$

if within-group covariance matrices are used and

$$D_j^2(\underset{\sim}{X}) = (\underset{\sim}{X} - \underset{\sim}{\mu}_j)' \Sigma^{-1} (\underset{\sim}{X} - \underset{\sim}{\mu}_j)$$

if a pooled covariance matrix is used, where

Σ_j = the covariance matrix for the observations within group j,

Σ = the pooled covariance matrix,

$\underset{\sim}{X}$ = a px1 vector of the observed variable values of the rth observation,

$\underset{\sim}{\mu}$ = a px1 vector of the variable population means.

The probability of group membership, i.e. whether the city is more likely to exhibit rapid or slow income growth, is determined for each observation by a Bayesian technique using the Mahalanobis distance; the observation is assigned to the group to which it has the greatest posterior probability of membership.

Assume two p-dimensional multi-normal populations π_1 and π_2 with mean vectors $\underset{\sim}{\mu}_1$ and $\underset{\sim}{\mu}_2$ and covariance matrices Σ_1 and Σ_2. Assume further that the prior probabilities of group membership are p_1 = $\Pr\{\pi_i\}$. Then

$$\Pr\{\pi_i|\underset{\sim}{X}\} = \frac{\Pr\{X|\pi_i\} \cdot \Pr\{\pi_i\}}{\sum_{j=1}^{2} \Pr\{X|\pi_j\} \cdot \Pr\{\pi_j\}} \qquad i = 1, 2$$

$$= \frac{[(2\pi)^{-p/2} \cdot |\Sigma_i|^{-\frac{1}{2}} \cdot \exp\{-\tfrac{1}{2}(\underset{\sim}{X} - \underset{\sim}{\mu}_i)' \Sigma_i^{-1}(\underset{\sim}{X} - \underset{\sim}{\mu}_i)\}]\, p_i}{\sum_{j=1}^{2} [(2\pi)^{-p/2} \cdot |\Sigma_j|^{-\frac{1}{2}} \cdot \exp\{-(\underset{\sim}{X} - \underset{\sim}{\mu}_i)' \Sigma_j^{-1} (\underset{\sim}{X} - \underset{\sim}{\mu}_j)\} \cdot p_j]}$$

Having defined $D_j^2(\underset{\sim}{X}) = (\underset{\sim}{X} - \underset{\sim}{\mu}_j)' \Sigma^{-1}(\underset{\sim}{X} - \underset{\sim}{\mu}_j)$ we can now write

$$\Pr\{\pi_i|\underset{\sim}{X}\} = \frac{\exp\{-\tfrac{1}{2} D^2(\underset{\sim}{X}_i) - \tfrac{1}{2} \ln|\Sigma_i| + \ln p_i\}}{\sum_{j=1}^{2} \exp\{-\tfrac{1}{2} D^2(X_j) - \tfrac{1}{2} \ln|\Sigma_j| + \ln p_j\}} \qquad i = 1, 2$$

Under the assumption that $\Sigma_1 = \Sigma_2$, this reduces to

$$\Pr\{\pi_i|\underset{\sim}{X}\} = \frac{\exp\{-\tfrac{1}{2} D^2 (\underset{\sim}{X}, \underset{\sim}{\mu}_i) + \ln p_i\}}{\sum_{j=1}^{2} \exp\{-\tfrac{1}{2} D_j^2 (\underset{\sim}{X}) + \ln p_j\}} \qquad i = 1, 2$$

The probabilities of group membership are calculated from the sample by replacing the $\underset{\sim}{\mu}_i$ and $\underset{\sim}{\mu}_j$ by their estimates from the sample. Under the assumption of equal prior probabilities ($p_1 = p_2 = \tfrac{1}{2}$), the group membership probability reduces to

$$\Pr\{\pi_i|\underset{\sim}{X}\} = \frac{\exp\{-\tfrac{1}{2} D_i^2 (\underset{\sim}{X})\}}{\sum_{j=1}^{2} \exp\{-\tfrac{1}{2} D_j^2 (\underset{\sim}{X})\}} \qquad i = 1, 2$$

Since $D_i^2 (\underset{\sim}{X}) \geq 0$, it is clear that $\Pr\{\pi_i|\underset{\sim}{X}\}$ will be maximized for whichever i minimizes $D_i^2 (\underset{\sim}{X})$. We assign the observation to group 1 if

$$D_1^2 (\underset{\sim}{X}) > D_2^2 (\underset{\sim}{X})$$

i.e. $(\underset{\sim}{X} - \underset{\sim}{\mu}_1)' \Sigma^{-1} (\underset{\sim}{X} - \underset{\sim}{\mu}_1) < (\underset{\sim}{X} - \underset{\sim}{\mu})' \Sigma^{-1} (\underset{\sim}{X} - \underset{\sim}{\mu}_2)$

i.e. $\underset{\sim}{X} \Sigma^{-1} \underset{\sim}{X} - 2\underset{\sim}{\mu}_1' \Sigma^{-1} \underset{\sim}{X} + \underset{\sim}{\mu}_1' \Sigma^{-1} \underset{\sim}{\mu}_1 < \underset{\sim}{X}' \Sigma^{-1} \underset{\sim}{X} - 2\underset{\sim}{\mu}_2' \Sigma^{-1} \underset{\sim}{X}$

$+ \mu_2' \Sigma^{-1} \mu_2$

i.e. $(\underset{\sim}{\mu}_1 - \underset{\sim}{\mu}_2)' \Sigma^{-1} \underset{\sim}{X} >$ some constant.

The Discriminant Approach

The work presented herein using disciminant analyses applies only to the dependent variables percent change in community population, 1970-73, and percent change in real community per capita income, 1969-72. The variables returned as significant by the stepwise algorithm in each sub-model were used to develop the discriminant rule for the respective dependent variables. The observations used to develop the discriminant rule consisted only of the slowest-growing (income or population) quintile and the fastest-growing quintile. The middle group was ignored.

The observations in the slow-growing set were assigned a priori to group 1 and the observations in the fast-growing set were assigned to group 2. Posterior probabilities of group membership were then calculated for each observation according to the rule

$$\Pr\{\pi_i \mid \underset{\sim}{X}\} = \frac{\exp\{-\frac{1}{2} D_i^2 (\underset{\sim}{X})\}}{\sum_{j=1}^{2} \exp\{-\frac{1}{2} D_j^2 (\underset{\sim}{X})\}} \qquad i = 1, 2$$

The discriminant rule developed was not necessarily a linear one. If the chi-square test showed no significant difference between the slow group and the fast group within-group covariance matrices, then a pooled covariance matrix was used which results in a non-linear form of the discriminant rule.

Discriminant analysis was employed for two reasons. First, it provides a tool which the researcher or policy-maker can use to distinguish between growing and lagging areas. Second, it provides a check for the results of the stepwise regression analysis. If discriminant rule successfully classifies a high percentage of the observations, we can be reasonably sure that the independent variables used do in fact influence or are associated with the dependent growth variable.

Principal Components Analysis

The list of variables whose impact on population and income growth we would like to test totals 111. Since the number of observations from the Arkansas and Oklahoma data sets is less than 100, insufficient degrees of freedom are available if all variables were included in a single regression model. Further, the independent variables are intercorrelated with each other in a complex fashion, with some of the zero-order coefficients greater than .95. Recognizing that multicollinearity would cause problems and that too few degrees of freedom were available to include all independent variables in a single regression model, we initially grouped the variables according to six logical subsets which were consistent with a recognized theory of development and employed a stepwise algorithm which, among other things, deleted variables from the final estimated equation which were multicollinear. Use of principal components is a second method of circumventing these problems.

In this section we retain all the independent variables and attempt instead to reduce their dimensionality and eliminate the interactions by using principal components analysis. This technique creates a smaller number of new variables which are linear combinations of the original ones. These components have the desirable statistical properties of being uncorrelated with each other and extracting a maximum amount of the variance from the original variables. It should be noted that the new variables are arbitrary up to a linear transformation, being measured on a standardized scale for convenience. Our task becomes that of interpreting the components to see if they correspond to meaningful identifiable patterns as well as being statistically significant.

The analyst employing the principal components technique to reduce the effective dimensionality of a set of variables is faced with a complex question of how many factors to create. Unless there is perfect collinearity in the original variable set, addition of further components will always add slightly to the amount of variance explained at the expense of the desired parsimony. For this reason, the principal components analysis was performed twice using a different number of factors each time. In the first instance, the number of factors retained in the analysis was limited to those with eigenvalues greater than 1.0. Eigenvalues less than 1.0 indicate that the component contributes less to the total variance than one of the original variables. Factor scores were computed for each observation and were regressed on the dependent variables percent change in population between 1970 and 1975 and absolute change in median per capita income between 1969 and 1974 primarily to see how much of the variation in the dependent variable could be explained by the components. Then, the number of factors retained was reduced to ten and the procedure was repeated. This resulted in more parsimony and a more logical grouping of the variables under each factor. The regression results were examined to see which factors were significant.

The technique of principal component analysis is used herein to identify the dependence structure under the assumption that no *a priori* patterns of causality are available. For this purpose the observable variates are represented as functions of the same number of latent component variates, as described below.

Suppose that the random variables of interest $X_1, \ldots, X_p$ have a certain multivariate distribution with mean $\underset{\sim}{\mu}$ and covariance matrix Σ.

The rank of Σ is $r \leq p$ and the q largest characteristic roots

$$\lambda_1 > \sim\sim\sim > \lambda_q$$

of Σ are all distinct.

From this population a sample of N independent observation vectors has been drawn. These observations may be summarized in the N x p data matrix

$$X = \begin{pmatrix} x_{11} & . & . & . & x_{1p} \\ . & . & . & . & . \\ . & . & . & . & . \\ X_{N1} & . & . & . & X_{Np} \end{pmatrix}$$

Σ may be estimated by the sample covariance matrix S

$$S = \frac{1}{N-1} \sum_{h=1}^{N} (\underset{\sim}{X}_h - \bar{\underset{\sim}{X}}) (\underset{\sim}{X}_h - \bar{\underset{\sim}{X}})^1$$

The information necessary for the principle component analysis is contained in S. At this stage, however, a decision must be made as to the appropriate measure of dependence: (a) the variances and covariances of the observations, implying analysis in the original units of the responses; or (b) the correlations between the original variables, implying that each variable has been standardized before the analysis is carried out. If the responses are in widely different units, linear components of the original quantities would have little meaning and the standardized variates and correlation matrix should be employed.

The first principle component of the sample values of the responses $X_1, \ldots, X_p$ is the linear compound

$$Y_1 = a_{11}X_1 + \ldots + a_{p1}X_p$$

whose coefficients a_{i1} are the elements of the characteristic vector associated with the greatest characteristic root ℓ_1 of the sample covariance matrix S (correlation matrix R) of the responses. They are scaled so that $\underset{\sim}{a}_1' \underset{\sim}{a}_1 = 1$, implying that the characteristic root is interpretable as the sample variance of Y_1. In the extreme case of X of rank one the first principal component would explain all the variance in the multivariate system. In the more usual case of the data matrix of full rank the importance and usefulness of the component would be measured by the proportion of the total variance attributable to it.

In general, the j-th principal component of the sample of p-variate observations is the linear compound

$$Y_j = a_{ij} X_1 + . . . + a_{pj} X_p$$

whose coefficients are the elements of the characteristic vector of the sample covariance matrix S (correlation matrix R) corresponding to the j-th largest characteristic root ℓ_j. If $\ell_i \neq \ell_j$, the coefficient of the i-th and j-th components are necessarily orthogonal; if $\ell_i = \ell_j$, the elements can be chosen to be orthogonal, although an infinity of such orthogonal vectors exists. The sample variance of the j-th component, is ℓ_j, and the total system variance is thus

$$\ell_1 + . . . + \ell_p = trS \qquad (\ell_1 + . . . + \ell_p = trR = p)$$

The importance of the j-th component is measured by

$$\frac{\ell_j}{trS} = \frac{\ell_j}{\sum_{i=1}^{p} \ell_i} \qquad \left(\frac{\ell j}{trR} = \frac{\ell j}{p}\right)$$

The algebraic sign and magnitude of a_{ij} indicate the direction and importance of the contribution of the i-th response to the j-th component. More precisely

$$\frac{a_{ij}\sqrt{\ell_j}}{s_i}$$

is the product moment correlation of the i-th response and the j-th component.

Shortcomings of the Community Data Profile System

An obvious and basic shortcoming of the Community Data Profile System was the inconsistency of the data collection among the various multi-county planning districts. Four problems were apparent.

1. Different survey-takers interpreted the questions differently. For example, a survey question was: "Number of Physicians in the Area." Some interpreted "area" as meaning the county in which the community was located while others interpreted "area" as the multi-county planning district in which the community was located.

2. Many questions were unanswered. The researcher using the data does not know whether a blank response implies that the data was unavailable or whether the survey-taker systematically excluded some questions. Judgment was carefully exercised in filling in the blank data items. For example, if the response to whether stoker coal was available was blank, it was assumed that this was actually a negative response. On the other hand, if the response to the question about the distance to the nearest port was blank, that distance was taken from a map.

3. Some larger cities, such as Poteau and El Reno, Oklahoma, were not surveyed while others with 1970 populations as small as five were included. The omissions appear to be random, and there is no large

block of data missing from any one multi-county district. No attempt was made to collect data when the community survey was not reported by ORC.

