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I am submitting herewith a dissertation written by Dale Joseph Leuck entitled "A Cross-Sectional and Time Series Model of Multi-Industry Employment in Rural Tennessee Counties." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Agricultural Economics.

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A CROSS-SECTIONAL AND TIME SERIES MODEL OF MULTI-INDUSTRY EMPLOYMENT IN RURAL TENNESSEE COUNTIES

A Dissertation

Presented for the

Doctor of Philosophy

Degree

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Dale Joseph Leuck

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ABSTRACT

Rural industrialization in Tennessee is expected to contribute to economic growth in rural counties by more than offsetting declining agricultural employment. Not all the rural counties in Tennessee are expected to increase their industrial employment levels by the same magnitude, however. The critical factor influencing the future course of industrial growth in any rural county is its past economic structure. Relatively little is known about the economic structure of rural Tennessee counties or the extent to which the past economic structure may influence industrial growth.

In order to develop an understanding of the determinants of rural industrial growth, the economic structure of rural Tennessee counties was measured by applying a factor analysis to 40 economic variables describing rural communities at two points in time--1960 and 1970. Three interpretable factors resulted which described: 1) the nature of the industrial structure of each rural county and those contiguous counties, 2) the expenditures made on the infrastructure by local governments, and 3) the quality or productivity of the local labor force.

The latter two of the factors were then shown to be responsible for the distribution of the total level of manufacturing employment in the state among the 76 rural Tennessee counties. The 1960 values explained the distribution of manufacturing employment for the 1965 to 1970

period and the 1970 values for the 1971 to 1976 period. Furthermore, the rural counties with higher factor scores tended to be geographically concentrated, thus illustrating the hypothesis that manufacturing growth occurs in regional "matrices of development."

Manufacturing employment projections were made for each of 56 rural counties for the years 1977 to 1981 by using projections of manufacturing employment from the Tennessee Econometric Model. These projections were then used as exogenous variables in a six-equation simultaneous system to project rural employment levels for the following industries: retail trade, wholesale trade, construction, finance, services, and miscellaneous. The accuracy of the 1977 projections for all seven industries was analyzed in order to validate the model. Acceptable margins of error were calculated.

Although much rigor is still required in developing models of rural industrial growth, the concepts used in this study appear to be sound, although in need of refinement. They are intended to form a groundwork for other studies focusing on the issue of the determinants of rural industrial growth.

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CHAPTER 1

INTRODUCTION

1.1 THE PROBLEM

Throughout the 1960's and into the early 1970's, employment in the primary industries in the South (agriculture, mining, forestry) declined in absolute numbers, but was more than offset by increases in manufacturing employment and induced employment in the secondary industries (wholesale and retail trade construction, finance, services, and miscellaneous).[1] This trend is expected to continue for the manufacturing industries because of: 1) labor, land, and tax cost advantages associated with rural communities; 2) the quality of processing, marketing, and transportation technologies associated with the past development of a manufacturing base; 3) the availability of efficient interstate highway and water transportation systems; and 4) a general feeling by industry groups that rural communities offer a higher overall "quality of life."[2] Since the growth of secondary industry is induced as some function of the net increase of manufacturing employment growth over agricultural employment decline, the growth of secondary industry is also expected to continue.

The conceptual dynamics of the rural employment growth process are illustrated in Figure 1. For a given level of market availability

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[1] Haren (14) and Haren and Holling (15).

[2] See Summers (30) and Haren (14) for a discussion of these points.

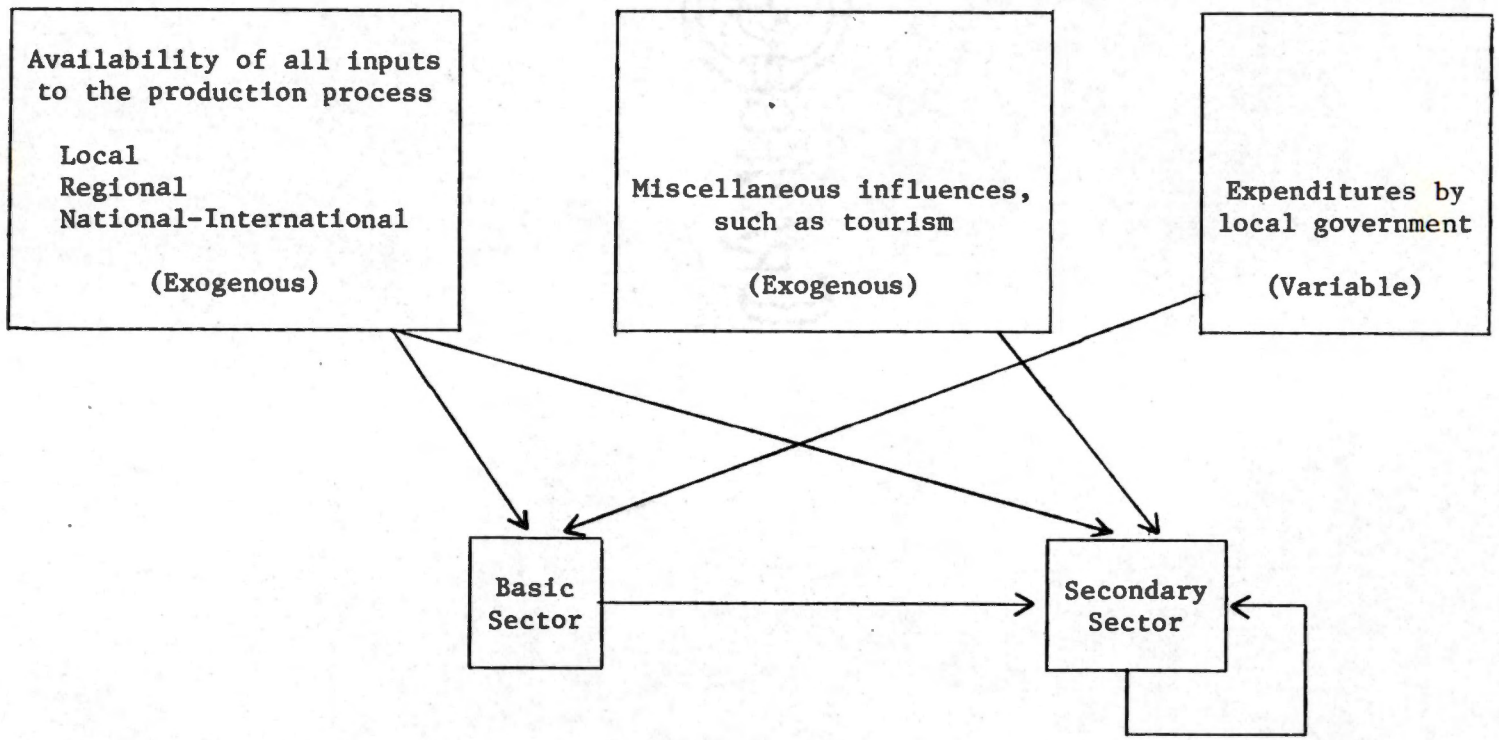


Figure 1. Flow of influences on rural industrial growth.

and exogenous influences, the expenditures by local government for the provision of an infrastructure have a direct effect upon the employment levels in the basic sector. In addition, employment growth in the basic sector induces growth in the secondary sector. Some industries comprising the basic sector purchase inputs directly from some industries of the secondary sector, and income earned by persons employed in the basic sector is spent for goods produced in the secondary sector. Lastly, industries of the secondary sector purchase goods from one another, and labor income generated in the secondary sector is also spent there.

A common problem faced by many rural communities has been the ability of community leaders to influence plant location decisions so that the community can realize the direct and induced employment effects from the location of manufacturing industries.[3] Some of the financial inducements to location have been community expenditures for industrial parks; the provision of community services; improved highways, police and fire protection; health care and hospitals; parks; and changes in the property tax rate.

A second problem has been the tendency for employment, particularly in the manufacturing sector, to be unstable about its trend. This instability may be illustrated by Figure 2, which shows plots of the actual values of total employment in Tennessee of the manufacturing (Y_1), wholesale and retail trade (Y_2), and service industries (Y_3), respectively, around linear OLS functions, with time as the dependent variable. The coefficients of determination indicate the relative instability of

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[3]See U.S. Department of Commerce publication (35) for details.

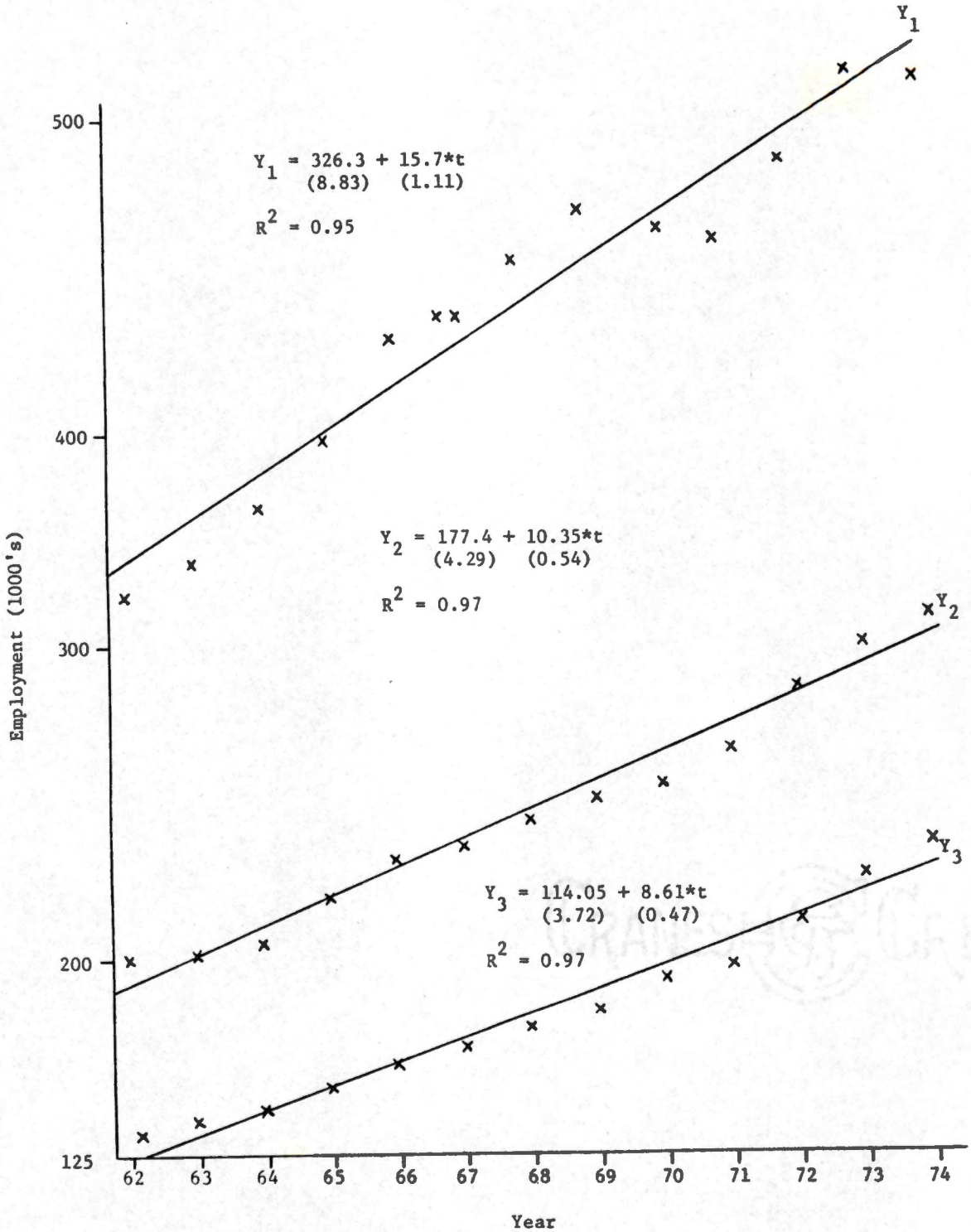


Figure 2. Comparative growth in employment.

employment in these industries over time. The manufacturing sector is very sensitive to national economic trends, as indicated by the values above trend in the late 1960's which turn below trend during the 1970-71 recession. The apparent cyclical tendency in the wholesale and retail trade and service industries disappeared when the natural log of the employment in these sectors was regressed against time.[4]

Information in a study by Gunter (12) can be used to illustrate the magnitude of employment instability generated by the cyclical nature of the economic growth process and by wrong decisions of industrial decision-makers. During the period from 1967 to 1973, 296 plants located in 105 rural Tennessee communities and directly generated 20,138 new jobs. Of these 296 plants, however, 56, or approximately 19 percent, discontinued operation during the same period, resulting in 2,347 jobs, or 12 percent, being terminated. During the 1967-73 period, the 296 locating plants expanded their operations to include an additional 17,965 employees. Plant contractions for the same period amounted to a loss of 5,710 jobs. A potential of 38,124 new jobs in the basic sector were created in Tennessee by plant locations and expansions during the 1967-73 period. When adjusted for job losses of 8,057 due to plant contractions and closings, the net increase in new basic sector jobs was 30,046, approximately 79 percent of the total possible number of jobs.

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[4]The coefficient of determination improved to 0.99 for both secondary sector equations and declinsed to 0.93 for the manufacturing sector when the single logged equation was estimated. Rates of growth for the former two sectors were estimated to be 4.12 and 4.9 percent, respectively. A comparison of the best results for the manufacturing sector (linear) with the best results for the secondary industries (single logged) underscores the relative instability of manufacturing employment.

The regression equations (Figure 2) and the computations provided by Gunter illustrate the magnitude of annual fluctuation in employment, particularly manufacturing, which occurs in Tennessee. These fluctuations exist at the county level, and, in fact, their real magnitude may be dampened somewhat in the averaging process used to obtain state totals. In addition, the interaction between manufacturing (basic sector) employment and secondary employment may result in fluctuations in secondary sector employment if the fluctuation in manufacturing employment is great enough or a secular decline in the growth rate of manufacturing occurs.

In summary, actions by local agencies and exogenous influences combine to yield fluctuating basic and secondary employment. Without quantitative estimates of the impacts of the forces behind the fluctuations, public policy instruments directed toward influencing rural employment and private investment decisions may be relatively less effective.

1.2 STUDY OBJECTIVES

The objective of the study was to develop an econometric model capable of explaining the variability of basic and secondary sector employment among rural Tennessee counties and over time. Consequently, the model was both cross-sectional and longitudinal. Employment projections for individual counties were made from one to five years after the last time period included in the model's structure. The employment projections should be of use to the private sector in ascertaining the optimum county for the location of private business enterprises and the

"potential" employment of these counties based on changes in local government spending on infrastructural facilities. Details of the model are identified in Chapters 3 and 4.

Summary of the Model

A major hypothesis of the study was that rural communities may be characterized by economies of localization and urbanization which determine the distribution of total manufacturing employment among the rural counties. Localization economies result from a concentration of firms creating ". . . a research institute, marketing organizations, and other collective facilities that individual manufacturers would be unable to provide for themselves" (28, p. 84). Localization economies may also result from access to higher quality labor, specialized educational institutions, and input and output markets. Urbanization economies arise from the agglomeration effects associated with a highly developed infrastructure and large population base. The components of localization and urbanization economies were assumed to provide services to a finite set of factors and to function as complements to one another. For example, the effectiveness of the services provided by market availability in generating manufacturing employment were assumed to be dependent upon a complementary set of services provided by other components.

The logical consequence of viewing economies of localization and urbanization as inputs into the production process is that counties which are similar in these dimensions may be considered as belonging to a similar "economic matrix." These counties were hypothesized to specialize in the production of similar goods which may be produced comparatively cheaper in that matrix than elsewhere. The optimal

location of a particular type of manufacturing industry would be in a county which was located in an economic matrix where a comparative advantage exists in producing that type of product. An additional hypothesis was that spatial correlation exists among rural counties on each dimension of these economies. Therefore, employment was expected to be affected by the magnitude of these economies, and employment growth was expected to be geographically clustered.

The structure of the model is recursive. The total employment in the state for the manufacturing sector is taken as exogenous, and its distribution among rural counties is explained by variables representing the distribution of the localization and urbanization economies amoung counties. The residuals of the manufacturing sector equation are hypothesized to be linearly uncorrelated with the residuals of the secondary sector equations so that the two blocks of equations may be separatively estimated. The observed levels of local employment in the basic sector--manufacturing and agriculture--are then incorporated as explanatory variables into a simultaneous equation system explaining local employment in the secondary industries--construction, wholesale trade, retail trade, finance, services, and miscellaneous. Other explanatory variables in the simultaneous secondary system are the employment levels of secondary industries which are linked through product demand relationships.

The normative projections of employment in the seven industries comprising the model are constrained by parameters manifesting the past structure of rural employment growth, and, as such, the projections are conditional upon the persistence of that structure into the future. The use of annual data suggests than an average of previous structures was

estimated and that the influence of the most current structure on future employment is biased by the inclusion of past structures such that future observed employment may lie outside the normative forecast range provided by the model. This is a common problem in economic analysis where a long time series is used.

Future values of the total basic sector employment are substituted into the model to determine the distribution among rural counties of future basic and secondary sector employment, given a constant relative distribution of localization and urbanization economies among the rural counties. The effect of local policy decisions on future employment is determined by varying the level of local government expenditures on the local infrastructure, a dimension of urbanization economies.

1.3 USEFULNESS OF THE MODEL

The most common method of explaining employment growth at the local level has been through the development of specific income and employment multipliers (1, 3, 18, 21) from primary data. These multipliers are generally restricted to explaining employment and/or income changes in the secondary sector induced by exogenous but unexplained changes in basic sector employment. In addition to not explaining the level of basic sector employment for each county, the input-output method may be extremely expensive when applied to all rural counties of Tennessee. The econometric model developed in this study attempts to explain manufacturing employment levels in rural counties and to link

those levels to employment in the secondary sector.[5] Although less refined than input-output models, the econometric approach is also less expensive. The usefulness of the model lies in the normative projections of manufacturing and secondary sector employment and in the parameters of the recursive system of equations.

Uneconomical industrial growth may occur because of a lack of information regarding actual production costs in rural counties or because of poor judgments made by private industry officials based upon available information. The normative projections are assumed to be roughly accurate during the intermediate term (five years) so that counties with observed employment farthest from the projected levels may be counties in which industry has grown at a rate faster or slower than warranted by economic considerations. In choosing optimum counties for location, industry may select those counties with observed employment levels farthest below the projected values for more refined feasibility studies. The model than functions as a filtering process in its capability of presenting to decision-makers counties which are arrayed according to their relative "possible" feasibility for industrial growth.

The parameters of the basic sector are distribution coefficients which provide estimates of the proportion of total basic manufacturing employment in the state distributed to rural counties as a linear function of their levels of localization and urbanization economies. These

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[5] An equation explaining agricultural employment in the rural counties was not estimated because of difficulty in obtaining reliable employment data for agriculture. However, agricultural employment was used to explain secondary sector employment in order to minimize the bias of not including a relevant correlated explanatory variable.

parameters provide estimates of the distribution of economic advantages among rural counties in manufacturing growth and relative magnitude of future growth. The parameters of the secondary sector subsystem are multiplier coefficients which give the change in employment of an endogenous sector in response to a change in employment of an explanatory variable. The multiplier coefficients may be used to assess the optimum amount of growth in employment in linked sectors once accurate estimates of employment in exogenous industries are made.