4. There was some ambiguity in the phrasing of some of the questions. For example, does "Number of High School Graduates Entering the Labor Force Annually" mean the number of people actually completing high school in the community who are available for full-time employment next September? Does it account for in-migration of fresh graduates from surrounding communities? Are those who enroll in post-secondary training excluded from the estimate? The reported figures are apparently the number of graduates at the local high school, which is actually not what the questions asks.

It should be noted here that the Ozarks Regional Commission has discontinued use of its Community Data Profile System. Other states, such as Mississippi, have recently adopted a form of it.

CHAPTER IV

REGRESSION RESULTS

Regression Results for Sub-Models

The FORWARD SELECTION STEPWISE procedure was applied to each set of candidate independent variables described in the discussion of the sub-models for the three data sets--Oklahoma, Arkansas, and the composite--for dependent variables percentage change in 1970-73 community population, percentage change in 1970-75 population, percentage change in 1969-72 median per capita income, absolute change in 1969-72 median per capita income, and absolute change in 1969-74 median per capita income. The coefficients of multiple determination (R^2's) and numbers of significant coefficients returned by the stepwise algorithm are reported in Tables XI-XVI.

Of the five sub-models, spatial factors explained more of the variation in 1970-75 population change than other sub-models when measured by the R^2 criterion. Natural resource variables were the weakest of the group. For all the data sets, the socio-demographic and political-governmental sub-models accounted for about the same amount of variation. The labor force sub-model explained more of the variation for the Arkansas data set than for the Oklahoma data set. The results for 1970-73 population sub-models were consistent with the 1970-75 sub-models but as a group they explained less variation.

The R^2's of every sub-model using absolute change in 1969-74 money income were greater than .30. Much of the explanatory power of the models occurred because base year income (CTY_Y69) was included as an independent variable in each. Using the R^2 criterion, the spatial sub-model explained the most variation for the Oklahoma data set; it also performed well for the Arkansas data set. The labor force sub-model explained the most variation for Arkansas and also performed well on the Oklahoma data set. The weakest models were the natural resource for Oklahoma and the political-governmental for Arkansas.

An examination of the R^2 statistics, showing the proportion of the variance in the dependent variable that is attributable to the independent variables included in the models, lends insight into the relative explanatory powers of the models. Since the candidate variables for each sub-model are limited to those relating to a specific group thought to influence development, the coefficients in the regression sub-models generated by stepwise will probably manifest specification bias.

To complete the specification of the growth models, the variables whose coefficients were found significant in the sub-models were then used to develop second-level models. Two second-level models were developed for an income and population dependent variable in each of the three data sets. In the first second-level model all variables whose coefficients were significant in the sub-models using a particular dependent variable were included in a final regression model using the same dependent variable. The results of these regressions are not reported in detail herein, but they are used to verify the results of the second group of second-level models.

In the second group of models the observations on the variables with significant coefficients in the sub-models were linked with the observations on the variables used by Forsht and Jansma (1975) in developing their models to form an expanded data set. These variables which primarily relate to the occupational structure of the labor force are listed in Table XVII. The stepwise technique was then applied to the expanded data sets. The variables whose coefficients were significant at the .05 level for dependent variables percent change in 1970-75 population and absolute change in 1969-74 income are discussed in this chapter.

Percent Change in Population, 1970-75

Two-State Model

Twelve variables were significant at the .10 level (Table XVIII). In the interest of brevity and to possibly avoid bias from use of the stepwise procedure only the nine variables significant at the .05 level will be discussed.

Standardized partial regression coefficients were calculated in order to determine which variables exerted the strongest influence on population change. In the composite model as well as in the two single-state models the 1960-70 population growth trend (X7_70) was found to be the most important explanatory variable. The inertia of the growth process present during that ten year period carried over into the succeeding five year period. The estimated equation suggests that if a community grew by 100 percent between 1960 and 1970, holding all other variables constant we would have expected it to grow by 25 percent between 1970 and 1975.

TABLE XVII

VARIABLES USED IN FORSHT-JANSMA MODEL

X1_70 = Median years school completed, 1960

X2_70 = Median income of families, 1960

X4_70 = Log of total central place area population, 1960

X5_70 = Log of distance to nearest SMSA central city, in mile

X6_70 = Percentage change in total central place area population, 1940-50

X7_70 = Percentage change in total central place area population, 1950-60

X8_70 = Percentage (of labor force) employed as professional workers, 1960

X9_70 = Percentage employed as managers, 1960

X10_70 = Percentage employed as clerical workers, 1960

X11_70 = Percentage employed as sales workers, 1960

X12_70 = Percentage employed as crafstmen, 1960

X13_70 = Percentage employed as operators, 1960

X14_70 = Percentage employed as household and service workers, 1960

X15_70 = Percentage employed as laborers, 1960

X16_70 = Percentage employed in agriculture, 1960

X17_70 = Percentage employed in mining, 1960

X18_70 = Percentage employed in construction, 1960

X19_70 = Percentage employed in manufacturing durable goods, 1960

X20_70 = Percentage employed in manufacturing nondurable goods, 1960

X21_70 = Percentage employed in transportation and public utilities, 1960

TABLE XVII (Continued)

X22_70	=	Percentage employed in wholesale and retail trade, 1960
X23_70	=	Percentage employed in services (finance, insurance, services, and real estate), 1960
X24_70	=	Percentage employed in government, 1960
X25_70	=	Density of central place (population per square mile), 1960

TABLE XVIII

FINAL REGRESSION EQUATION FOR TWO-STATES--DEPENDENT VARIABLE: PERCENT CHANGE IN POPULATION 1970-75

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO	PROB > F
REGRESSION	12	2.119006	0.176584	26.113	0.0001
ERROR	136	0.919657	0.006762		
CORRECTED TOT	148	3.038663	0.020532		RSQUARE = 0.6973

SOURCE	DF	B VALUE	STD DEVIATION	T FOR H0:B=0	PROB > |T|	LABEL
INTERCEPT	1	-0.14034690	0.06805683	-2.06220	0.0411	
CO_POP70	1	0.00000045	0.00000011	3.95761	0.0001	COUNTY POPULATION,1970
Q100	1	0.00279218	0.00085663	3.25949	0.0014	AVG. NO. OF FRT. TRAINS PER DAY
TIGER1	1	-29.91433747	9.43562175	-3.17037	0.0019	POLICEMEN PER 1000 POPULATION
Q1028	1	-0.00567016	0.00206705	-2.74312	0.0069	NO. OF UNIONS
X7_70	1	0.25710805	0.03102654	8.28671	0.0001	PERCENT CHANGE IN POPULATION 1960-70
X9_70	1	1.09723689	0.31823538	3.44804	0.0008	% MANAGERS,1970
X11_70	1	1.34249348	0.40141572	3.34440	0.0011	% SALES WORKERS,1970
X14_70	1	-0.67511068	0.22696331	-2.97447	0.0035	% HOUSEHOLD AND SERVICE WORKER,1970
X15_70	1	0.81700467	0.42546460	1.92026	0.0569	% LABORERS,1970
X18_70	1	0.74523763	0.28903466	2.57837	0.0110	% IN CONSTRUCTION,1970
X19_70	1	0.21084124	0.10996356	1.91737	0.0573	% IN MANUFACTURING DURABLE GOODS,1970
X25_70	1	-0.00001560	0.00000859	-1.81619	0.0715	POPULATION DENSITY OF CITY,1960

STANDARDIZED B VALUES

	TNDEP175
INTERCEPT	0
CO_POP70	0.22364642
Q100	0.18381230
TIGER1	-0.16480444
Q1028	-0.14959026
X7_70	0.46828715
X9_70	0.19690198
X11_70	0.18056081
X14_70	-0.16319523
X15_70	0.10450163
X18_70	0.13673972
X19_70	0.10784967
X25_70	-0.09354334

The second most influential variable was 1970 county population (CO_POP70). Communities located in more populous counties tended to grow faster. Since heavily populated counties imply the existence of urban and/or suburban areas, one can conclude that communities with economic linkages to larger cities grow more rapidly.

Population growth was positively associated with the number of freight trains passing through the community each day (Q100). Manufacturing plants and distribution centers often require good access to rail freight services. In theory they would be attracted to the better served areas and population growth would be stimulated in the process.

Population growth is negatively associated with the presence of larger numbers of labor unions (Q1028). Many industrialists have moved to the South in recent years to escape high labor costs attributable to union pressure in the North. That they avoid areas in the South where union activity is strong should not be surprising.

Throughout this study regardless of how the model is specified, population growth is negatively associated with the number of policemen per 1,000 population (TIGER1). If we view this as a proxy for social disharmony, we conclude that such disharmony has an adverse effect on growth.

Four variables from the list of candidates suggested in the Forsht-Jansma study (1975) relating to the composition of the labor force were significant at the .05 level. Duncan and Reiss (1956) suggested that the composition of the labor force would give insight into the economic opportunities available in a community; from this, inferences can be drawn about growth. The positive signs attached to percent of the labor force who are managers (X9_70) and sales workers

(X11_70) and the negative sign attached to percent of the labor force who are household or service workers (X14_70) suggest that areas in which employment/economic opportunities are greater have experienced more population growth.

A significant positive coefficient was also found for percent of the labor force employed in construction (X18_70). As population growth occurs, a demand is created for new family dwellings and commercial buildings which causes an increase in the demand for construction workers to appear. This result of course is as much a result as a cause of growth.

These labor force measures are not strictly determinants of the growth process. They are, however, indicators of underlying economic processes present within a community and may be extremely useful in formulating predictive models.

Arkansas

Eleven variables were found significant at the .05 level in the Arkansas data set (Table XIX). Those already discussed in the two-state model will not be discussed here.

Growth was positively associated with county population density (POPDENS1) but negatively associated with city population density (X25_70). The existence of such a ring pattern associated with population growth is consistent with the findings of Bogue and Harris (1954) and Forsht and Jansma (1975). Less densely settled cities have more available land for new commercial and residential construction. Growing cities also tend to annex outlying areas of lower population density so that people who use city services in connection with their jobs also

TABLE XIX

FINAL REGRESSION EQUATION FOR ARKANSAS--DEPENDENT VARIABLE: PERCENT CHANGE IN POPULATION 1970-75

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO	PROB > F	
REGRESSION	10	1.497886	0.149789	26.206	0.0001	
ERROR	63	0.360100	0.005716			
CORRECTED TOT	73	1.857986	0.025452		RSQUARE = 0.8062	
SOURCE	DF	B VALUE	STD DEVIATION	T FOR H0:B=0	PROB > |T|	LABEL
INTERCEPT	1	-0.03371963	0.07505985	-0.44924	0.6548	
POP70	1	-0.00000387	0.00000096	-4.02415	0.0002	POPULATION,1970
Q100	1	0.00200834	0.00101377	1.98106	0.0520	AVG. NO. OF FRT. TRAINS PER DAY
POPDENS1	1	0.00040706	0.00020512	1.98443	0.0516	POPULATION PER SQUARE MILE
Q1309	1	-0.04272817	0.02098804	-2.03583	0.0460	LODGING?
Q1386	1	0.06622677	0.02161793	3.06351	0.0032	IND. ED. CENTER IN COUNTY?
X7_70	1	0.27387024	0.04150908	6.59784	0.0001	PERCENT CHANGE IN POPULATION 1960-70
X10_70	1	1.20801053	0.39713054	3.04185	0.0034	% CLERICAL WORKERS,1970
X11_70	1	1.34370072	0.53117267	2.52969	0.0139	% SALES WORKERS,1970
X14_70	1	-0.79373226	0.32517666	-2.44105	0.0175	% HOUSEHOLD AND SERVICE WORKER,1970
X25_70	1	-0.00004404	0.00001308	-3.36649	0.0013	POPULATION DENSITY OF CITY,1960

STANDARDIZED B VALUES

	INDEP175
INTERCEPT	0
POP70	-0.30418344
Q100	0.15711338
POPDENS1	0.18011240
Q1309	-0.12156953
Q1386	0.17581598
X7_70	0.44450570
X10_70	0.21895178
X11_70	0.16691310
X14_70	-0.16530564
X25_70	-0.21252899

may be assessed their share of the expense of providing public services. Annexation of outlying areas reduces city population density. Higher county population density is a measure of suburbanization associated with an expanding population base.

Communities located in counties with an industrial education center (Q1386) grew faster. Such institutions attempt to provide readily marketable skills to enrollees who in turn form a labor pool which attracts industries into the area.

Oddly, communities without lodging facilities--hotels or motels--grew faster than those which had them. Since such facilities are almost always financed and operated by the private sector and represent a considerable investment in an immobile resource, they are typically built in response to a demand for services and are more a result than a cause of growth. Once constructed they will continue to be operated as long as variable costs can be recovered. The ORC community data profile made no distinction as to the age, value or rental rates for the rooms. However, we expect a negative correlation between value per lodging unit and rate of growth.

Percent of the labor force employed as clerical workers (X10_70) was positively associated with growth. This is consistent with the findings of earlier studies (Duncan and Reiss, 1956) suggesting a high positive correlation between clerical and professional employment and linking professional employment levels with economic opportunities within a community.