The influence of local government policies in generating employment through investments in the local infrastructure may also be estimated by the model. Counties with low normative employment levels, for example, may increase their employment levels by increasing the level and/or distribution of expenditures of infrastructural characteristics.

1.4 ORGANIZATION OF THE DISSERTATION

The following chapter reviews recent empirical and theoretical models of rural industrial growth. The manner in which the present study circumvents the shortcomings of the various models is illustrated. In addition, the review of theoretical literature suggests a method to measure the location and urbanization economies responsible for the distribution of manufacturing employment among rural counties. Chapter 3 presents and discusses how the variables underlying location and urbanization economies actually affect rural manufacturing employment. The dynamics of the seven-industry model is also discussed in Chapter 3. Chapter 4 develops measures of the urbanization and location economies

by means of factor analysis. Chapter 5 tests the structure of the seven-equation econometric model and its forecasting capabilities. Chapter 6 summarizes the major findings, discusses the shortcomings of the study, and offers suggestions for future research.

CHAPTER 2

REVIEW OF LITERATURE AND DEVELOPMENT OF THEORETICAL CONCEPTS

2.1 REVIEW OF EMPIRICAL MODELS OF MANUFACTURING EMPLOYMENT GROWTH

There are only a limited number of models explaining industrial growth in rural areas. The studies reviewed here were concerned primarily with manufacturing employment and used communities, counties, or regions as units of analysis. Smith, Deaton, and Kelch (SDK) (29) used rural Tennessee and Kentucky counties as observations to explain the location of manufacturing plants within a limited time frame. Gunter (12) used rural communities (towns) as units of analysis to explain the expansion of previously located plants as a function of community economic characteristics and national economic trends. Dorf and Emerson (8) aggregated the employment caused by both location of new and expansion of old industries in a cross-sectional model of increases in plants having over 100 employees and of increases in total employment changes for plants of over 100 employees. The units of analyses were a sample of nonmetropolitan communities from the seven states comprising the West North Central region of the U.S. and the explanatory variables were regional economic factors. The pooled cross-sectional, time series study by Olsen et al. (24) explained the employment levels in several different manufacturing industries at three points in time (1950, 1960, 1970) over 702 regions in the U.S. as a function of the corresponding area

characteristics and national economic trends. The effect of the national economic trends upon a region were measured by computing conceptually appropriate gravity coefficients for each area. The resulting explanatory power of the model was quite good.

These cross-sectional studies were of value as prototypes in developing measures that explained cross-sectional differences in manufacturing employment. The first three studies, in particular, tended to be somewhat weak on a conceptual basis. Although the dependent variables were measured as changes over a time interval, the models by SDK and Dorf and Emerson did not explicitly incorporate the effects which national economic growth over the respective time interval would have had on the entire study region. This and the aggregation of dissimilar industries may have been a major factor leading to the relatively low explanatory power of the models (unadjusted R^2's ranging from 0.22 to 0.43 for SDK and from 0.30 to 0.63 for Dorf and Emerson). Gunter incorporated the effects of national economic trends through the use of change in value of input and output indices. The use of these indices and the aggregation of dissimilar industries may have also reduced the potential explanatory power of Gunter's model (an unadjusted coefficient of determination ranging from 0.02 to 0.2 depending upon the model variation). These points are further discussed below.

The weaknesses of the models discussed above provide a criteria for measuring the acceptability of the multi-industry employment model presented in Chapters 3 and 4. These weaknesses are:

1. The aggregation of industries with dissimilar production functions.

2. The use of value indices for measuring the effects of material input and output prices which are derived from national markets.
3. The aggregation of employment resulting from the separate decisions of industrial location and expansion.

The Aggregation Problem and the Use of Value Indices as Proxies for Prices (a-b)

Gunter's single equation model (12), explaining the expansion of 20 two-digit SIC-coded industries between 1967 and 1973, may be used in illustrating the bias caused by weaknesses 1 and 2. Gunter's dependent variable was the change in employment between 1967 and 1973 which occurred in each of the 20 industries in 72 rural communities. The explanatory variables of this cross-sectional change in labor demand model include:

1. The change in wage and materials cost differentials between plants in Tennessee and the nation corresponding to each of the 20 industries.
2. Thirty-two community characteristics, reduced to two composite community factors by factor analysis for each of the 72 communities.
3. A nationwide change in the value of shipments index corresponding to each industry as a measure of national demand.

An implicit simplifying assumption was that labor supply was perfectly elastic.

Conceptually, Gunter's model might better have consisted of 20 separate equations, one for each industry. This can be illustrated by assuming away any other bias. The explanatory variables associated with the change in the labor demand equation of each industry, such as the change in the value of shipments indices, P_{22} and P_{25}, and the unique production function of each industry give rise to the unique change in the labor demand equations [Henderson and Quandt (16), p. 69], such as SIC_{22} and SIC_{25} in Figure 3.[6] Lease squares estimation of this aggregated data results in an average labor demand function being estimated.

In addition to being theoretically unappealing, the estimation of an average function results in the percentage of total variance explained being different from that associated with either of the individual demand functions, as expressed by comparative R^2 values. Two extreme cases may be used in illustrating that the R^2 associated with the average function may be higher or lower than that associated with either individual function. In panel a of Figure 4, the individual regression functions are horizontal lines which imply that none of the deviations from the mean value of the dependent variable are due to regression. As a consequence, both R^2_{22} and R^2_{25} are equal to zero, but the R^2 of the average function is greater than zero. In panel b, the opposite case occurs, and the R^2 of the average function is zero. The coefficients of determination ranging from 0.02 to 0.10 in the six variations of Gunter's model may partially be accounted for by this problem.

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[6]The industries corresponding to SIC_{22} and SIC_{25} were used for illustrative purposes.

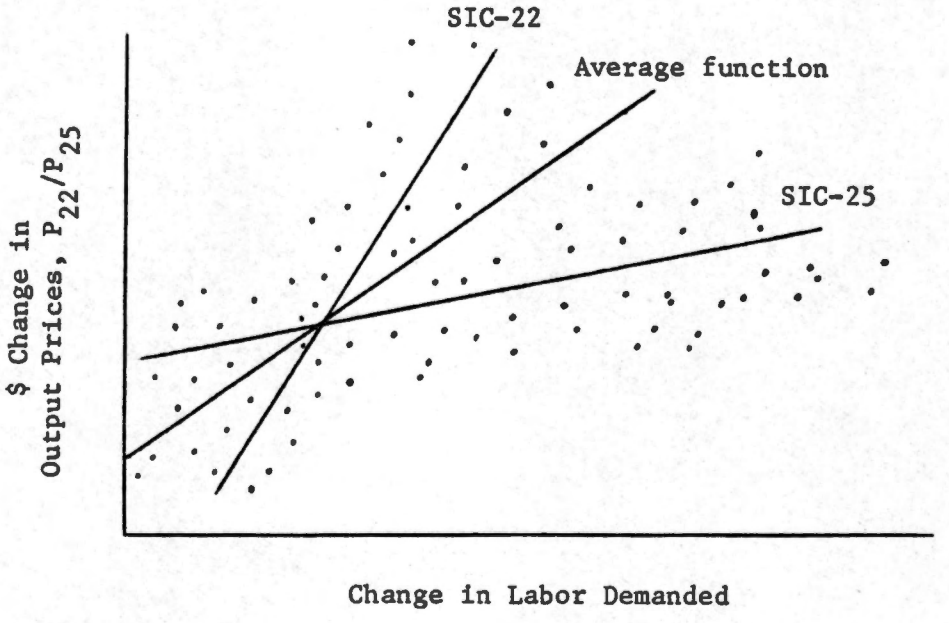
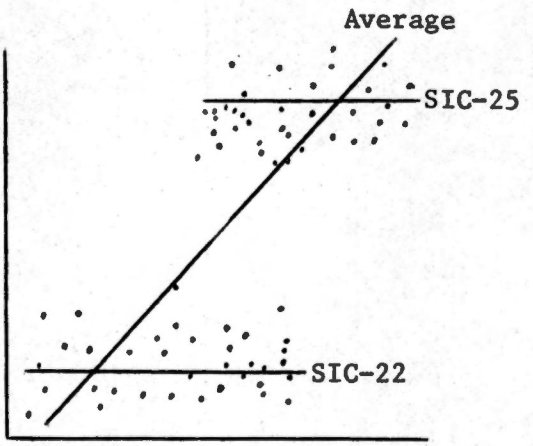
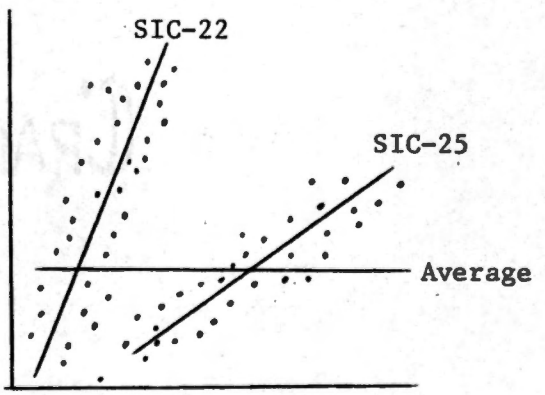


Figure 3. Illustration of the problem in aggregating change in labor demand functions--plotted in labor-output price space.



Panel a



Panel b

Figure 4. The effect on R^2 of estimating an average function.

The use of value indices may also bias the coefficient of determination downward. Value indices are often used because 1) they are a succinct method of representing the influence of many inputs and outputs, and 2) because it is difficult to impute particular input and output prices as being relevant to broad classes of industries. In Gunter's study, a high change in the nationwide value of shipments index was assumed to represent an increase in the level of output demand, while a high change in the materials cost index represented a decrease in input supply. The former was hypothesized to result in an increase in labor demand and the latter a decrease in labor demand. The benefits of using change in value indices as explanatory variables in a linear system must be weighed, however, against the introduction of specification error caused by the tendency of a nonlinear relation between the value indices and labor demand to exist and possibly to bias the direction of the relationship.