Oklahoma

Nine variables were significant at the .05 level (Table XX).

TABLE XX

FINAL REGRESSION EQUATION FOR OKLAHOMA--DEPENDENT VARIABLE:
PERCENT CHANGE IN POPULATION 1970-75

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO	PROB > F
REGRESSION	10	0.715937	0.071594	12.336	0.0001
ERROR	64	0.371435	0.005804		
CORRECTED TOT	74	1.087372	0.014694		RSQUARE = 0.6584

SOURCE	DF	B VALUE	STD DEVIATION	T FOR H0:B=0	PROB > |T|	LABEL
INTERCEPT	1	0.52346498	0.11271790	4.64403	0.0001	
DROPOUT	1	-0.08081444	0.02543093	-3.17781	0.0023	DROPOUT RATE OF SCHOOL SYSTEM
Q149	1	0.00120545	0.00087433	1.37871	0.1728	NO. OF TRK. TERMS. IN 45 MI.
TIGER1	1	-38.26584855	11.74368521	-3.25703	0.0018	POLICEMEN PER 1000 POPULATION
FARMDENS	1	-0.09695186	0.06062843	-1.59912	0.1147	COUNTY LAND AREA IN FARM USE
X7_70	1	0.18301792	0.04640996	3.94351	0.0002	PERCENT CHANGE IN POPULATION,1960-70
X8_70	1	-0.50677591	0.22965310	-2.20670	0.0309	% PROFESSIONAL WORKERS
X14_70	1	-1.04381229	0.31934757	-3.26858	0.0017	% HOUSEHOLD AND SERVICE WORKER,1970
X15_70	1	1.47022061	0.61853715	2.37693	0.0205	% LABORERS,1970
X24_70	1	-0.44465235	0.23451248	-1.69607	0.0625	% GOVERNMENT,1970
X25_70	1	-0.00003210	0.00001021	-3.14414	0.0025	POPULATION DENSITY OF CITY,1970

STANDARDIZED B VALUES

	INDEP175
INTERCEPT	0
DROPOUT	-0.27720485
Q149	0.11909587
TIGER1	-0.27781841
FARMDENS	-0.15105599
X7_70	0.35394404
X8_70	-0.17216271
X14_70	-0.25747144
X15_70	0.19218936
X24_70	-0.14486515
X25_70	-0.24095286

Communities in counties whose school systems had high dropout rates grew slower. The dropout rate might be considered a proxy for the quality of the community educational environment, which includes measures of the quality of school teachers, instructional methods, and the physical plant as well as parental and citizen attitudes toward education in general.

Greater numbers of truck terminals (Q149), an indicator of the availability of motor freight service, were positively associated with growth. New industrial locations and expansions would be expected to occur where good trucking service is available.

Although county land in agricultural use (FARMDENS) was not as significant as the other variables, its negative coefficient nevertheless confirms the hypothesis that population growth in Oklahoma is not occurring in predominantly rural areas of the state.

Others (Duncan and Reiss, 1956, and Forsht and Jansma, 1975) have found that growth is positively associated with the number of white-collar workers in the labor force. The findings here suggest the opposite. One might be tempted to conclude that our findings are in error were it not for the fact that the two variables indicative of white-collar employment--professional workers (X8_70) and government workers (X24_70)--have similar standardized partial regression coefficients. A possible explanation is that the western portion of Oklahoma which has had below average growth has above average income levels and can attract or retain higher numbers of professionals and support more government workers because of a high tax base. In the declining areas of southeastern Oklahoma there are many specialized government workers who deliver services to the Indian population concentrated in that area of the state.

Laborers (X15_70) are positively associated with growth. Since employment of laborers is highly correlated with the employment of construction craftsmen, this finding seems reasonable.

Absolute Change in Median Per Capita Money Income, 1969-74

Two-State Model

Base year per capita income (CTY_Y69) was the most influential explanatory variable in all three models of income (Table XXI). Since many pay increases are tied either formally or informally to changes in the consumer price index, this was an expected finding.

The next most influential variable, number of available hotel and motel rooms (ROOMS), was negatively related to income growth. Economic theory suggests several reasons for such a finding. Much lodging is demanded by tourists en route and at the resort and by businessmen travelling and attending conventions. Areas whose lodging facilities have high occupancy rates throughout the year might be expected to experience above average income increases because labor demands from that sector are stable. However, in areas where demand for lodging is seasonal, such as the Arkansas Ozarks, the lodging coefficients might reflect the drag on per capita incomes sometimes found in resort areas because employment is only part-time.

Prospective hotel and motel entrepreneurs might be attracted to areas where there is abundant cheap labor because operation of a lodging facility is labor intensive. Since low-wage workers' salaries do not increase very fast because they lack skills needed for advancement, the variable could be capturing this effect.

TABLE XXI

FINAL REGRESSION EQUATION FOR TWO-STATES--DEPENDENT VARIABLE: ABSOLUTE CHANGE IN MEDIAN PER CAPITA INCOME 1969-74

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO	PROB > F
REGRESSION	11	4941701.949675	449245.631789	19.096	0.0001
ERROR	137	3222947.406029	23525.163548		
CORRECTED TOT	148	8164649.355705	55166.549701		RSQUARE = 0.6053

SOURCE	DF	B VALUE	STD DEVIATION	T FOR H0:B=0	PROB > |T|	LABEL
INTERCEPT	1	-73.18188586	204.58042964	-0.35772	0.7211	
CTY_Y69	1	0.49019067	0.04877231	10.05059	0.0001	PER CAPITA INCOME,1969
DROPOUT	1	33.16897501	13.55496070	2.44700	0.0157	DROPOUT RATE OF SCHOOL SYSTEM
POPDENS1	1	0.34823377	0.12620633	2.75924	0.0066	POPULATION PER SQUARE MILE
ROOMS	1	-0.08501276	0.01562407	-5.44114	0.0001	NO. OF HOTEL AND MOTEL ROOMS
FARMDENS	1	204.57761856	80.25428635	2.54914	0.0119	COUNTY LAND AREA IN FARM USE
RAINFALL	1	6.09990724	2.89236500	2.10897	0.0368	ANNUAL RAINFALL
X10_70	1	-1756.58087879	533.84371666	-3.29041	0.0013	% CLERICAL WORKERS,1970
X11_70	1	1482.20906235	732.40772814	2.02375	0.0449	% SALES WORKERS,1970
X12_70	1	-1086.77842476	458.33674755	-2.37114	0.0191	% CRAFTSMEN,1970
X13_70	1	-580.78890811	294.02648937	-1.97529	0.0502	% OPERATIVES,1970
X21_70	1	1239.48164883	567.91746651	2.18250	0.0308	% IN TRANSPORTATION AND UTILITIES,1970

STANDARDIZED B VALUES

	GROW74
INTERCEPT	0
CTY_Y69	0.73416317
DROPOUT	0.21350230
POPDENS1	0.17613093
ROOMS	-0.30467233
FARMDENS	0.21623209
RAINFALL	0.24259877
X10_70	-0.23848199
X11_70	0.12161672
X12_70	-0.15588437
X13_70	-0.14273184
X21_70	0.14056940

A third argument explaining the negative sign of the ROOMS coefficient employs the concept of resource fixity. Motels and hotels may be built in response to increased demand for lodging and they may be more properly classed as a result rather than a cause of growth. Once in place the motel will continue to operate as long as variable costs are recovered. Since it is impossible to relocate the facilities, the adjustment to decreased demand will be very slow.

School dropout rates can have both positive and negative influence on income growth. High dropout rates would seem to be symptomatic of problems within the educational system or of problems with community and parental attitudes toward education. These effects captured by high dropout rates would cause income growth to lag. On the other hand, when a youngster drops out of school he often becomes employed; his earnings contribute to at least a short-run rise in average incomes. That high dropout rates are associated with large income increases suggests that the latter effect predominates.

Two indicators of the significance of geographic location were included in the regression model. Communities located in more densely populated counties--a measure of suburbanization--experienced greater income growth. Communities located in areas with a greater proportion of the land devoted to agriculture (FARMDENS) also experienced gains. Income from agriculture increased greatly during 1970-1975. The significance of these coefficients would imply that towns located in sparsely settled areas with little reliance on agriculture, such as those which might be found in southeastern Oklahoma or north central Arkansas, experienced less than average income increases.

Examination of the occupational structure of the labor force yields information useful in predicting future income changes. Changes in the supply and demand for workers mirror changes or adjustments occurring in the areal economy. Institutional rigidities common to the occupation--such as unionization and length of training periods--further explain remuneration practices. To infer that community income grows because a certain proportion of the labor force is employed in, for example, non-durable goods manufacturing may be tenuous. However, to use such a variable as a predictor, knowing that a certain pattern of wage characteristics is associated with a sector, is consistent with the methodology of economic research. Information gleaned from labor force variables may be used for prescriptive purposes if they can be manipulated by planners. The knowledge that having a one percent increase in the labor force employed in the manufacturing of durables is associated with greater income increase than, for example, a one percent increase in employment in non-durable goods manufacturing would be valuable to the industrial development specialist who must select industries for his community.

There were four coefficients associated with variables describing the occupational composition of the labor force which were significant--clerical workers (X10_70), sales workers (X11_70), craftsmen (X12_70), and transportation and utilities workers (X21_70). The signs and magnitudes of the coefficients reflect pay practices attributable to change in demand for these services.

Arkansas

Eight variables were significant in the Arkansas model (Table XXII).

TABLE XXII

FINAL REGRESSION EQUATION FOR ARKANSAS--DEPENDENT VARIABLE: ABSOLUTE CHANGE IN MEDIAN PER CAPITA INCOME 1969-74

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO	PROB > F
REGRESSION	7	2713801.990689	387685.998670	16.297	0.0001
ERROR	66	1570102.603906	23789.433393		
CORRECTED TOT	73	4283904.594595	58683.624583		RSQUARE = 0.6335

SOURCE	DF	B VALUE	STD DEVIATION	T FOR H0:B=0	PROB > |T|	LABEL
INTERCEPT	1	484.78691933	239.42551488	2.02479	0.0469	
CTY_Y69	1	0.51312383	0.08068291	6.35976	0.0001	PER CAPITA INCOME,1969
ROOMS	1	-0.07735437	0.01622839	-4.76661	0.0001	NO. OF HOTEL AND MOTEL ROOMS
ST_PK	1	-107.31546063	39.03837352	-2.74897	0.0077	STATE PARK IN COUNTY
X10_70	1	-1935.54972009	787.94590382	-2.45645	0.0167	% CLERICAL WORKERS,1970
X13_70	1	-1371.62316467	404.65657861	-3.38960	0.0012	% OPERATIVES,1970
X16_70	1	3070.55680852	1072.59530840	2.86274	0.0056	% IN AGRICULTURE,1970
X24_70	1	3504.32673567	1125.65510786	3.11314	0.0027	% IN GOVERNMENT,1970

STANDARDIZED B VALUES

	GROW74
INTERCEPT	0
CTY_Y69	0.69851535
ROOMS	-0.37608932
ST_PK	-0.21292852
X10_70	-0.23103803
X13_70	-0.28391343
X16_70	0.29362297
X24_70	0.23825116

Three were mentioned in the previous two-state discussion.

The presence of a state park in the county reduced income change. An examination of a map of Arkansas shows that most state parks are located in rather isolated rural areas having marginal agricultural land. Although the areas may have great aesthetic value, they have little economic value and their low acquisition cost was probably a factor in their creation. A negative coefficient would not be inconsistent with theory.

The significant positive coefficients associated with government employment (X24_70) reflect the built-in cost of living and job advancement adjustments common to the sector. Average U. S. farm family income as a percentage of average non-farm income rose significantly during the 1969-74 period, perhaps explaining the coefficient for agricultural labor (X16_70). Operatives (X13_70), defined primarily as those workers employed in manufacturing, failed to obtain rapid income increases.

Oklahoma

The Oklahoma income change model had a higher R^2 and a larger number of significant coefficients than any other model in this study (Table XXIII).

Income growth was negatively associated with the percentage of children ages five to sixteen (AMEND_SH) enrolled in school. Since this variable is closely related to the school dropout rate (DROPOUT), the arguments advanced in the discussion of the significance of the coefficient for that variable in the two-state model apply.

Communities having educational television available (Q426), a county planning commission (Q1162), and a library (Q1442) experienced

TABLE XXIII

FINAL REGRESSION EQUATION FOR OKLAHOMA--DEPENDENT VARIABLE: ABSOLUTE CHANGE IN MEDIAN PER CAPITA INCOME 1969-74

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO	PROB > F
REGRESSION	13	3268553.995482	251427.230422	25.238	0.0001
ERROR	61	607686.671184	9962.076577		
CORRECTED TOT	74	3876240.666667	52381.630631		RSQUARE = 0.8432

SOURCE	DF	B VALUE	STD DEVIATION	T FOR H0:B=0	PROB > |T|	LABEL
INTERCEPT	1	455.84929584	260.74543905	1.74825	0.0855	
CTY_Y69	1	0.36932490	0.04283678	8.62168	0.0001	PER CAPITA INCOME,1969
AMEND_SH	1	-7.95945481	2.68995970	-2.95895	0.0044	PER CENT OF CHILDREN 5-16 IN SCHOOL
Q385	1	-102.56228013	28.18657017	-3.63869	0.0006	TAXI?
Q426	1	134.66887752	28.71046659	4.69058	0.0001	EDUCATIONAL TV AVAILABLE?
Q1162	1	147.71360676	30.21281012	4.88911	0.0001	COUNTY PLANNING COMMISSION?
Q1442	1	200.06990792	59.38082366	3.36927	0.0013	LIBRARY?
Q1457	1	-100.19722853	28.05523941	-3.57143	0.0007	PUBLIC RECREATION PROGRAM?
X6_70	1	54.99148372	30.08942871	1.82760	0.0725	PERCENT CHANGE IN POPULATION,1950-60
X7_70	1	-162.88879374	63.96598041	-2.54649	0.0134	PERCENT CHANGE IN POPULATION,1960-70
X9_70	1	1211.67679989	552.53558170	2.19294	0.0321	% MANAGERS,1970
X11_70	1	2167.24835422	740.68099046	2.92602	0.0048	% SALES,1970
X21_70	1	1598.58152866	460.73791297	3.46961	0.0010	% TRANSPORTATION AND UTILITIES,1970
X25_70	1	0.02580350	0.01514764	1.70347	0.0936	POPULATION DENSITY OF CITY,1970

STANDARDIZED B VALUES

	GROW74
INTERCEPT	0
CTY_Y69	0.54599769
AMEND_SH	-0.16346630
Q385	-0.21267022
Q426	0.26597313
Q1162	0.28732992
Q1442	0.19774474
Q1457	-0.20559399
X6_70	0.11550117
X7_70	-0.16684604
X9_70	0.14128405
X11_70	0.17664285
X21_70	0.20668889
X25_70	0.10258830

greater income growth. These variables represent positive influences in the community development process.

It might seem that availability of taxi service (Q385) would make a positive contribution to income growth since it adds to the range of transportation services. However, the negative coefficient suggests otherwise. There are two markets for taxi services. The first is created by residents of large cities who do not own autos and by businessmen in these cities. In smaller town markets, taxis are used more by older persons who do not drive and by those who for financial reasons do not own cars. Since large metropolitan areas were excluded from the study area, the taxi variable relates to the latter market. Thus, the coefficient sign may indeed be attributable to the economy of the community and not merely spurious.

The significant coefficients of the labor force variables included in the final step of the regression suggest that much of the income increase can be attributed to employment in management (X9_70), sales (X11_70), and in the transportation and utilities sector (X21_70). Persons employed in these fields apparently received above normal pay increases. Wage data compiled by the U. S. Department of Labor (1975) support this finding.

CHAPTER V

RESULTS OF DISCRIMINANT ANALYSES

Of particular interest to researchers is whether the variables selected by the stepwise regression algorithm discussed in the previous chapter reliably identify slow- and fast-growing communities. To assess the effectiveness of the stepwise technique and to glean further insight into growth processes, the variables selected for each of the five sub-models by stepwise using percentage change in real community per capita income between 1969 and 1972 and percentage change in community population between 1970 and 1973 as dependent variables were used to develop discriminant rules which separate slow-growth and fast-growth communities.

For each particular model associated with one of the two dependent variables, a discriminant rule was developed. This yielded 30 rules--five sub-models x three data sets (Arkansas, Oklahoma, and the combined set) x two dependent variables. The rules were developed using the observations on the slowest-growing quartile and on the fastest-growing quartile. The communities in the middle two quartiles were not considered in the development of the rules.

The observations in the slow-growing set were assigned *a priori* to group 1 and the observations in the fast-growing set were assigned to group 2. Posterior priorities for group membership were then calculated for each observation according to the rule

$$P_r\{\pi_i|\underset{\sim}{x}\} = \frac{\exp\{-\frac{1}{2}D_i^2(X)\}}{\sum_{j=2}^{2} \exp\{-\frac{1}{2}D_j^2(\underset{\sim}{x})\}} \qquad i = 1, 2$$

Classification results for each of the models are presented in Tables XXIV and XXV. Not presented is the form of discriminant rule sometimes seen

$$Y = B_1X_1 + B_2X_2 + . . . + B_nX_n$$

where Y is a critical value. That is, observations scoring less than Y = some number are assigned to one group and observations scoring higher are assigned to another. In developing the rules the computer routine was allowed to use either the linear rule or the non-linear rule. A test for homogeneity of within-group covariance matrices was performed (i.e., probability > chi-square $\geq$ .10). In the case of homogenous covariance matrices the non-linear formulation of the rule was employed.

A second set of discriminant rules was devised for the Arkansas and Oklahoma sets (excluding the composite set) using the first and fifth quintiles rather than quartiles. The percentage of correct classifications obtained under each rule in the second set is presented in Tables XXVI and XXVII.

Simple correlation coefficients were calculated between the regression R^2's and the percent of observations classified correctly using discriminant analysis. For quartiles with percent population change as the dependent variable, the correlation was .93. For quartiles with percent income change, the correlation was .98. For quintiles with percent population change, the correlation was .93. For

TABLE XXIV

CONTRAST BETWEEN EFFICIENCY OF REGRESSION MODELS AND CORRESPONDING DISCRIMINANT RULE FOR DEPENDENT VARIABLE CHANGE IN POPULATION 1970-73, QUARTILES

Model	No. of variables used in rule	R^2	Percent classified correctly with discriminant rule
Oklahoma labor force	4	.3037	63.2
Oklahoma spatial	3	.2672	68.4
Oklahoma natural resource	1	.0260	65.8
Oklahoma socio-demographic	2	.1750	70.0
Oklahoma political-governmental	3	.2834	57.9
Arkansas labor force	3	.2261	66.7
Arkansas spatial	5	.2874	63.9
Arkansas natural resource	3	.2135	61.1
Arkansas socio-demographic	3	.3430	94.1
Arkansas political-governmental	2	.2319	70.6
Two-state labor force	2	.1301	66.2
Two-state spatial	2	.1131	58.1
Two-state natural resource	2	.0631	63.1
Two-state socio-demographic	3	.1908	71.3
Two-state political-governmental	6	.2625	78.4

TABLE XXV

CONTRAST BETWEEN EFFICIENCY OF REGRESSION MODELS AND CORRESPONDING DISCRIMINANT RULE FOR DEPENDENT VARIABLE CHANGE IN INCOME 1969-72, QUINTILES

Model	No. of variables used in rule	R^2	Percent classified correctly with discriminant rule
Oklahoma labor force	3	.2832	78.9
Oklahoma spatial	3	.2094	64.8
Oklahoma natural resource	3	.1951	63.2
Oklahoma socio-demographic	5	.2875	76.2
Oklahoma political-governmental	4	.3720	84.2
Arkansas labor force	3	.3064	69.4
Arkansas spatial	6	.3375	80.6
Arkansas natural resource	3	.2691	80.6
Arkansas socio-demographic	4	.3280	77.8
Arkansas political-governmental	4	.2769	75.0
Two-state labor force	5	.2070	75.7
Two-state spatial	5	.1908	68.9
Two-state natural resource	3	.1716	73.7
Two-state socio-demographic	5	.1997	75.0
Two-state political-governmental	6	.1849	64.9

TABLE XXVI

CONTRAST BETWEEN EFFICIENCY OF REGRESSION MODELS AND CORRESPONDING DISCRIMINANT RULE FOR DEPENDENT VARIABLE CHANGE IN INCOME 1969-72, QUINTILES

Model	No. of variables used in rule	R^2	Percent classified correctly with discriminant rule
Oklahoma socio-demographic	3	.2832	85.3
Oklahoma political-governmental	3	.2094	70.0
Oklahoma natural resource	3	.1951	90.0
Oklahoma spatial	5	.2875	80.0
Oklahoma labor force	4	.3720	59.3
Arkansas socio-demograhpic	3	.3064	92.9
Arkansas political-governmental	6	.3375	75.0
Arkansas natural resource	3	.2691	82.1
Arkansas spatial	4	.3280	82.1
Arkansas labor force	4	.2769	75.0

TABLE XXVII

CONTRAST BETWEEN EFFICIENCY OF REGRESSION MODELS AND CORRESPONDING DISCRIMINANT RULE FOR DEPENDENT VARIABLE CHANGE IN POPULATION 1970-73, QUINTILES

Model	No. of variables used in rule	R^2	Percent classified correctly with discriminant rule
Oklahoma socio-demographic	4	.3037	70.6
Oklahoma political-governmental	3	.2672	56.7
Oklahoma natural resource	1	.0250	80.0
Oklahoma spatial	2	.1750	66.7
Oklahoma labor force	3	.2834	67.7
Arkansas socio-demographic	3	.2261	89.3
Arkansas political-governmental	5	.2874	75.0
Arkansas natural resource	3	.2135	57.1
Arkansas spatial	3	.3430	75.0
Arkansas labor force	2	.2319	71.4

quintiles with percent income change, the correlation was .97. This indicates a measure of consistency between the two statistical methods in identifying slow-growth and fast-growth communities.

The results obtained using the discriminant technique reinforce the regression results presented in Chapter IV. We may reasonably conclude that the variables used in formulating the discriminant rules are associated with community growth processes.

CHAPTER VI

RESULTS OF PRINCIPAL COMPONENTS ANALYSES

In this section the results of the regression of factors developed using principal components analysis on dependent variables measuring population and income change are reported.

Three principal factor solutions were computed for the Arkansas data set, containing twenty-seven, ten, and seven factors. The twenty-seven factor solution was computed because there were twenty-seven factors with eigenvalues greater than one. The ten and seven factor solutions were computed because relatively large first differences in the eigenvalues tended to occur around these points and because statistical theory suggests that a smaller number of factors should be used to avoid meaningless results often occuring in higher numbered factors and contributing little to the model's explanatory power.

Three principal factor solutions were computed for the Oklahoma data set, containing twenty-eight, ten, and seven factors. The twenty-eight factor solution was computed because twenty-eight factors had eigenvalues greater than one. After comparing solutions it was concluded that the ten factor solution best described each data set because the rotated factor loading patterns were less complex (i.e., there were fewer occurrences where a variable had more than one factor loading equal in magnitude) and the eigenvalues seemed to suggest that a natural break occurred near that level. After the rotated factor loading matrix was computed, factor scores for each individual observation were computed by multiplying the n x 1 column vector of observations on the n variables for each community by the tranpose of the factor loading matrix. The factor scores for each community observation then were used as independent variables in the regression models. Further, when the factors created by the principal components analysis were regressed on the dependent variables superior regression results (a higher proportion of significant coefficients) were obtained using ten factors.

After the initial factor pattern was estimated, it was rotated by the varimax method. The varimax rotation is considered superior to any other orthogonal rotation process and was used because of the ease of interpretation of the results and the general usage of this type of rotation in economics (Harman, 1967).

Rotated factor loadings for the Arkansas and Oklahoma ten factor data sets are presented in Tables XXVIII and XXIX. Factor loadings are interpreted in three ways. First, they represent the relative importance of each factor in influencing each observed variable. Second, the factor loadings represent the net correlation between each factor and each variable. For example, if a variable has a loading of .50 on Factor 1, then Factor 1 explains $(.50)^2$, or 25 percent, of the variance in that variable after allowing for the other factors. The cumulative sum of the squared factor loadings for each variable is shown as a communality, or the amount of variance explained by all ten factors. Third, the factor loadings serve as the basis for combining the variables into common groups. This is done on the basis of which factor has the highest loading with each particular variable. Once all the variables