A change in the nationwide value of shipments, for example, may occur because of 1) a shift to the right in the national demand function for that industry or 2) a shift in the supply function of the rest of the industry caused by factors exogenous to the study region. As noted in Kmenta (34, p. 400), the estimation of a linear relationship when a nonlinear relationship exists leads to biased and inconsistent estimates of the regression parameters.

In addition, a shift in the industry supply function results in a positive relationship between employment and the value of shipments only if the demand function is inelastic. For example, a leftward shift leads to a higher product price and implies greater local employment, but the

expected positive relation between local employment and the value of shipments will only be estimated if an inelastic demand function has resulted in an increase in the value of shipments. It is clearly possible that offsetting changes in the national supply demand structure might lead to no change in the value of shipments, but an output price change that would actually induce a change in labor demand.

An analogous set of arguments can be made for input supply shifts that face the local industry and the effect of national shifts in demand for inputs on local industrial growth.

The Distinction Between Industrial Location and Expansion (c)

A third type of estimation problem is encountered when the employment level of previously existing industry is aggregated with the employment created by newly located plants. The fitting of a linear relation between industrial employment and an appropriate price index, if available, from time series data may result in less than maximum variance explained because of the discrete nature of the industrial growth process.

These elements of industrial growth are presented in Figure 5. The expansion of existing industry occurs along (a) in response to changes in an index of exogenous price variables, I. Throughout region (a), economic profits accrue to the existing industry in the county. A new plant will not locate in the county until economic profits are at a level at which the location of a new plant will not drive them below zero. This occurs when the index of exogenous variables reaches (b). The location of new plants at (b) drives down economic profits, but

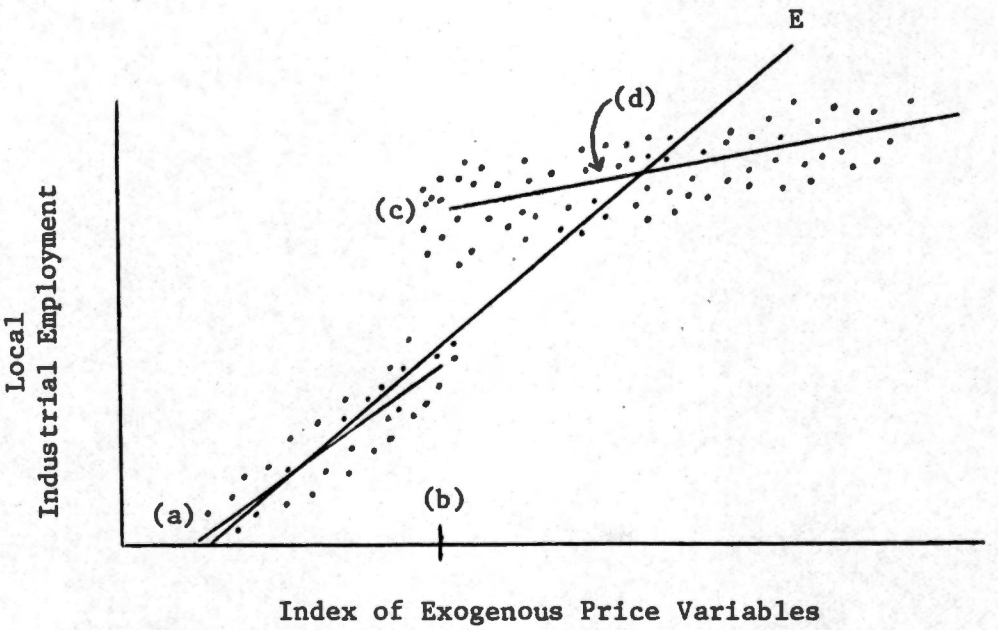


Figure 5. The discrete-continuous nature of the industrial growth process.

assures that economic profits to itself are nonnegative after all adjustments by other plants in the local industry are netted out. Some old plants may contract their employment levels while others may close down operations completely. The net effect of these adjustments and the new plant locations is represented by (c). The local industry then continues expanding along (d) until another threshold is reached, at which a similar set of adjustments is assumed to occur. Segments (a) and (b) may have different slopes, depending upon the technological structure of the new plants and any which have ceased operations at (c).

The two discrete functions comprising the industrial growth process are segments (a) and (d) in Figure 5. An estimated function, represented by line E, clearly results in an amount of variance explained which is less than would occur if the two discrete functions, (a) and (d), were estimated. Since it is not always easy (particularly inexpensive) to collect employment data on individual plants, the discrete segments may not be estimated.

The above conceptual weaknesses are not present in all models of rural employment, but have been discussed in order to better avoid them.

A number of elaborate econometric models estimated from time series data for small regions have successfully circumvented the problem of measuring the influence of national trends (2, 10, 20). The simplest model was that of Glickman (10), where the value of output for the Philadelphia SMSA region was specified solely as a linear function of United States gross national product. If it can be assumed that employment is roughly a linear function of output, then employment in the export industry (manufacturing) of a region can be specified as a linear function

of manufacturing employment in some relevant larger region, such as the entire U.S., or the state of Tennessee if Tennessee counties are the units of analysis. This assumes that influences caused by spatial redistribution of industry in the larger region and changing transportation costs are highly correlated with total employment.

Total manufacturing employment in Tennessee was used as an explanatory variable in order to circumvent the problems of using value indices because it has resulted from the interaction and spatial redistribution of the national supply-demand structure of inputs and outputs for all industries. As an aggregated variable, total manufacturing employment implicitly incorporates the distribution of industrial employment by types for all counties within the state. An important assumption of the study was that each type of manufacturing employment in the state was a linear function of the total, and each type of industrial employment in each county was a linear function of the total for each type of manufacturing industry. Total manufacturing employment in each county was therefore estimated as a linear function of the state total, that is

$$(1) \quad M_{ct} = C_{ct} \cdot M_t^T,$$

where M_{ct} is the total manufacturing employment in county c at time t, M_t^T is the total manufacturing employment in the state at time t, and C_{ct} is a distribution parameter. The distribution parameter was hypothesized to be a linear function of the economies of urbanization and location which varied among counties and over time. The distribution parameter may be expressed as

$$(2) \quad C_{ct} = a + \sum_{i}^{I} a_i \cdot F_{ct}^{i},$$

where F_{ct}^{i} represents the i^{th} factor underlying the localization and urbanization economies.

No statistical means of avoiding the problem of aggregating employment caused by location and expansion was used. Instead, it was hoped that the utilization of employment data would cause it to be averaged out among counties and over the many types of manufacturing industries aggregated into M_t^T.

2.2 REVIEW OF INDUSTRIAL DEVELOPMENT LITERATURE

The empirical models reviewed in Section 2.1 have theoretical foundations based on highly aggregated, Keynesian-type theory. Highly aggregated theory, and the Keynesian type in particular, conceptualizes growth in terms of employment, income, investment, and other broad indicators, while giving little attention to the micro-determinants of rural growth. This section reviews three bodies of theory useful in explaining rural manufacturing growth from a micro perspective. Each theory has a unique contribution to offer in developing a general theory of rural manufacturing growth, although overlap exists in what each attempts to explain and its method of doing so.

These theories discuss the influence of national economic trends upon the industrialization process of rural communities as these trends are constrained by the distribution of localization and urbanization economies among rural counties.

The Staple Theory of Economic Development

The staple theory of economic growth postulates that self-sustained regional industrial development depends upon the region's ability to capture the "surplus" generated by export-oriented industries which have located in the region, and channel it into a diversified industrial base comprised of industries which are backward and forward linkages to existing industries and final demand or secondary sector linkages. The major question addressed by the staple theory is that of why some communities are able to diversify, particularly to a secondary sector, while others remain tied to a single export sector, with the former, as was illustrated by Figure 2, p. 4, being more sensitive to national economic fluctuations. North (23) breaks the answer into two facets: ". . . a) the natural endowments of the region, and b) the production functions of the industries comprising the industrial base."

The natural endowments of the region include primarily the availability of labor, natural resources, the availability of basic and secondary sector products used as inputs in linked basic and secondary industry, and the infrastructural characteristics of the community. The influence which natural endowments have on the economic diversity of a region may be expressed as a quote from North (23, p. 945):

> The natural endowments of the region dictate the initial export commodities of the area. If these endowments are such as to result in a tremendous comparative advantage in one commodity over any other, then the immediate consequence will be for resources to concentrate upon its production. If, on the other hand, the region has broad production possibilities, such that the rate of return upon the production of a number of goods and services is not too much less than upon the initial export commodity, then with the growth of the region and accompanying change in factor proportions, the production of other goods and services is likely to be a simple process.

The production function of the industrial base determines the distribution of income, which has significant effects upon the development of the secondary (consumer goods) sector. North (23, p. 946) states that:

> With the more equitable distribution of incomes, there is a demand for a broad range of goods and services, part of which will be residentiary, thus inducing investments in other types of economic activities. There will tend to develop trading centers to provide a wide variety of such goods and services. . . .

In addition to facilitating the demand for consumer goods, an industrial base which fosters a more equal distribution of income also contributes to the development of more and better infrastructural facilities. In conjunction with the demand for goods and supply of factors, the nature of the production function also determines the following: ". . . demand for factors; demand for intermediate inputs; possibility of further processing," and through these, the range of domestic investment opportunities and the extent of industrial diversification.

In summary, as demand for the export good increases, the resulting income flowing to the export sector will find its way into productive investments in both the export (basic) and consumer (secondary) sectors. Watkins (38) notes that:

> . . . by classifying these income flows, we can state the staple theory in the form of a disaggregated multiplier-accelerator mechanism. In classifying investment flows in this capital theoretic manner, the associated multiplier coefficients may be categorized according to whether they correspond to investments in forward, backward, or final demand linkages.

The Role of Linkages in the Industrial Development Process

Gupta (13), in his summary of Hirshman's unbalanced growth theory, lists a number of factors responsible for the development of backward,

forward, and final demand linkages in an economy which parallel North's two diversifying influences.

Backward linkages are those in which inputs are produced for the expanding export sector. The location and size of plants which are backward linkages depends on the demand for inputs of the export industry to which they are linked, and the relative prices at which the inputs can be produced. The following conditions increase the probability of a backward linkage developing, and affect the size of the linkage:

1. The size of the input-using industry.
2. The ability of a locating industry for the output of the locating industry.
3. The joint demand by several industries for the output of the locating industry.
4. The ability of the locating industry to produce multiple products which satisfy the needs of several industries.
5. The ability of the locating industry to also produce a product, or products, for final consumption purposes, as well as for use in the industrial sector.

In general, an industry is more likely to become a backward linkage to industries which 1) acquire a high percentage of their inputs from the linked industry, 2) produce a large volume of output, 3) use homogenous inputs, and 4) have many industries using their inputs.

Forward linkages are those in which an industry uses the output of the exporting industry as an input into its own production process, thus transforming the export industry into an industry partially oriented

to the domestic market. The important determinants of the existence and size of this linkage are the nature of the input sector, the production function of the forwardly linked industry, and the nature of its market. Specifically, these conditions are the following:

1. The use, by a locating industry, of a high proportion of products produced by an input-producing industry.
2. The ability of input-suppliers to produce large volumes of inputs, so that economies of scale are in effect, resulting in lower prices.
3. The use, by the locating industry, of many locally produced inputs so that transportation costs may be minimized.
4. The use of the output of locating industry in may markets.
5. The larger and closer the markets are to the point of production.

Final demand linkages are those which industries develop which produce consumer goods for domestic consumption. Final demand linkages are identical to forward linkages, with the exception that markets are restricted to those of the domestic consumption sector. Therefore, the development of final demand linkages in the community depends upon the same set of conditions as the development of forward linkages, as well as the level of distribution of local income caused by the production functions of the basic industries.

Scitovsky (27) summarizes the factors responsible for the development of backward, forward, and final demand linkages in an economy. An existing industry of greater scale induces a greater scale in backwardly linked industry by providing a larger market for its outputs. A larger

scale in forwardly linked industries is induced by a larger existing industrial base because of economies of scale that normally characterize large-scale industries provide inputs to forwardly linked industries at less cost. The diversity of the existing industrial base induces greater industrial growth in backwardly linked industries because their market potential is enhanced. Similarly, a large and diverse industrial base has a greater potential for providing many inputs to forwardly linked industries. Since many products find their way to the local retail market, the size of this market, as measured by regional population and income, is also hypothesized to affect industrial growth.

The Urban-Industrial Impact Hypothesis[7]

The urban-industrial impact hypothesis may be used in illustrating why industrial linkages are more efficient when industries are clustered together and the importance of broader types of urbanization and localization economies. This theory was intended to explain why entire communities tend to lag behind other during the development process and is best described by three propositions:

1. Economic growth in a region occurs at different times and at different locations, as contrasted to a generalized process which proceeds at a constant rate in all places.
2. The centers of growth are primarily urban-industrial in composition.

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[7] This discussion draws on Nichols (22), Schultz (26), and Bryant (4).

3. Market efficiency is highest at or near the center of a particular matrix of development.

The driving force behind regional growth in the model is factor market efficiency which is due to the agglomeration effects associated with urban-industrial centers.

First, the expansion of industrial jobs increases the number and variety of jobs available to previously unemployed or underemployed workers. This increases the subjective probability of obtaining a job and fosters migration from lower income regions, thereby maintaining the wage rates at levels consistent with the marginal value products of the various labor groups, which is an inducement to further industrialization. As some of the older industries become more capital-intensive, portions of this larger and more diverse labor force become available to newly locating firms. Skills may also be passed down easier to new workers when they have frequent opportunities to come in contact with seasoned workers, as they do when the work force is concentrated and diverse. The maintenance of a competitive wage rate in a region of many industries and a large labor force means that the location of a new industry will not significantly influence the prevailing wage rate by virtue of its location. Therefore, the firm can be more confident of 1) more accurately forecasting its labor costs, and 2) the future insignificance of variations in labor costs.

Secondly, the urban-industrial center mobilizes savings, which can be made available to industry at relatively low rates of interest. This combination of changes in the factor markets decreases the capital-labor price ratio, thus fostering the substitution of capital for labor.

However, the expansion effect of the decrease in capital costs causes an increase in labor usage which nets out the decrease in labor associated with the substitution effect.

Thirdly, as incomes in the community increase, demand is created for agricultural products and consumer goods, which makes specialization of agricultural production and the location of consumer goods industries feasible. This is especially important because it signifies the transformation of the industrialization process from one depending largely upon national demand shifts to a process which is more dependent upon regional economic conditions.

Fourthly, benefits accrue to a concentration of similar firms in the the same industry. A firm may gain access to labor with special skills, or to educational institutions which specialize in training labor for the jobs required by that industry. Economies necessary for developing ". . . a research institute, a marketing organization, and other collective facilities that individual manufacturers would be unable to provide for themselves. . . ." also exist.[8] A region with a high concentration of similar industries may also be expected to have numerous ". . . machine makers and repaireres, suppliers of components, containers . . . and other industries ancillary to the main one and providing goods and services for it." In general, small firms are more likely to realize these economies because larger firms ". . . create economies internal to themselves which others have to obtain externally."

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[8]The quotations in this and the following paragraph are from Smith (28, p. 84).

Fifthly, any type of firm locating in an urban-industrial matrix may realize economies associated with a highly developed infrastructure which may be expressed directly ". . . through the reduced cost of specific inputs." An infrastructure includes such items as utilities, transportation and communication facilities, research organizations, educational institutions, and other characteristics which may vary by community. The inputs to the firm, through which reduced costs are expressed, are the outputs of the various facets of the infrastructure.

The urban-industrial impact model, to quote Schuh (25), contains several limitations. It

> . . . says little about which communities among the many possible candidates should be encouraged to grow, . . . what economic activities should be encouraged in those centers, . . . or how to make those chosen poles grow.

However, the integration of the urban-industrial model with the staple theory and Hirshman's theory of industrial linkages provides several propositions useful in formulating a model of rural industrial growth.

2.3 THE CONTRIBUTION OF THE THREE INDUSTRIAL DEVELOPMENT THEORIES IN DEVELOPING A GENERAL THEORY OF RURAL INDUSTRIAL GROWTH

The propositions derived from the review of literature in the previous section are described in Figure 6, which is a refinement of Figure 1, p. 2. One major proposition is that the distribution of localization and urbanization economies among all counties in the state (rural and SMSA) and the spatial distribution of manufacturing industry markets outside the state, which represent the national market influences,

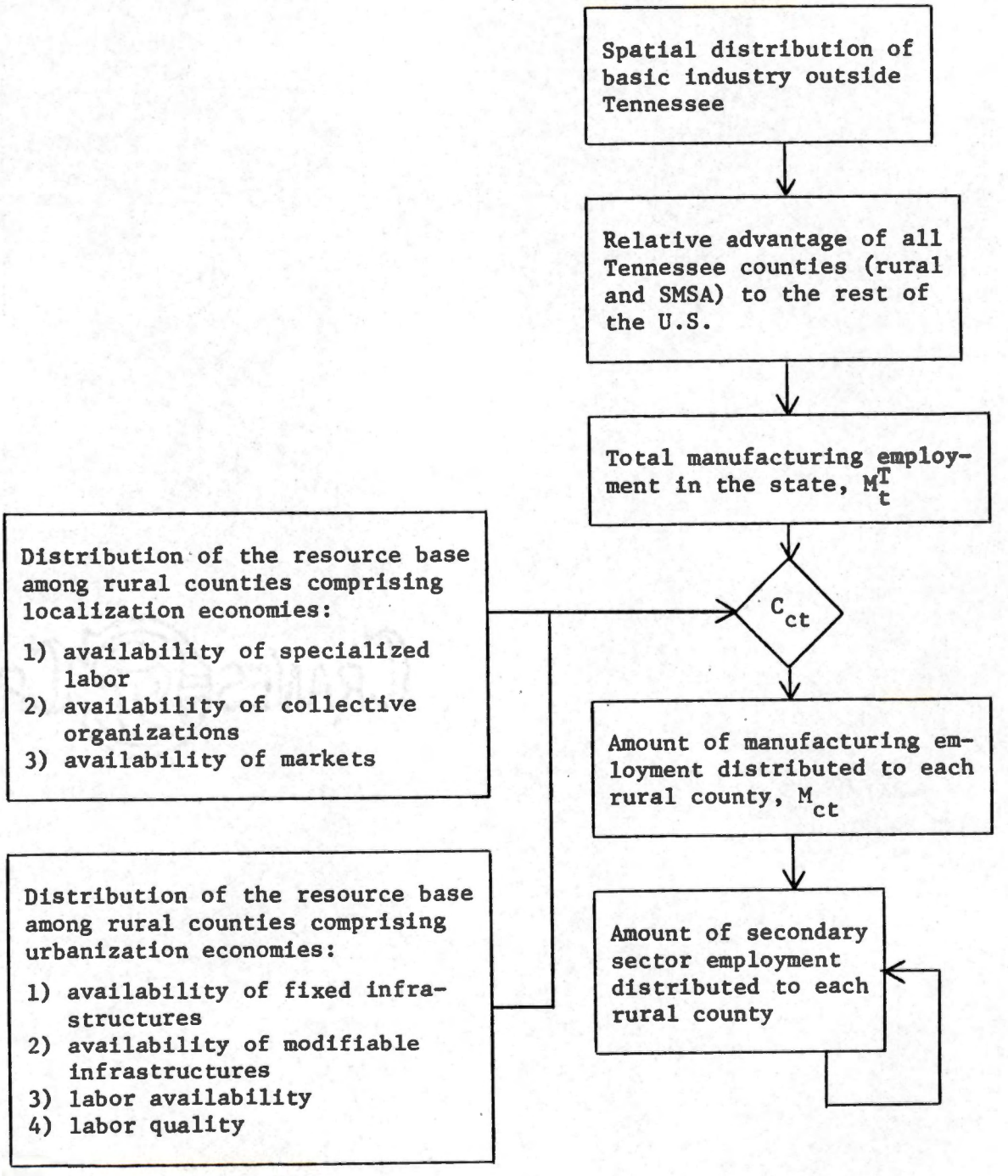


Figure 6. Refined conceptual model of rural industrial growth.