TABLE XXVIII

ROTATED FACTOR PATTERNS FOR PRINCIPAL COMPONENTS ANALYSIS OF OKLAHOMA DATA SET

ROTATED FACTOR PATTERN

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6	FACTOR7	FACTOR8	FACTOR9	FACTOR10
POP70	0.10393	-0.05598	0.90769	0.15981	0.00183	0.02722	0.01497	-0.07037	-0.00163	-0.00355
X1_70	0.63122	-0.09879	0.51876	0.12900	-0.19550	0.09459	-0.06126	0.03151	-0.17101	-0.14440
X2_70	0.64458	-0.39644	0.22548	0.19840	-0.38021	-0.08657	0.11121	0.09811	-0.07617	-0.15665
X4_70	0.16453	-0.08305	0.87173	0.19151	-0.09166	0.01999	-0.13460	-0.03691	0.00392	-0.11101
X5_70	-0.18330	0.54231	-0.34598	0.09309	0.01576	0.29504	0.00038	0.17876	0.18110	-0.26039
X6_70	0.17405	-0.63412	0.16704	-0.10121	-0.03797	0.03288	0.27734	-0.01387	-0.11195	-0.03645
X7_70	0.12605	-0.36020	0.05940	0.06651	0.13017	0.00578	0.58110	0.23380	0.07896	0.13841
X8_70	0.21336	0.04873	0.48310	-0.14293	0.03095	0.00086	0.05277	0.04851	-0.12060	-0.50633
X9_70	-0.29964	0.44234	-0.07935	0.26943	-0.02022	0.11542	0.11683	-0.13950	-0.06819	0.20237
X10_70	0.35427	-0.23150	0.53785	0.04072	0.06273	-0.21490	0.01799	0.18490	-0.22712	-0.22156
X11_70	0.09871	0.25822	0.22855	0.24672	-0.12484	0.04296	0.06451	-0.42870	-0.19540	0.19484
X12_70	-0.09195	-0.56871	-0.21244	-0.03295	-0.13091	-0.19353	0.14100	0.27365	-0.03120	0.31011
X13_70	-0.06335	-0.23437	-0.40792	0.00960	-0.11442	-0.20003	-0.46406	-0.12169	0.21330	-0.02132
X14_70	-7.24E-05	0.41675	-0.08471	-0.14398	0.27699	0.20641	0.01074	-0.00039	0.05465	0.18631
X15_70	-0.11220	0.03221	-0.17188	0.00514	0.05813	-0.11150	-0.09855	-0.08890	0.59243	0.20642
X16_70	0.18344	0.20474	-0.34279	-0.04685	0.21269	0.53372	0.06175	-0.02834	-0.12117	0.07795
X18_70	-0.30506	0.07823	-0.22477	-0.15640	0.06567	-0.13937	0.40427	0.09093	0.02044	0.25016
X19_70	0.04316	-0.64011	-0.13049	-0.01083	-0.01184	-0.26685	-0.27980	0.10385	0.35037	0.01707
X20_70	0.11382	-0.00137	0.10331	0.15445	0.05785	-0.16623	-0.08741	0.00672	0.11318	-0.58267
X21_70	-0.01130	-0.50359	-0.11551	-0.04454	-0.03101	-0.15284	0.10307	0.29584	-0.09483	0.20491
X22_70	-0.16681	0.34956	-0.06335	0.06914	0.02820	0.29721	0.18525	-0.36844	0.00058	0.28519
X23_70	0.15496	-0.02539	0.30690	0.17048	-0.17773	0.15315	-0.11805	-0.42822	-0.08372	0.27653
X24_70	-0.18782	0.12106	0.21845	0.00423	0.24590	-0.13991	0.18021	-0.22215	-0.20013	0.24962
X25_70	0.15032	-0.11978	0.04108	-0.13964	0.13584	0.19617	-0.06307	0.06519	-0.08077	-0.42884
POVERTY	-0.82616	0.32779	-0.18393	0.14180	0.20270	-0.02554	0.12801	0.02338	0.08910	0.04074
RURNONFM	-0.49495	0.47174	-0.34393	0.11746	-0.09589	-0.38606	0.19809	0.11272	-0.06277	0.15288
RURFARM	-0.05431	0.57433	-0.54022	0.19059	0.07764	-0.09087	0.25849	-0.24202	-0.26846	0.07140
DROPOUT	-0.58851	-0.05498	-0.13348	-0.04023	-0.03172	-0.19640	-0.48810	0.07638	0.15245	0.00829
ETHNIC1	0.56506	0.21000	-0.01182	-0.25270	-0.29371	0.17160	0.11384	0.11080	-0.35697	-0.04790
ETHNIC3	-0.47457	0.05606	-0.12580	0.21838	0.25612	-0.27602	-0.03976	-0.08609	0.29770	0.01434
SKLPNR2	-0.41750	-0.23970	-0.01325	0.32298	-0.25290	-0.06716	0.37121	0.04702	0.28606	-0.04077
COLLEGE2	0.32942	0.14916	0.19007	-0.00675	0.02054	0.48658	-0.19100	0.11310	-0.01355	-0.25043
AMEND_SH	0.59436	-0.04142	0.01795	0.05745	0.14686	-0.16909	0.03911	-0.10866	0.07378	0.17255
CO_POP40	0.05798	-0.95724	0.02398	-0.03374	0.04161	-0.06941	-0.01760	-0.04729	0.08244	-0.01957
CO_POP50	0.13487	-0.95921	0.03653	-0.07464	0.05022	-0.01631	0.03636	-0.02911	0.04748	-0.03308
CO_POP60	0.16009	-0.95478	0.03770	-0.09160	0.05066	0.00164	0.08266	-0.03459	0.02455	-0.02935
CO_POP70	0.16087	-0.95213	0.03426	-0.09496	0.06171	-0.00345	0.10165	-0.02726	0.01900	-0.01809
PCCO_MD	0.26014	-0.74679	0.03958	0.02881	-0.02558	0.10193	-0.13283	-0.03990	0.04429	-0.33304
PCCO_DDS	0.52004	-0.34125	0.02341	0.08063	-0.08413	0.41286	-0.13791	-0.07023	-0.04896	-0.41271
CTY_Y69	0.65469	-0.07498	0.20521	0.16627	-0.37808	-0.01847	0.00138	-0.02030	-0.10756	-0.27059
DEPENDRA	-0.59103	0.16707	-0.50506	0.27201	-0.09693	-0.11048	0.10381	-0.16042	0.08729	0.03466
Q99	0.09494	-0.45623	-0.09114	-0.20938	-0.15717	-0.03388	0.01426	0.01594	0.06436	0.19684
Q100	-0.05459	-0.04717	0.17398	0.13625	-0.02794	-0.00414	-0.45748	0.18056	0.12451	-0.07548
Q104	0.18074	-0.06235	0.49860	0.27597	-0.18277	0.00124	-0.25599	0.14515	0.19126	0.00296
Q149	-0.07089	-0.49773	-0.07301	0.09954	0.07277	-0.44696	-0.13725	0.25356	-0.08076	0.06531
Q151	-0.21950	-0.22071	0.26427	0.19284	-0.21920	-0.30903	-0.31154	-0.17275	-0.05322	-0.15779
Q221	-0.23894	0.13216	-0.32417	0.30891	0.03988	0.07239	0.02665	0.10107	0.00757	0.07438

TABLE XXVIII (Continued)

ROTATED FACTOR PATTERN

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6	FACTOR7	FACTOR8	FACTOR9	FACTOR10
Q269	0.14647	-0.03006	0.36216	-0.12461	0.17130	-0.19275	-0.09918	-0.10118	0.38868	0.27624
Q320	-0.12932	0.13948	0.03251	0.06052	0.09051	0.01660	-0.21607	-0.27424	-0.47594	0.11495
Q212	0.02014	0.33803	0.08499	-0.04558	-0.21801	0.73974	0.01500	-0.18035	-0.25882	0.06448
Q383	0.19275	0.04434	0.06602	-0.08392	0.03092	-0.01146	-0.10032	-0.51463	0.08210	-0.12013
Q384	0.02327	0.05633	0.41107	-0.23304	-0.22981	-0.05208	0.10722	-0.01139	0.00757	0.34264
Q335	0.00996	0.14286	0.46950	0.05980	-0.04910	-0.18030	-0.41614	0.06850	-0.13053	-0.03967
Q408	0.04226	-0.08702	0.12379	0.00157	0.23551	-0.27343	-0.23395	0.46527	0.24988	-0.05508
Q421	-0.33845	0.04209	-0.04709	0.12925	-0.04047	-0.44330	-0.05857	0.30231	-0.14394	-0.22002
Q426	0.35238	0.12782	-0.00157	0.32052	0.03884	-0.14230	-0.43584	-0.00126	-0.29338	-0.10103
Q1005	0.54759	0.06608	0.27769	-0.01860	0.02930	0.06807	-0.13202	-0.08076	0.23337	0.16619
Q1006	0.21117	0.21051	0.12966	0.02502	-0.13717	-0.06668	-0.22598	0.14653	-0.40908	0.13395
Q1015	-0.07039	0.03454	0.01652	0.05786	-0.04144	0.13219	-0.12575	0.59725	-0.03407	0.15445
Q1016	0.11541	0.07124	0.11818	0.13836	0.03453	-0.08097	-0.19249	0.34068	-0.05349	0.51089
Q1018	0.09361	0.00695	0.08905	0.12059	0.07598	-0.01068	0.05804	0.55778	-0.04085	-0.05232
PINK2	-0.19389	0.45462	-0.00374	0.02152	-0.00061	0.60560	0.24999	0.21747	-0.06908	-0.03153
POPDENS1	0.16537	-0.94901	-0.01956	-0.10564	0.06796	-0.00909	0.09682	-0.01088	-0.01117	-0.05929
ROOMS	0.06431	0.11149	0.78628	0.22143	-0.05843	0.15741	0.04897	-0.04115	0.06295	-0.07972
Q1309	-0.19537	0.19270	0.15680	0.39102	0.10755	0.27244	0.01757	-0.08179	0.23804	0.11299
EDA_AREA	-0.50202	0.19800	0.25555	-0.12349	-0.06924	-0.50025	-0.05450	0.28922	0.03740	-0.13009
OZARK	-0.67818	0.11452	-0.02636	0.09163	-0.05219	-0.48737	-0.09373	0.19414	0.02618	0.06524
POLCUL1	0.08844	0.13039	-0.19889	0.01950	-0.02265	0.67639	0.09707	0.09729	-0.15087	-0.05595
POLCUL3	-0.26012	-0.44146	-0.04003	0.09699	0.28153	-0.24665	0.15043	0.49742	0.23326	-0.15154
Q1162	0.52300	-0.08152	0.24075	0.11593	0.07509	0.06355	-0.08704	0.11159	0.24222	0.05214
Q1163	0.32208	-0.21464	0.17360	0.18256	-0.12661	-0.03063	-0.03454	0.07701	0.18274	-0.11660
Q1171	0.07835	0.02793	0.77472	0.01030	0.10297	0.03849	0.06839	-0.06124	-0.00766	0.09846
CO_DEBT	0.14629	-0.93335	-0.07080	-0.11504	0.06907	-0.00587	0.13374	-0.02817	-0.01326	-0.06218
Q1173	0.14062	0.02101	-0.01953	0.02075	-0.26649	-0.23890	-0.47878	0.22274	-0.10484	0.01896
Q1179	0.11111	0.17098	0.10739	0.84916	-0.01870	-0.05340	-0.12171	0.03835	0.04946	-0.03372
Q1181	0.02676	0.02191	0.09327	0.85994	0.04487	-0.04576	-0.02896	0.08095	-0.01982	0.02018
Q1183	0.02587	0.17631	0.11844	0.85181	-0.01562	0.02267	-0.04929	-0.00827	0.08053	-0.05779
Q1185	-0.18703	0.06115	0.07991	0.50375	0.01501	-0.05851	0.08830	-0.00838	-0.28095	0.05050
Q1187	0.12891	0.28994	0.10532	0.67778	-0.03765	-0.06683	-0.17306	0.12392	0.02945	0.00978
Q1440	0.12435	0.04010	0.09321	0.32482	0.13415	0.31035	-0.26875	0.14754	-0.41070	0.01128
Q1442	0.07505	-0.10678	0.05487	0.66348	0.27391	0.14349	-0.09410	0.03923	0.01711	-0.02144
Q1457	0.07657	0.20956	0.22013	0.26178	-0.06836	0.31129	-0.19736	0.22464	0.10134	-0.08224
EDADUMMY	-0.04367	0.00804	0.71239	0.13537	-0.02832	-0.13222	0.01034	-0.13855	-0.15087	-0.08421
TIGER1	-0.06932	0.15903	-0.12152	0.21895	0.07737	0.08413	-0.42061	-0.09357	0.03648	0.16525
DEM68PC	-0.74538	0.20374	0.23154	-0.09229	0.06124	0.17154	-0.32090	-0.12700	-0.09645	0.06423
REP68PC	0.89918	-0.12842	-0.14745	0.12774	-0.00376	0.09177	0.08065	0.00486	0.03810	-0.13167
ST_PK	-0.22545	-0.41268	-0.04254	0.01861	0.12014	-0.04554	0.31612	0.08774	0.10997	-0.02375
FARMDENS	0.50801	0.44081	-0.01995	-0.02157	-0.16436	0.38086	-0.21847	-0.23048	-0.33265	-0.11343
MINDENS1	0.01388	-0.00390	0.03993	-0.15837	-0.87886	-0.02365	-0.07972	-0.10203	-0.01752	0.04630
MINVAL71	0.08105	0.08250	0.01308	-0.10499	-0.90506	0.04707	-0.03139	-0.05587	0.01072	0.09467
MINVAL74	0.11289	0.05212	0.01852	-0.10826	-0.89426	0.02387	-0.06446	-0.07803	0.03052	0.11376
WATERREC	-0.25619	0.22778	0.17889	-0.07594	0.43930	-0.20768	0.13691	0.05262	0.01505	0.24217
IRR_LAND	0.09170	0.09918	-0.02084	0.12117	-0.30031	0.38353	0.20233	0.18085	-0.05123	0.09810
PCMIN_EM	-0.05995	0.17711	0.17773	0.17715	0.18601	-0.10239	0.10717	0.14368	0.46380	-0.04767

TABLE XXVIII (Continued)