together determine the quantity and distribution of manufacturing employment available in the state. A corollary is the hypothesis that the distribution of economies of localization and urbanization in Tennessee relative to the rest of the United States has created an economic advantage in Tennessee for a constant distribution of types of manufacturing industry because of the "natural endowments" of Tennessee relative to the rest of the United States. These include the types of natural resources available in the state, the previously existing distribution of industrial linkages, and the urban-industrial characteristics which facilitate efficient market structure and create external economies in production. This hypothesis may be described by the equation

$$(3) \quad M_{it}^{T} = a_i + b_i \cdot M_t^{T},$$

where M_{it}^{T} is the total employment of industry i in year t, and M_t^{T} is the total manufacturing sector employment in Tennessee. If equation (3) is a true representation of manufacturing employment growth and if, as a second corollary, manufacturing employment in industry i of county c, M_{ict}, is a linear function of total employment for that industry in the state, that is

$$(4) \quad M_{ict} = d_{ic} + e_{ic} \cdot M_{it}^{T},$$

then total manufacturing employment in county c, M_{ct}, may be represented by a linear distribution function

$$(5) \quad M_{ct} = \sum_{i}^{I} d_{ic} + \sum_{i}^{I} e_{ic} \cdot a_i + \sum_{i}^{I} e_{ic} \cdot b_i \cdot M_t^{T} = \sum_{i}^{I} M_{ict} = C_{ct} \cdot M_t^{T},$$

which is identical to equation (2).

Data limitations prohibited the testing of equations (3) and (4). Instead of being empirically validated assumptions, these equations were accepted as maintained hypotheses (i.e., untested) for the purpose of justifying the estimation of the manufacturing employment distribution equation (5). The structural validity of equation (5) rests on the reasonableness of these assumptions, however.

A second proposition was that employment in the secondary sector was determined by expenditures made by employees in the manufacturing and agricultural sectors, supply and demand linkages between manufacturing and secondary industries, and the induced income expenditures among the industries comprising the secondary sector. The supply and demand linkages between the manufacturing and secondary industries and among industries of the secondary sector were assumed to be represented as a linear function of employment in those industries.

The theories developed from the review of literature form the conceptual base for the model used in this study. In summary, three points should be made. First, total manufacturing employment was used as the variable measuring the influence of national economic trends upon manufacturing employment in all Tennessee counties. Secondly, the literature review supported the maintained hypothesis that different types of manufacturing employment may be distributed among rural counties as a function of the distribution of economies of urbanization and location among the rural counties. Lastly, the structural form of the distribution of individual types of manufacturing employment as a function of the state total was assumed to be linear.

CHAPTER 3

THE CONCEPTUAL MODEL

3.1 THE MEASUREMENT OF LOCALIZATION AND URBANIZATION ECONOMIES

No fully acceptable means of measuring the economies of localization and urbanization was found in the literature, but as Dorf and Emerson (8) note, several variables are commonly factor analyzed in order to reduce the data into a succinct set of uncorrelated factors. The only a priori reason for expecting uncorrelated factors to adequately represent localization and urbanization economies was because an earlier distribution of industrial structure among the rural counties may have resulted in the development of specialized economies among the counties. More importantly, the mathematical solution for correlated factors is indeterminant unless previous theoretical and/or empirical research exists to suggest the degree of correlation to impose on the factors.[9]

The studies (8, 12) which have attempted to measure community-specific characteristics via factor analysis have led to the conclusion that five uncorrelated factors may exist. These are:

Urbanization Economies

1. Community and industrial services which vary directly with the degree of urbanization of a county, but which

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[9]The reader should see Gunter (12) for a good overview of the role of factor analysis in industrial development research and Kleinbaum and Kupper (17) or Gorsuch (11) for a mathematical presentation.

are not modifiable by local government policies in the short or intermediate run.

2. Community and industrial services which vary directly with the degree of urbanization of a county, but which may be modifiable at least in the intermediate term by local government expenditures.
3. General labor availability.
4. General labor quality.

Localization Economies

5. Regional industrial linkages supplying input and output markets and collective facilities.

The variables used to measure urbanization and localization economies were constrained by the secondary data available in the 1967, 1971, and 1974 editions of the Tennessee Statistical Abstract (6) and the 1962 and 1972 editions of the City and County Data Book (36). The data were available only at roughly ten-year intervals. Thus, two observations were available for each county for analyzing the growth in rural employment over a twelve-year time period. The assumption was made that accurate annual information was also difficult for industrialists to obtain, and their decisions were extensively based on available census data. Their decisions regarding the location or expansion of manufacturing industry throughout the 1960's was assumed to be based on the 1960 census data, while their decisions for the 1970's were assumed to be based on 1970 census data. Therefore, the values of the 1960 variables were used to cover the period from 1965 to 1970 and the 1970 data were used for the period from 1971 to 1976. The variables used to

measure urbanization economies may be found in Table I. They are discussed below in relation to the four urbanization characteristics outlined above.

Urbanization Economies

Two of the variables used to measure the fixed community and industrial services were variables measuring the degree of health protection. A higher degree of health protection was hypothesized to ensure more productive workers and to increase their opportunity cost of moving from the county. Many other services, particularly the capacity of sewage and water systems, were also hypothesized to be important. The association between these services and the high population levels and densities of urban centers, however, may be illustrated by the correlations in Table II. These correlations indicate a positive association between these two important industrial services and other measurable variables. The quantity of bank deposits was used to measure community and industrial services because they provide funds to both industry and individuals. Lastly, the distance of the county seat to the nearest SMSA was used as a measure because of the industrial and consumer markets available in SMSA counties.

County governments are free to improve their comparative positions at inducing industrial growth through the allocation of local government revenues to various public services. The public services include educational expenditure per pupil, the amount spent on highway development, public welfare, health and hospitals, police protection, natural resources and parks, financial expenditure, and other expenses. These expenditures

TABLE I

VARIABLES MEASURING URBANIZATION ECONOMIES*

Economic Factors		Variables
Non-Modifiable Community Services:		
1	--	Number of doctors
2	--	Number of hospital beds
3	--	Bank deposits
4	--	Distance from the county seat to the nearest SMSA
Non-Modifiable Community Services and Labor Availability:		
5	--	County population
6	--	Population in contiguous counties
7	--	Population density in the county
8	--	Percent of population living in urban areas
9	--	Unemployment rate
10	--	Size of civilian labor force
Community and Industrial Services Other Than Those Measured by Labor Availability and Which May Be Influenced by Local Government Policies:		
11	--	Education expenditure per pupil
12	--	Highway expenditures
13	--	Public welfare expenditures
14	--	Health and hospital expenditures
15	--	Expenditures on police protection
16	--	Expenditures on natural resources and parks
17	--	Financial expenditures
18	--	Property tax rate
Labor Quality:		
19	--	Percent females in the labor force
20	--	Percent of labor force over 25 years of age with a high school education
21	--	Median age of the population
22	--	County per-capita income

*A listing of the sources for these variables may be found in Appendix A.

TABLE II

CORRELATION MATRIX BETWEEN LABOR AVAILABILITY MEASURES AND COMMUNITY AND INDUSTRIAL SERVICES[a]

Labor Availability Measures	Excess Services Available Available in the Community (Gal/Day)	
	Water	Sewage
Community Population, 1970	.70	.72
Population Density in the County, 1970	.34	.43
Percent Urban Population in the County, 1970	.42	.35
Population in Contiguous Counties, 1970	.19	.14
Relative Economic Utilization of Manpower, 1970[b]	-.23	-.14

[a]These correlations were taken from Gunter (11), p. 55.

[b]This was a measure similar to an unemployment rate used by Gunter.

are hypothesized to measure some of the quantity and quality of community and industrial services which are not measured by the labor availability variables. In particular, they are hypothesized to measure that part which is amenable to change based on local industrial development policies. Industry must pay a cost for obtaining the community and industrial services. This cost occurs in the form of property taxes. If the costs of construction and property values are relatively homogeneous among counties, the cost to industries of obtaining these services may be measured by the property tax rate. The tax rate is also amenable to modification by the county.

The third factor was labor availability. Labor availability is made possible by the number and variety of jobs available in urban areas which, according to Todoro (34), draws an excess amount of labor from the countryside, and by the shorter commuting distances involved for employees. The excess amount of labor is hypothesized to vary directly with the population of a county and the population in contiguous counties, given a particular unemployment rate. The shorter commuting distance associated with urban areas may be represented by the population density of the county and by the percent urbanization of the county. Lastly, the per capita income of the county was used as a measure of wage rates.

Conceptually, labor quality (the fourth factor) may be defined only relative to the specific job which the employee performs. However, this relative definition cannot be adequately operationalized, at least in a succinct manner. With these considerations in mind, the following three variables were used to measure labor quality: 1) percent females in the labor force; 2) percent persons 25 years or older with a high

school education; 3) median age of the population; and 4) county level per capita income.

Localization Economies

The region surrounding the county in which localization economies were considered relevant to industries was arbitrarily limited to the county and all contiguous counties. The rationale behind this was that the influence of markets, collective organizations, and specialized labor within this arbitrarily selected region was more pronounced than the effects of these factors from a greater distance away in the state. While the effects of the factors which have their sources outside the state are incorporated in the state total of basic employment, those intrastate market influences not captured by the regional (i.e., the county and contiguous counties) measure of localization economies are included in the error term of the statistical equation that is used to estimate the manufacturing sector distribution equation (5). A large error term was taken to imply that the extra-county by intrastate influences were large.

The variables used to operationalize the concept of localization economies may be found in Table III. These variables were chosen because they were hypothesized to represent the three basic types of localization economies, namely the availability of: 1) specialized labor, 2) collective organizations providing services to industries, and 3) input and output markets. These facets of localization economies were assumed to be highly intercorrelated and also correlated with the magnitude and distribution of employment in industries.

TABLE III

DISTRIBUTION OF INDUSTRIAL EMPLOYMENT USED FOR MEASURING LOCALIZATION ECONOMIES*

Variable Number	Variable Name	Variable Number	Variable Name
1.	Agriculture, Forestry, and Fisheries	11.	Food and Kindred Products
2.	Mining	12.	Textile Mill Products
3.	Construction	13.	Fabricated Textile Products
4.	Furniture, Lumber, and Wood Products	14.	Printing and Allied Products
5.	Primary Metal	15.	Chemical and Allied Products
6.	Fabricated Metal	16.	Other Nondurable Goods
7.	Non-Electrical Machinery	17.	Communications, Utilities, and Transportation Services
8.	Electrical Machinery	18.	Retail Trade
9.	Motor Vehicles and Transportation Equipment	19.	Finance
10.	Other Durable Goods	20.	Other

*A listing of the data sources for these variables may be found in Appendix A.

The variables presented in Tables II and III were reduced into a succinct number of uncorrelated factors which are discussed in Chapter 4. The specific hypotheses regarding the manner in which these derived factors influence manufacturing employment are discussed in Chapter 5.

3.2 THE CONCEPTUAL MODEL

The conventional method of handling differential growth of resources among sectors is to estimate a system of supply and demand equations associated with each sector. A supply and demand equation would be estimated for each input and the final product for each industry. The typical form of an input demand equation would include output price and the prices of other inputs as arguments. The demand equation for final output includes income, price of the output, and the prices of alternative consumption goods as arguments. The supply functions of physical inputs include the price of the inputs and the prices of materials flowing into the production of these inputs, while the supply function of labor contains the wage rate and shifters, such as population.

Physical input prices were difficult to incorporate for three reasons. First, most industries, even those more narrowly defined than the ones being used, process a myriad of inputs, making it difficult to construct indices of input prices, even when the prices of individual inputs are known. Secondly, it is difficult to identify the inputs associated with each industry, and, thirdly, accurate measures of these prices would be difficult. Similar measurement problems are also associated with the quantity of output and the quantity of inputs other than labor. The only variables of the classical model of multi-sector

development capable of being measured directly from secondary sources was the quantity of labor employed in each sector.

The purpose of the discussion in Chapter 2 on the aggregation problem was to illustrate the desirability of disaggregating industrial employment as much as possible. The major limitation to disaggregation is the disclosure law imposed by state government upon the publication of county level industrial employment for an industry comprised of less than 50 employees. This is a particularly common problem at a level of aggregation lower than two-digit SIC-coded industries. Unfortunately, the problem was serious enough to warrant a level of aggregation which was higher than the two-digit level originally desired. Even with the data aggregated into seven sectors, disclosure problems and the lack of county level data for the agricultural sector caused the deletion of many observations from the study.[10]

The multi-sector model consisted of manufacturing and six industries comprising the secondary sector. These six industries were: wholesale trade; retail trade; construction; finance; services; and miscellaneous.[11] The difficulty of obtaining input and output price and

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[10]The original intention was to include data for all 76 rural (non-SMSA) counties for the 15 years of 1962 through 1976--a total of 1,140 observations. The unavailability of county agricultural employee data for 1962 and 1963, plus the periodic unavailability of this data and the disclosure problems of the other seven industries, reduced the total observations to 588. Data for agricultural employment were obtained from the Tennessee Annual Average Work Force Estimates (32) from 1963 to 1973 and from Tennessee Data for Affirmative Action Programs (33) thereafter.

[11]The miscellaneous industries included mining, agricultural services, forestry and fisheries, and other unclassified industries. An equation for agricultural employment was not estimated because of data measurement problems. Agriculture was used as a linked industry in the secondary sector in order to avoid the statistical bias of not including it. However, some bias no doubt remains because of the data measurement problems associated with agricultural employment.

quantity data and the difficulty of collecting good data on wage rates did not allow the development of a complete structural system of equations, even for these seven industries.

The first assumption underlying the actual model was that all prices in all counties may be considered exogenous. This assumption is based on a balance of realism and simplicity of modeling. The actual prices of both conventional and unconventional inputs available at local, regional, and national levels probably depend upon a linear combination of current and lagged demand. A model taking account of this process would also have to account for spatial differences and spatial and temporal disequilibrium in prices. This would have been a complex modeling task, particularly in the area of modeling endogenous prices for the nonconventional inputs, such as marketing associations or infrastructural expenditures by local government. The prices of inputs purchased nationally were assumed to be exogenous for all rural counties and differing among counties by transportation costs.

Wage rates were also constrained to be exogenous in the study. This is a less tenuous assumption than for prices of nationally purchased inputs. Some literature (40) has shown considerable underemployment in rural labor markets of Tennessee, with a fixed "reservation price" for labor associated. In counties of limited labor supply where the growth of rural industry may affect wage rates, the influence of endogenous wage rates may also be reasonably hypothesized to be of a short-term nature, with the longer term effects being determined by the "reservation wage" at which return migrants are willing to return to the county and depress the temporarily higher wage back to an equilibrium level.

These conclusions regarding the labor market have not been rigorously tested but are made to add some theoretical credibility to the desire of simplifying the model and reducing costs by not modeling the county wage rages as endogenous.

A second crucial assumption of the model was that a proportion of the income accruing to a sector goes to the employees which is spent on consumer goods in the county, while another proportion flows to the industry which spends it for inputs both inside and outside the county.

Dynamics of the Seven-Industry Model

The dynamics of the seven-industry employment model may be illustrated in Figure 7. In part A, the total employment in the state is determined by the relative advantage of Tennessee manufacturing production as compared with the rest of the United States. These quantities are assumed to be determined by the mutual influence of national, regional, and local markets on rural Tennessee counties. The prices of inputs acquired in the national markets by industries in rural counties have been assumed to differ only by transportation costs, which are constant over time, and these transportation cost differentials have been assumed to be picked up by the local and regional availability of conventional and nonconventional inputs which reflect the comparative advantage in production among counties. This is indicated in part B. The measure of local and regional influences, C_{ct}, is hypothesized to be responsible for allocating total manufacturing employment among the rural counties in part C.

Since the model is recursive, the county level employment in manufacturing and agriculture may be considered exogenous in the secondary

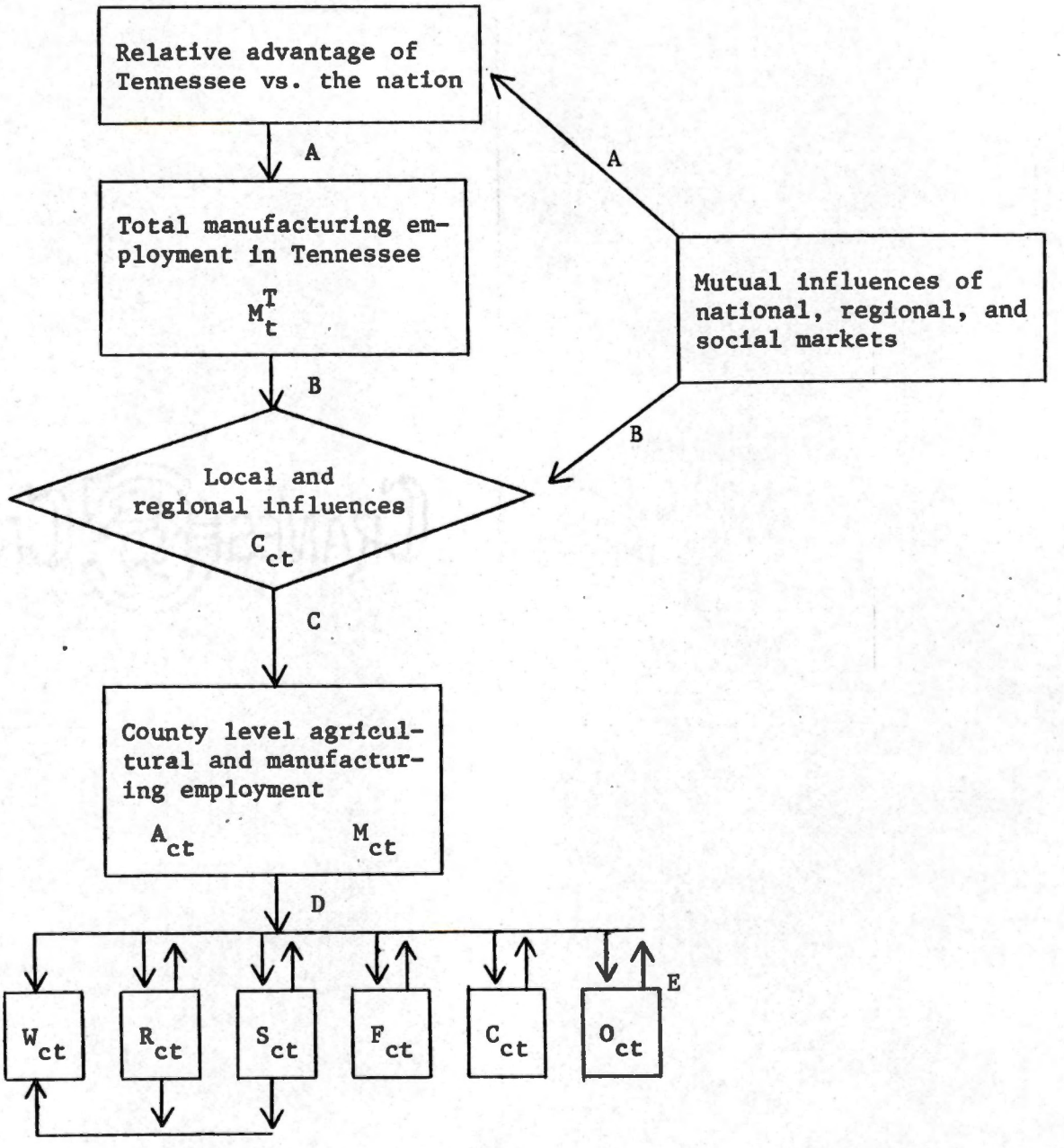


Figure 7. Dynamics of the seven-industry model.

sector. The growth of manufacturing and agricultural employment creates a demand for secondary sector goods in two ways. First, the income accruing to employees of these industries may be used by these employees in their roles as consumers to purchase consumer goods from the retail trade and miscellaneous industries, for residential construction, and for financing their expenditures from the finance industry. Secondly, both industries comprising the basic sector also directly use the outputs of the construction and finance industries in maintaining their production processes. In addition, agriculture purchases feeds and other agricultural goods from the wholesale trade industries, while the manufacturing industry may sell a small portion of its output to the wholesale trade industry. These influences are shown in part D.