ROTATED FACTOR PATTERN

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6	FACTOR7	FACTOR8	FACTOR9	FACTOR10
TEMP	-0.68144	0.17575	0.19987	-0.20090	-0.12658	0.09977	0.04128	-0.07248	-0.06554	0.03723
RAINFALL	-0.54630	-0.18919	0.02576	0.01423	0.13211	-0.58860	0.04077	0.30443	0.30988	-0.05616
Q61	0.10537	-0.93219	0.09102	-0.02643	0.08026	-0.03414	0.08065	0.02607	0.04406	-0.04880
Q1028	0.05297	-0.12362	0.46680	0.24140	0.02592	0.02505	-0.09489	0.06560	0.08844	-0.12116
Q1479	-0.19437	0.03465	0.04883	0.07174	-0.27395	0.25387	-0.16636	-0.00717	-0.08813	-0.06980
Q1380	0.23264	0.03970	0.19409	0.31470	0.03615	0.40951	-0.36509	0.04348	-0.05429	0.13271
Q1386	0.24157	-0.08095	0.32634	0.15091	0.12291	0.06302	-0.05188	0.21914	-0.01943	0.23367
PCPROP	-0.22034	0.56922	-0.55622	0.11046	0.09952	0.01388	0.17623	-0.06852	-0.38441	0.14271
PCFRMPRO	-0.16941	0.56692	-0.54056	0.11417	0.12524	0.01762	0.24454	-0.08955	-0.36600	0.11745
PCGOVTEM	-0.03797	0.24332	0.62290	-0.14043	0.28041	0.02965	0.15026	0.02396	-0.10951	0.30410
PCPRNOFW	0.21137	-0.66115	0.13587	0.00073	-0.25410	-0.08474	-0.25796	0.04530	0.41544	-0.31021
PCMFG_EM	-0.04405	-0.37554	0.05378	0.06449	-0.20810	-0.12142	-0.20236	-0.08601	0.70820	-0.17549
UNDEREM	-0.10128	0.54251	-0.08052	-0.10448	0.23049	0.22324	0.35382	-0.04664	-0.27091	-0.01350
NWORK_WK	-0.77248	0.23313	-0.30236	0.15368	0.11244	-0.17871	0.10467	0.10478	0.13511	0.05450
WRKOUTLO	-0.10159	0.27564	-0.27452	-0.03118	0.06983	-0.62724	-0.02206	0.14172	-0.10586	0.33776
ED_ML70	0.80410	-0.27318	0.36550	-0.06599	-0.09011	0.19798	-0.08128	-0.05734	-0.01934	-0.06560
ED_FEM70	0.82850	-0.24778	0.30773	-0.10817	-0.08510	0.19328	-0.12203	-0.10908	-0.09837	-0.06578
MEDIANAG	-0.32963	0.24100	-0.49430	0.02451	-0.10568	0.08839	-0.22596	-0.24162	-0.27902	-0.20703

TABLE XXIX

ROTATED FACTOR PATTERN FOR PRINCIPAL COMPONENTS ANALYSIS OF ARKANSAS DATA SET

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6	FACTOR7	FACTOR8	FACTOR9	FACTOR10
POP70	-0.47809	0.19868	0.12438	0.26886	0.08461	-0.06769	-0.59146	0.03780	0.11431	0.19285
X1_70	-0.20484	0.71391	-0.04291	0.32908	0.29262	-0.18650	-0.12465	-0.15148	-0.05023	0.10287
X2_70	-0.40638	0.58551	0.03030	0.13609	-0.05423	-0.23930	-0.13622	-0.22296	-0.27497	0.16598
X4_70	-0.36873	0.24690	0.02699	0.28647	0.17094	-0.16554	-0.68262	0.02042	0.00059	0.06758
X5_70	0.62574	-0.06383	-0.24133	-0.14380	0.11810	0.11648	0.04747	0.03740	-0.10269	-0.03759
X6_70	-0.40997	0.14039	-0.07958	0.03711	0.24796	-0.20340	-0.33123	-0.03299	-0.09447	-0.30225
X7_70	-0.28173	0.42559	0.05333	-0.26047	0.02344	0.09531	0.27083	0.05375	-0.08441	-0.02537
X8_70	0.06343	0.25475	-0.04106	0.18702	0.61746	0.01078	0.05854	-0.00215	-0.00689	0.19101
X9_70	0.12378	0.22484	-0.07944	-0.10175	0.13390	0.12293	-0.04501	-0.00243	0.07879	0.63970
X10_70	-0.24266	0.32951	0.02756	0.12789	0.31571	0.04908	-0.30329	-0.11224	-0.25087	0.38769
X11_70	-0.18042	0.14943	-0.10796	-0.06594	0.10314	0.03507	-0.03260	0.03868	-0.11998	0.70563
X12_70	-0.10244	0.28290	0.13571	0.01597	-0.62162	0.05771	0.35364	0.03435	-0.11357	0.16675
X13_70	0.29341	0.03914	0.01847	-0.09445	-0.69753	0.12427	0.09096	-0.02764	0.07606	-0.26209
X14_70	0.37568	-0.28146	0.09290	0.26864	0.21107	0.26974	-0.02625	-0.08859	0.09759	0.02603
X15_70	0.20205	-0.21543	0.16971	0.27522	-0.34682	0.18206	0.13134	0.13456	0.00121	-0.27742
X16_70	0.14033	-0.56991	0.12238	-0.25110	0.15335	0.29998	0.09151	0.04131	0.06488	-0.10621
X18_70	0.03781	0.08280	0.06939	-0.12896	-0.16932	0.11698	0.48266	0.30182	-0.03776	0.25190
X19_70	0.16899	-0.00143	0.02337	0.08377	-0.55089	0.07790	0.22120	-0.00208	-0.20308	-0.26733
X20_70	0.32021	0.06153	-0.10306	-0.11572	-0.37434	0.24052	0.18740	-0.14755	0.24118	-0.18842
X21_70	-0.32820	0.05581	0.08516	-0.12489	0.06459	-0.01680	-0.05015	-0.10793	0.06678	0.48715
X22_70	0.03814	-0.07385	-0.01555	-0.16913	0.05020	0.16034	0.00228	0.08732	-0.15404	0.71069
X23_70	-0.34601	0.25506	-0.05233	0.06869	-0.10423	0.11189	0.03103	0.02463	-0.05168	0.45855
X24_70	-0.35174	-0.11493	0.20312	0.07195	-0.01339	-0.06527	0.30594	-0.11091	0.13391	0.29508
X25_70	-0.20616	-0.26697	0.15732	-0.10972	0.02270	-0.07498	-0.42176	-0.16529	-0.33919	0.03459
POVERTY	0.27939	-0.89269	-0.03270	-0.16811	0.10377	0.04116	0.06843	0.02778	0.02095	-0.01377
PURNOFM	0.63387	0.19160	-0.09069	0.02328	-0.10957	-0.20628	0.41776	0.03115	-0.18520	-0.07273
RURFARM	0.43156	-0.12978	0.02995	-0.73778	-0.19006	0.07382	0.17114	-0.02181	0.03563	0.04848
DROPOUT	-0.09776	-0.78510	0.06825	-0.10001	-0.14983	0.06310	-0.15452	-0.09791	-0.21996	0.06889
ETHNIC1	0.11249	0.81862	-0.03541	-0.26250	-0.19565	0.05645	0.13254	0.19406	0.08577	0.14383
SKLENR2	0.16336	-0.82162	0.13169	-0.05058	-0.09918	-0.04719	-0.24446	-0.09947	-0.11613	-0.09428
COLLEGE2	-0.01561	0.44477	-0.09661	-0.08706	0.59032	0.00236	-0.18100	-0.05676	-0.10513	-0.23846
AMEND_SH	-0.19224	-0.41504	0.05627	-0.15685	-0.06286	-0.20806	-0.31556	0.08405	-0.28510	0.09529
CO_POP40	-0.93326	0.06959	0.02431	-0.04476	0.04543	0.02612	-0.14276	0.02814	-0.00049	0.00111
CO_POP50	-0.94129	0.11116	0.01875	-0.02824	0.05832	0.03006	-0.12160	0.01901	-0.02198	0.00383
CO_POP60	-0.94595	0.14184	0.00327	0.00320	0.07708	0.03983	-0.07257	-0.00446	-0.02807	0.01297
CO_POP70	-0.93441	0.21098	-0.00833	0.00914	0.09281	0.05765	-0.05067	-0.00781	-0.01344	0.01012
PCCO_MD	-0.67499	0.45071	-0.07465	0.16639	0.22029	0.10627	-0.13276	0.12394	0.01339	0.18433
PCCO_DDS	-0.43108	0.56169	-0.07302	0.19918	0.27099	0.17301	-0.22128	0.14528	0.07689	0.20351
CTY_Y69	-0.22326	0.70700	-0.02873	0.05890	-0.00495	-0.19478	-0.16926	-0.15620	-0.13415	0.37172
DEPENDRA	0.17796	-0.85729	0.02940	-0.00188	-0.12162	0.01671	0.06676	-0.02756	0.09744	0.04270
Q99	-0.10976	-0.08237	0.70212	0.11122	-0.01183	0.03170	0.20527	0.07425	-0.08630	-0.02933
Q100	-0.68213	0.03302	-0.16524	0.02057	-0.02092	0.01561	0.20325	-0.10673	0.05612	0.34074
Q104	-0.22888	-0.18527	-0.15142	0.11488	-0.19962	-0.00024	-0.30359	0.08190	-0.16965	-0.17721
Q149	-0.39288	0.15003	-0.24818	0.00518	0.01991	0.09062	0.09916	0.02408	0.07299	-0.25571
Q151	-0.81960	0.15490	-0.20399	0.05488	0.02606	0.04210	0.03456	-0.07977	-0.02112	0.06951
Q221	0.42469	-0.27981	0.16956	-0.11553	-0.04545	-0.01680	0.09456	-0.28498	-0.06847	-0.03155
Q269	-0.05539	-0.18071	0.38321	-0.12356	-0.11360	-0.01608	-0.15031	0.24429	0.46196	-0.02780

TABLE XXIX (Continued)

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6	FACTOR7	FACTOR8	FACTOR9	FACTOR10
Q320	0.11448	0.06038	-0.03561	0.06000	0.03321	-0.41538	-0.00487	-0.34606	0.01516	0.01854
Q212	0.30633	0.15569	0.48897	0.28831	-0.05367	-0.07992	0.02580	0.03416	-0.07269	0.00716
Q383	0.18207	0.11984	-0.50965	0.33310	0.10697	-0.02447	-0.10325	0.04862	-0.16222	0.03678
Q384	-0.29873	-0.05149	0.00767	0.19993	-0.29029	0.09082	-0.03581	0.31702	-0.29409	0.07621
Q385	0.07877	0.31758	-0.53618	0.01272	0.02461	0.00515	-0.24972	-0.06067	-0.07277	0.15637
Q408	-0.33344	0.06826	-0.41513	-0.14351	0.02882	0.01086	0.13483	-0.09563	0.33708	0.19537
Q421	-0.15838	-0.11114	-0.23739	-0.14244	0.14732	0.03852	0.08177	-0.04796	-0.06536	-0.20405
Q426	0.12179	-0.07163	-0.17174	0.05472	0.05587	0.02680	-0.09927	0.02832	-0.57835	0.09471
Q1005	0.03413	-0.11921	-0.52515	0.18758	0.16718	0.01338	0.21422	0.01620	-0.28450	-0.00058
Q1006	0.00025	-0.06400	-0.79265	0.09460	-0.03613	0.02986	0.14251	0.14311	-0.09717	-0.07818
Q1015	0.06077	0.25739	-0.14640	-0.18138	0.24251	-0.33439	-0.12977	0.02126	0.11308	-0.09571
Q1016	-0.04075	0.25667	-0.25815	-0.26930	-0.07937	-0.19506	0.05760	0.10393	0.54972	-0.00894
Q1018	-0.35842	0.06678	-0.10857	-0.07048	-0.24004	-0.28257	0.29217	0.14133	0.14611	-0.00728
FIRK2	0.37120	0.07030	-0.28562	-0.28893	-0.20728	-0.07874	-0.35153	0.22390	0.38635	0.04838
POPDENS1	-0.94136	0.18216	-0.01596	0.02320	0.07251	0.04563	-0.04931	0.00154	-0.00283	0.03497
ROOMS	-0.01312	-0.09843	-0.04823	0.26393	0.09523	0.03808	-0.25974	0.23121	0.09669	0.19834
Q1309	0.04016	-0.01197	-0.67170	-0.00345	0.15256	-0.00726	-0.22340	-0.21595	0.42835	0.06480
EDA_AREA	0.27007	-0.53165	0.03915	-0.18595	-0.12645	-0.02374	0.36260	0.16605	0.00813	-0.01390
OZARK	-0.08095	0.71954	-0.04412	-0.01439	0.06683	0.12295	0.32774	0.13015	0.06601	0.02235
Q1162	-0.27440	0.16066	-0.14731	-0.06651	-0.00627	0.07048	0.19988	0.39613	-0.40557	-0.02393
Q1163	-0.00771	-0.13747	-0.12319	0.04301	-0.17155	0.06376	-0.08989	0.07177	-0.48865	-0.02558
Q1171	-0.01732	-0.09539	-0.10768	-0.02897	0.03932	-0.01250	-0.35798	0.03921	-0.11613	-0.00400
CO_DEBT	0.13082	-0.00552	0.13196	0.25506	-0.04328	0.10868	-0.21143	0.04696	0.14774	0.20197
Q1175	0.08604	0.05295	-0.20732	0.16113	0.24375	0.01946	-0.08338	0.03951	-0.13540	0.02514
Q1179	-0.03541	-0.05279	-0.42011	0.24641	-0.18579	0.07658	0.11984	0.27133	-0.06786	-0.03093
Q1181	-0.02245	-0.03705	-0.82089	0.11830	-0.06743	-0.03079	0.07533	0.18765	-0.08166	-0.06709
Q1183	-0.06769	0.10582	-0.76816	-0.04081	-0.05631	-0.12939	0.01491	0.17105	-0.07826	-0.10569
Q1135	-0.14586	-0.06733	-0.63948	-0.17619	-0.08103	0.01800	-0.07806	0.31604	0.05484	0.04231
Q1187	-0.11733	0.06282	-0.51414	-0.05360	0.04422	-0.15922	-0.01896	0.26070	-0.13545	-0.03671
Q1440	-0.03843	0.20577	-0.55771	0.03040	0.21977	-0.06748	-0.14996	-0.12042	0.01940	0.12871
Q1442	-0.07650	0.07124	-0.62461	-0.06553	0.05178	0.06243	-0.19972	-0.16546	-0.30110	0.11475
Q1457	0.04166	0.18106	-0.30525	-0.07025	-0.03276	0.01606	0.06145	0.00216	-0.46381	0.05241
EDADUMMY	-0.04090	0.26340	0.01042	0.23113	-0.04755	0.10191	-0.58148	-0.06990	0.12399	0.10512
TIGER1	0.00422	-0.14533	-0.36176	0.16751	0.08957	0.18212	0.13354	-0.33701	0.17878	0.25136
DEM68PC	-0.13542	-0.64137	-0.06272	0.17093	0.47594	0.04277	0.03163	-0.01154	0.06681	-0.07102
REP68PC	-0.03829	0.76425	-0.17406	-0.27315	-0.08526	0.08805	-0.10289	0.24981	0.27113	0.18036
ST_PK	0.20304	0.00848	-0.11619	0.02990	0.15235	0.04167	0.10721	0.78343	0.09540	0.05827
FARMDENS	-0.00023	-0.39207	0.17328	-0.74968	-0.00306	0.06737	-0.26742	0.09203	-0.02015	0.04381
MINDENS1	0.04253	-0.02723	-0.02962	0.05806	0.13292	-0.91137	0.02394	-0.05025	0.04931	-0.09693
MINVAL71	0.04677	-0.01007	-0.03329	0.05909	0.13610	-0.91343	0.00922	-0.06220	0.04084	-0.11245
MINVAL74	0.13307	-0.05527	-0.00209	0.13838	-0.00461	-0.76170	-0.05207	0.07769	0.10807	-0.11817
WATERREC	0.20304	0.00848	-0.11619	0.02990	0.15235	0.04167	0.10721	0.78343	0.09540	0.05827
IRR_LAND	0.01824	-0.16294	0.38371	-0.31458	-0.12165	0.19772	-0.01262	-0.30461	-0.16714	0.03134
PCMIN_EM	0.02808	0.15946	0.03317	0.47453	-0.08937	-0.47073	0.06570	0.10255	-0.04327	-0.00374
TEMP	0.01064	-0.46995	0.13279	0.62641	0.16021	-0.01849	0.07468	-0.28394	-0.07741	-0.10258
RAINFALL	0.09263	-0.33464	0.24622	0.53961	0.13407	0.05682	0.00906	-0.24496	-0.28974	-0.05253
Q61	-0.79311	0.15872	-0.02022	0.14334	0.20369	0.11647	-0.01258	-0.08677	-0.16209	-0.15597

TABLE XXIX (Continued)

	FACTOR1	FACTOR2	FACTOR3	FACTOR4	FACTOR5	FACTOR6	FACTOR7	FACTOR8	FACTOR9	FACTOR10
Q1028	-0.48448	0.11763	-0.26353	0.25152	0.00608	-0.00689	-0.21875	0.01365	-0.04290	0.24253
Q1479	0.04680	-0.03185	-0.12303	0.25433	0.00148	-0.06340	-0.11967	0.07699	-0.03217	-0.09343
Q1380	-0.10072	0.15888	-0.33920	-0.07272	-0.19432	-0.06962	0.09177	0.35811	0.07351	-0.26914
Q1386	-0.10273	0.00914	-0.10945	-0.06351	-0.05239	-0.03710	-0.17401	0.49321	-0.23798	-0.03394
PCPROP	0.45878	-0.15866	0.02427	-0.64507	-0.08004	0.16526	0.21580	-0.04950	0.13780	0.26189
PCFRMPRO	0.37695	-0.23357	0.05265	-0.63683	-0.09657	0.19986	0.14040	-0.14267	0.07230	0.14032
PCGOVTEM	-0.28491	0.02263	0.00340	0.08231	0.69885	-0.13589	0.16895	0.15469	0.07201	-0.20298
PCPRNOFW	-0.02562	0.41808	0.02223	0.57095	-0.39160	0.03425	-0.19223	-0.26277	-0.07402	-0.06166
PCMFG_EM	0.35694	0.32533	-0.09713	0.28744	-0.50794	-0.09438	0.08153	-0.19815	0.08888	-0.32209
UNDEREM	0.45933	-0.24179	-0.05907	-0.72159	0.13802	0.06305	0.15322	0.06662	0.04674	-0.00793
NWORK_WK	0.28863	-0.78235	-0.05437	-0.07870	0.08592	0.08767	0.13723	0.04554	-0.01759	0.02259
WRKOUTLO	0.11850	-0.04753	0.16218	0.04689	-0.23686	-0.08909	0.37585	-0.01161	0.01993	-0.11191
ED_ML70	-0.43153	0.72525	-0.02227	0.35243	0.16752	-0.00864	-0.15231	-0.05453	0.05236	0.05019
ED_FEM70	-0.33947	0.74745	-0.00574	0.40125	0.19078	0.02512	-0.06464	-0.03934	0.07156	0.01103
MEDIANAG	0.33153	0.38648	-0.08366	0.13391	-0.22157	0.00133	0.34665	0.21728	0.17742	0.40089

are relegated to their respective factors, these factors can be identified by a meaningful interpretation of the variables in the factor; this is done by examining a common bond within them.

Factor scores are then computed for each observation in the data sets. These scores are then regressed on dependent variables percent change in population between 1970 and 1975 and absolute change in median per capita income between 1969 and 1974. Those factors significant at the .05 level are discussed in the text that follows.

Care must be exercised in interpreting the results of factor regression. If a variable has a positive loading on a factor and the resultant regression coefficient is positive, then one may infer that the variable is positively related to the dependent variable. If the variable has a negative loading and the resultant regression coefficient is negative, then the variable is positively related to the dependent variable.

Also of interest was how much of the variation in the dependent variables could be explained by using a maximum number of factors. The "maximum" number of factors which can be used in a principal components analysis is defined here as the number of factors possessing eigenvalues greater than one. This is reported in Table XXX.

Oklahoma Income

The factors developed through principal components analysis were regressed on the dependent variable absolute change in median per capita income between 1969 and 1974. Two of the ten factors were significant at the .05 level (Table XXXI).

TABLE XXX

RESULTS OF REGRESSION PRINCIPAL OF COMPONENTS

Model	No. of Factors	R^2	No. of Factors	R^2
Oklahoma Income	27	.6884	10	.4527
Oklahoma Population	27	.6923	10	.4697
Arkansas Income	28	.5855	10	.3492
Arkansas Population	28	.8087	10	.5056

TABLE XXXI

REGRESSION OF PRINCIPAL COMPONENTS CREATED FROM OKLAHOMA DATA SET--DEPENDENT VARIABLE: ABSOLUTE CHANGE IN MEDIAN PER CAPITA INCOME 1969-74

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO	PROB > F
REGRESSION	10	1606864.998768	160686.499877	4.714	0.0001
ERROR	57	1942849.471821	34085.078453		
CORRECTED TOT	67	3549714.470588	52980.812994		RSQUARE = 0.4527

SOURCE	DF	B VALUE	STD DEVIATION	T FOR H0:B=0	PROB > |T|
INTERCEPT	1	1268.58823529	22.38863894	56.66214	0.0001
FACTOR1	1	8.78152450	3.43797921	2.55427	0.0133
FACTOR2	1	-3.18812053	2.92349956	-1.09052	0.2801
FACTOR3	1	-4.13180689	2.99856751	-1.37793	0.1736
FACTOR4	1	13.12373557	4.54334792	2.88856	0.0055
FACTOR5	1	-6.42538962	5.24119530	-1.22594	0.2253
FACTOR6	1	-6.97446281	5.21898116	-1.33636	0.1867
FACTOR7	1	0.92195194	6.18921359	0.14896	0.8821
FACTOR8	1	-9.22358089	6.63605009	-1.38992	0.1700
FACTOR9	1	-10.74263224	6.43734654	-1.66880	0.1006
FACTOR10	1	-4.11086748	7.35220470	-0.55913	0.5783

Variables with high positive loadings on Factor 1 were, in order of their loading, percent of popular vote in the county received by the Republican presidential nominee in 1968; median education level of county female adults; median education level of county male adults; 1969 median city per capita income; 1969 median income of city families; median education levels of city adults, 1970; percentage of children ages 5-16 enrolled in school; percentage of county population who are of the white race; whether electricity suppliers are interconnected; and whether there is a county planning commission. Variables producing high negative loadings were percent of county families with incomes in the poverty range; the non-worker to worker ratio; percent of the popular vote in the county received by the Democratic presidential nominee in 1968; mean annual temperature; whether the community is located in the area originally served by the Ozarks Regional Commission; the county dependency rate; the county school dropout rate; and mean annual rainfall. The variable group suggests that the factor is a measure of <u>Community Affluence</u>. The sign of the regression coefficient is positive. One may deduce that affluence exerts a positive influence on absolute income gain.

Six variables were positively correlated with Factor 4. They were whether a city had plumbing, electrical, building, fire, and housing codes and whether there was a public library in the community. These variables are indicative of the <u>Quality of City Government</u>. The positive sign associated with this factor's regression coefficient suggests that good quality government promotes income gains.

Oklahoma Population

The same factors developed through principal components analysis were regressed on the dependent variable percentage change in community population between 1970 and 1975. Three factors were significant at the .05 level and three additional factors were significant at the .10 level. Those at the .05 level will be discussed (Table XXXII).

Variables with high positive loadings on Factor 2 were percent of the county labor force employed as proprietors; percent of the county labor force employed as farm proprietors; the 1960 county underemployment rate; percent of county population classed as rural farm; and the log of the distance to the nearest SMSA city. Variables with high negative loadings were 1950 county population; 1940 county population; 1960 county population; 1970 county population; 1970 county population density; county debt; number of high school graduates entering the labor force annually; physicians per capita; percent of the county labor force employed in manufacturing; percent of the city labor force employed in durable good manufacturing; percentage change in city population between 1950 and 1960; percent of the city labor force employed as craftsmen; and percent of the city labor force employed in the transportation and public utilities sector. These variables are measures of the degree of <u>Urbanness</u> a city possesses. The negative coefficient associated with this factor (when urban attributes have negative loadings) suggests that more urban places are associated with higher population growth rates.

The variables loading heavily on Factor 4 were identified in the previous section. The positive sign of the coefficient suggests that good government is also positively associated with population growth.

TABLE XXXII

REGRESSION OF PRINCIPAL COMPONENTS CREATED FROM OKLAHOMA DATA SET--DEPENDENT VARIABLE: PERCENT CHANGE IN POPULATION 1970-75

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO	PROB > F
REGRESSION	10	0.486488	0.048649	5.048	0.0001
ERROR	57	0.549296	0.009637		
CORRECTED TOT	67	1.035784	0.015459		RSQUARE = 0.4697

SOURCE	DF	B VALUE	STD DEVIATION	T FOR H0:B=0	PROB > |T|	LABEL
INTERCEPT	1	0.03383939	0.01190450	2.84257	0.0062	
FACTOR1	1	0.00167394	0.00182804	0.91570	0.3637	
FACTOR2	1	-0.00319296	0.00155449	-2.05403	0.0446	
FACTOR3	1	-0.00023769	0.00159440	-0.14908	0.8820	
FACTOR4	1	0.00570682	0.00241579	2.36230	0.0216	
FACTOR5	1	-0.00498790	0.00278685	-1.78980	0.0788	
FACTOR6	1	-0.00245681	0.00277504	-0.88532	0.3797	
FACTOR7	1	0.01417347	0.00329093	4.30682	0.0001	
FACTOR8	1	-0.00224439	0.00352852	-0.63607	0.5273	
FACTOR9	1	0.00613414	0.00342287	1.79211	0.0784	
FACTOR10	1	0.00688965	0.00390932	1.76237	0.0834	

The variable with a high positive loading on Factor 7 was percentage change in total community population between 1960 and 1970. Variables with high negative loadings were average number of freight trains stopping each day, whether educational TV was available, whether there was a city manager form of government, percent of the labor force employed as operatives, per capita employment of policemen, and whether local taxi service was available. The factor seems to measure the Growth Momentum present in a community. A positive sign is associated with this factor's coefficient, suggesting that there is momentum in the growth process.

Arkansas Income

The ten factors developed by a principal components analysis of the Arkansas data set were regressed on the dependent variable absolute change in median per capita income between 1969 and 1974. The coefficients of three factors were significant at the .05 level; two additional ones were significant at the .10 level (Table XXXIII). Those significant at the .05 level will be discussed.

Variables with high positive loadings on Factor 3 were percent of the 1970 county population classed as rural non-farm and the log of the distance to the nearest SMSA city. Variables with high negative loadings were 1970 county population; 1960 county population; 1950 county population; 1940 county population; 1970 county population density; number of truck lines serving the community; and number of physicians per thousand population. This grouping seems to be an indicator of the degree of Urbanness of a community. The negative regression coefficient coupled with the signs of the loadings of the variables

TABLE XXXIII

REGRESSION OF PRINCIPAL COMPONENTS CREATED FROM ARKANSAS DATA SET--DEPENDENT VARIABLE: ABSOLUTE CHANGE IN MEDIAN PER CAPITA INCOME 1969-74

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO	PROB > F
REGRESSION	10	1496115.928920	149611.592892	3.381	0.0014
ERROR	63	2787788.665675	44250.613741		
CORRECTED TOT	73	4283904.594595	58683.624583		RSQUARE = 0.3492
SOURCE	DF	B VALUE	STD DEVIATION	T FOR HO:B=0	PROB > |T|
INTERCEPT	1	1274.72972973	24.45365549	52.12839	0.0001
FACTOR1	1	-5.43992932	2.82212135	-1.92760	0.0584
FACTOR2	1	1.92593198	2.97150826	0.64813	0.5193
FACTOR3	1	1.42315336	3.78618691	0.37588	0.7083
FACTOR4	1	-14.54404005	4.89917101	-2.96867	0.0042
FACTOR5	1	2.06303964	5.67922861	0.36326	0.7176
FACTOR6	1	-11.33855975	6.94254112	-1.63320	0.1074
FACTOR7	1	6.05282105	6.22718054	0.97200	0.3348
FACTOR8	1	-23.29200790	7.00532321	-3.32490	0.0015
FACTOR9	1	-12.93378496	7.42305092	-1.74238	0.0863
FACTOR10	1	11.84434526	6.87915893	1.72177	0.0900

suggest that more urban communities experienced greater income growth. The result for Arkansas is quite similar to that for Oklahoma previously discussed.

Variables with high positive loadings on Factor 4 were mean annual temperature, mean annual rainfall, and percent of the county labor force employed in the private non-farm wage and salary sector. Variables with high negative correlations with Factor 4 were the proportion of the county land area used for farming; the portion of the county population classed as rural farm; the 1960 county underemployment rate; the proportion of the county labor force employed as farm proprietors; and the proportion of the county labor force employed as proprietors. The factor pattern is suggestive of the Agricultural Linkage existing within the community economy. The negative sign of the factor's regression coefficient suggests that areas heavily reliant on agriculture had above average income gains.

Three variables had high positive correlations with Factor 8. They were whether there was a state park in the county; whether there was a water recreation area in the county; and whether there was an industrial education center in the county. Parks, reservoirs, and vo-tech schools often tend to be found deep in the hinterland. The pattern suggests Governmental Investment in Economically Marginal Areas. The negative coefficient suggests that such areas exhibited little income increase.

Arkansas Population

The same factors developed through principal components analysis were regressed on the dependent variable percent change in population between 1970 and 1975. Three factors were significant at the .01 level and an additional factor was significant at the .10 level (Table XXXIV). Those significant at the .01 level will be discussed.

Variables loading heaviest on Factor 1 were discussed in the preceding section. The sign of the coefficient leads to the conclusion that areas with more urban characteristics experience greater population growth.

Variables with high positive loadings on Factor 2 were, in descending order, percent of total county population who are white; percent of total county popular vote going to the Republican presidential nominee in 1968; 1970 county median adult female education level; 1970 county median adult male education level; 1970 city median adult education level; whether the city was in the area initially served by the Ozarks Regional Commission; 1969 median per capita income; 1969 median family income; and number of dentists per thousand population. Variables with high negative loadings were, in descending order, percent of county families with income in the poverty range; dependency rate; percentage of total county population enrolled in grades 1-12; school dropout rate; the non-worker to worker ratio; the portion of the total vote going to the 1968 Democratic presidential nominee; percentage of the city labor force employed in agriculture; and whether the community was in an area served by the Economic Development Administration. This factor is indicative of <u>Community Affluence</u>. The sign of the regression coefficient suggests that population growth is occurring in more affluent areas.

The percentage of the city labor force employed in construction had a high positive loading on Factor 7. Variables with high negative correlations with Factor 7 were the log of 1970 city population, 1970

TABLE XXXIV

REGRESSION OF PRINCIPAL COMPONENTS CREATED FROM ARKANSAS DATA SET--DEPENDENT VARIABLE: PERCENT CHANGE IN POPULATION 1970-75

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F RATIO	PROB > F
REGRESSION	10	0.939368	0.093937	6.442	0.0001
ERROR	63	0.918618	0.014581		
CORRECTED TOT	73	1.857986	0.025452		RSQUARE = 0.5056
SOURCE	DF	B VALUE	STD DEVIATION	T FOR H0:B=0	PROB > |T|
INTERCEPT	1	0.07840335	0.01403723	5.58539	0.0001
FACTOR1	1	-0.00538196	0.00161999	-3.32221	0.0015
FACTOR2	1	0.00470149	0.00170575	2.75627	0.0076
FACTOR3	1	0.00220994	0.00217340	1.01681	0.3131
FACTOR4	1	-0.00534877	0.00281229	-1.90193	0.0618
FACTOR5	1	0.00108701	0.00326007	0.33343	0.7399
FACTOR6	1	-0.00099807	0.00398525	-0.25044	0.8031
FACTOR7	1	0.01426952	0.00357461	3.99191	0.0002
FACTOR8	1	0.00329043	0.00402129	0.81825	0.4163
FACTOR9	1	-0.00571035	0.00426108	-1.34012	0.1850
FACTOR10	1	0.00548420	0.00394887	1.38880	0.1698

city population, and whether the city was an EDA-designated growth center. The groupings suggests a measure of City Population Size. The positive sign of the regression coefficient suggests that smaller cities and towns experienced greater percentage increases in population.

CHAPTER VII

SUMMARY

Using three multivariate statistical methods--regression analysis, discriminant analysis, and principal components analysis--111 variables hypothesized to be related to income and population growth processes have been examined. Some of these variables can confidently be labeled determinants of growth. Others found statistically significant are not structurally related to growth but are useful for predictions. Examples of the latter predictive variables are those suggested by Forsht and Jansma (1975) which describe the occupational composition of the labor force. These are indicators of underlying phenomena existing within an economy.

Application

The results of this study can be applied in at least two ways. First, the planner or researcher can take the regression equations developed here, collect the data called for in the equation, and make projections about population or income growth for a particular community. Although census and data bank sources were used in developing these models, the amount of data needed is sufficiently small enough for the model to be practical for use by one interested in the growth of an individual community. The models could be used for predicting future demands for public services and for estimating the future community tax base. It follows that some of the variables can be manipulated at various governmental levels to bring about a desired outcome.

Techniques

A review of the literature revealed that currently available econometric techniques have not been employed in investigating income and population growth processes. Most of the in-depth studies are carried out by geographers who rely primarily on the use of comparative statistics. No rigorous attempt is made to establish causal relationships and no attempt is made to determine relative strengths of the various determinants. This study demonstrates that use of econometric techniques to investigate growth is both feasible and desirable.

The Ozarks Regional Commission's Community Data Profile System was established for, among other reasons, the purpose of providing data for use in econometric planning models. However, the initiators suggested no specific techniques and, to our knowledge, no econometric work was accomplished using the data bank. Three econometric techniques were used in analyzing the available data. None proved wholly satisfactory but much was learned which can aid in the design of future data banks and subsequent analyses.

On theoretical grounds, regression analysis and principal components analysis seemed particularly applicable to the problem of analyzing the data. Each was found to have relative strengths and weaknesses.

Use of regression is desirable because specific variables can be identified which are linked to development processes. However, as more variables are inserted into the regression equation, the procedure tends to break down because of multicollinearity and because of the using up of degrees of freedom. If only a few specific variables are included, the equation is likely to be incompletely specified, resulting in estimation bias. Stepwise regression techniques can be used to partially circumvent these problems, but other problems are created when one employs stepwise. On one hand, single-equation regression models are simply not a perfect solution to the analytical problems when data as detailed as that provided by the ORC profiles are used, given the dependent variables which were specified. On the other hand, the variables which were found significant are surely linked to the growth process.

Using regression of principal components rather than regression of actual observations of specified variables resolves the issue of too many variables. However, the generality of the components and the subjectivity inherent in interpreting the meaning of the components reduces the value of the technique. Thus, while the ORC community profile variables were often too specific, the components were too general.

Though it would seem that superior models would result through the use of detailed data, the results of this study indicate that less detailed data, such as is typically reported by the Bureau of the Census, can be used to construct models which are just or satisfactory, especially for predictive purposes.

The principal components technique could probably be used satisfactorily to predict growth for given communities, but an immense amount of data is required for each application.

Discriminant analysis was investigated as a means of separating slow-growth cities from fast-growth cities. Although discriminant analysis is most appropriately applied in situations where the dependent variable is discrete rather than continuous as was the case here, satisfactory results were obtained in that variables thought to be associated with growth repeatedly yielded positive results when used to develop discriminant rules. It may have potential as a screening tool. Use of discriminant analysis served as a check on the other methods.

Variables

By examining the characteristics of the occupational composition of the labor force which are associated with growth, community leaders may gain insight into which economic activities should be promoted to achieve the desired level of growth. Although care must be exercised in interpreting these findings relating to these variables because they may be more predictive than prescriptive, they may indicate that activities related to commerce should be promoted if population growth is desired. Since export base theory suggests that a region grows by exporting its products to other regions, one might suggest that the service-related commercial activities be exportable outside the community and not primarily for consumption by community residents. Specifically, it was found that the proportions of the labor force employed in sales and in management were positively associated with community population growth. Looking at the nation's major cities one can readily identify fast-growing areas such as Dallas, Denver, and Atlanta as areas which have become increasingly important as regional trade and distribution centers. Cities whose growth seems to have stagnated such as New Orleans and St. Louis have not seen as much growth in the commercial sector. Apparently, the phenomena which is easily observed from a national standpoint is also present among smaller cities within a particular region.

Areas where a high percentage of the labor force is employed by government have shown less growth. Thus, federal and state governments should use caution when selecting certain areas as sites for new or expanded activities in order to stimulate population growth. On the other hand, closure of military installations or reductions in force of federal employees may not be as harmful in the long run to community growth as communities sometimes fear.

How can this knowledge be applied? Frequently community development organizations such as chambers of commerce and civic clubs must develop ideas about what types of activity they hope to attract to their towns. Choices are sometimes possible. For example, if an area striving for population growth must choose between a small manufacturing company or a regional sales of, say, farm machinery, both of which would employ the same number of people, the community should opt for the sales office.

Throughout this study variables were sought that community leaders could manipulate which would insure growth. Unfortunately, no specific item such as an industrial park or a particular form of city government was found. However, there are attributes which can be encouraged locally. The absence of labor unions was associated with population growth. Creation of an atmosphere within a community by its influential members which does not encourage union activity should contribute to population growth. Good rail service, measured by the number of freight trains passing through each day, was also positively associated with growth. Thus, those in smaller towns who are working to prevent rail line abandonment seem to be reacting rationally given that growth is desired.

Communities whose school systems have lower dropout rates have more population growth. Though dropout rates are a function of both the socio-economic character of students' families and the quality of the community educational system, efforts to lower the rate certainly would seem to promote growth since the value of the community's human capital would be increased as well as the attractiveness of the community to potential in-migrants.

Variables were found which should be considered by those formulating plans for increasing per capita income of community residents. Again, variables relating to the community occupational structure were significant. A high proportion of the labor force employed in manufacturing was negatively associated with income change. A high proportion in commerce was positively related. Although the variable measuring the proportion in government was negatively related to population growth, it was positively related to income growth. Similarly, though counties heavily dependent on agriculture have experienced net out-migration, residents of communities in those counties find their incomes increasing faster than those in less agriculturalized areas.

Several characteristics of growing-income areas were discovered over which community leaders can exert direct control. The existence of a county planning commission, a library, and the availability of educational television were positively related to income growth. Interestingly, the presence of a public recreation program was negatively associated with income growth, perhaps indicating where public dollars should be spent.

Government should not strain taxpayers by adding new employees merely to increase its size. The negative coefficient for government employment associated with population growth suggests that excessive amounts deter development.

Conclusions

What has been learned which we consider important?

First, the use of data as detailed as that provided by the ORC community profile does not appreciably increase the explanatory power of regression models because of the limitations inherent in regression.

Second, the dependent variables which were specified may be too complex and should be further divided to better capture the effects of phenomena occurring within an economy. A better way to analyze growth may be through use of a simultaneous system with variables more general than those used here. The results presented herein can be used to suggest points of departure for such studies.

The quality of the ORC baseline data used in this study is suspect. The goals originally established by ORC when it initiated the Community Data Profile System were never achieved probably because they were unrealistic in the beginning. As time passed, the system was obviously neglected by ORC administration and eventually was eliminated by 1977. Funding agencies typically attach too little importance to projects such as this because their benefits are often too intangible.

It is recommended that growth researchers use data collected by the Bureau of the Census since this is a consistent, reliable data source. The data can be supplemented with variables such as spatial location, initial resource endowments, etc. Past growth trends should be incorporated into the models.

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