The output of industries in the secondary sector may also be distributed directly to other secondary sectors, as well as to consumers. The construction, finance, and miscellaneous industries sell to both other secondary industries and consumers who invest in residential construction and/or finance their investments or purchases. The wholesale trade industry, however, does not directly serve consumers, but rather furnishes inputs to the retail trade and service industries. The service and retail trade industries exclusively serve only consumers. These relationships are shown in part E.

The economic structure of the seven-industry model may be represented by equations (6) to (18):

$$(6)\quad M_{ct} = a_{11} + \sum_i a'_{1i} \cdot F^i_{ct} \cdot M^T_t$$

$$(7)\quad W_{ct} = a_{21} + a_{22} \cdot t + a_{23} \cdot A_{ct} + B_{21} \cdot EW_{ct}$$

$$(8)\quad R_{ct} = a_{31} + a_{32}\cdot t + a_{33}\cdot A_{ct} + B_{31}\cdot ER_{ct}$$

$$(9)\quad S_{ct} = a_{41} + a_{42}\cdot t + a_{43}\cdot A_{ct} + B_{41}\cdot ES_{ct}$$

$$(10)\quad F_{ct} = a_{51} + a_{52}\cdot t + a_{53}\cdot A_{ct} + B_{51}\cdot EF_{ct}$$

$$(11)\quad C_{ct} = a_{61} + a_{62}\cdot t + a_{63}\cdot A_{ct} + B_{61}\cdot EC_{ct}$$

$$(12)\quad O_{ct} = a_{71} + a_{72}\cdot t + a_{73}\cdot A_{ct} + B_{71}\cdot EO_{ct}$$

$$(13)\quad EW_{ct} = R_{ct} + S_{ct}$$

$$(14)\quad ER_{ct} = M_{ct} + W_{ct} + S_{ct} + F_{ct} + C_{ct} + O_{ct}$$

$$(15)\quad ES_{ct} = M_{ct} + W_{ct} + R_{ct} + F_{ct} + C_{ct} + O_{ct}$$

$$(16)\quad EF_{ct} = M_{ct} + W_{ct} + R_{ct} + S_{ct} + C_{ct} + O_{ct}$$

$$(17)\quad EC_{ct} = M_{ct} + W_{ct} + R_{ct} + S_{ct} + F_{ct} + O_{ct}$$

$$(18)\quad EO_{ct} = M_{ct} + W_{ct} + R_{ct} + S_{ct} + F_{ct} + C_{ct}$$

The variables in this system are defined as follows:

t = time subscript t = 1,...,12 for the years 1965 to 1976.

c = county identification subscript c = 1,...,76 for the 76 rural (i.e., non-SMSA) counties.

M_t^T = total manufacturing employment in Tennessee.

County Level Variables

M_{ct} = manufacturing employment.

A_{ct} = agricultural employment.

F_{ct}^i = factor scores for the i^{th} factor.

W_{ct} = wholesale trade employment.

R_{ct} = retail trade employment.

S_{ct} = service employment.

F_{ct} = finance employment.

C_{ct} = construction employment.

O_{ct} = miscellaneous employment.

Parameters

a_{ij} = parameters associated with exogenous variables.

a'_{1i} = parameters associated with the i^{th} factor.

B_{i1} = parameters associated with the i^{th} endogenous variable which is comprised of the total employment in manufacturing and linked industries.

The system, as it is represented by equations (6) to (18), is conceptual in nature and not amenable to statistical estimation because it lacks the property of identification. Certain behavioral properties of the system are derived in Chapter 5 which overcome the absence of identification.

CHAPTER 4

THE MEASUREMENT OF LOCALIZATION AND URBANIZATION ECONOMIES BY MEANS OF FACTOR ANALYSIS

The purpose of Chapter 4 is to aggregate the community and industrial characteristics discussed in Chapter 3 as measures of localization and urbanization economies into a smaller set of underlying factors. The rationale behind this proposition is that 1) the localization economies of a region influence employment in a manner that is a linear combination of the employment levels in the various regional industries and b) the separate dimensions of urbanization economies which influence employment levels may be represented as linear combinations of the community characteristics. In this study, these underlying dimensions were developed in a factor analysis framework.

4.1 THE BASIC LINEAR MODEL[12]

Gorsuch (11, p. 87) describes factor analysis as a technique for summarizing ". . . the interrelationships among . . . variables in a concise but accurate manner as an aid in conceptualization . . ." and extracting ". . . the maximum amount of information from the original variables in as few derived . . . factors as possible to keep the solution understandable." In this framework, the factors may be viewed as

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[12]This section draws heavily on Gorsuch (11), Tatsuoka (31), and Kleinbaum and Kupper (17). An excellent basic introduction to factor analysis may be found in Chapter 21 of Kleinbaum and Kupper, while a moderately sophisticated discussion is presented by Gorsuch. Tatsuoka concentrates on basic multivariate statistical concepts which form a basis for factor analysis.

abstract theoretical constructs from which the observable and measurable variables are linearly derived.

The values of the variables can be exactly reproduced only if the number of factors is equal to the number of variables. A model which does this is called a full components model and is predicated on the assumption that a set of factors should theoretically reproduce the variables exactly. The full components model is constrained to reproduce the variables exactly by not allowing the existence of an error term.

The common factor model, used in this research, divides factors into two groups which are distinguished from one another in the following quote from Gorsuch (11, p. 23):

> The first group, the common factors themselves, consists of those factors which contribute to two or more of the variables, i.e., several variables have these factors in common. But the variables will seldom be calculable from the common factors alone, for each variable will be influenced by sources independent of the other variables. These sources may be legitimate causal influences which are not affecting the other variables, systematic distortions in the scores (usually called bias), or random error from inaccuracies of measurement. The non-common factor variance for each variable is summarized in a unique factor which contains the scores necessary to complete the prediction of that variable.

The common factor method was chosen because the variables were hypothesized to influence manufacturing employment as a set of variables containing complementing influences, while the effects of the independent variance associated with the variables, and represented by unique factors, was assumed negligible. This assumption was made because it seemed reasonable that variability in only one variable, for example, would have insignificant influence upon manufacturing growth in a county unless it were accompanied by variability in variables contributing complementary

influences. Furthermore, the factors were constrained to be orthogonal to one another. This is to say, the linear combinations of the variability in the original data represented factors which influenced manufacturing growth independent of one another. The only a priori reason for expecting this to be the case was because an earlier distribution of industrial structure among the rural counties may have resulted in the development of specialized economies among the counties. The industrial development literature reviewed in Chapter 2 appears to imply this case, although an empirical verification was not encountered in the literature. More importantly, the mathematical solution for correlated factors is indeterminate unless previous theoretical and/or empirical research exists to suggest the degree of correlation to impose on the factors, and indeed, and nature of the factors themselves. Since no line of research of this type has been done, the factors were constrained to be uncorrelated.

The general problem in factor analysis is to solve the characteristic equation

$$(19) \quad (P_{vf} \cdot R_{ff} \cdot P_{fv} - \lambda_{vv} \cdot I_{vv}) \cdot A_{vv} = 0_{vv},$$

where P_{vf} is a v by f matrix of correlations between the v variables and f factors, R_{ff} is an f dimensioned identity matrix of factor correlations, λ_{vv} is a square matrix of characteristics vectors, I_{vv} is v by v identity matrix, A_{vv} is a diagonal matrix of characteristic roots, and 0_{vv} is a v by v matrix of zeros.[13]

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[13]Gorsuch (11) presents the derivation of the common factor model on p. 49.

The common factor correlation matrix is an estimate of the observed correlation matrix in all elements except the unities on the diagonals. The diagonal elements in the estimated common factor correlation matrix are not unities but communality estimates of the proportion of a variable's variance accounted for by the common factors. The mathematical upper and lower bounds on communality estimates are 0.0 and 1.0, respectively. The use of 0.0 would imply the existence of only unique factors, while the use of 1.0 would imply the existence of only common factors and represent the principal components model.

The squared multiple correlation coefficient (R^2) of a particular variable with other variables represents a more accurate lower bound for the communality estimate. The R^2 gives the overlapping variance which a variable has with all other variables, but excludes the overlap which ". . . the variable might have with the factors in addition to that indicated from the overlap with the other variables."[14] Thus, the R^2 is a lower bound and may not be considered the communality at least in general. An offsetting tendency in the use of R^2 as a communality estimate is that actual (i.e., the computed) R^2's are usually biased upward because of capitalization on chance, with this bias increasing with the number of variables. For this reason, the computed R^2 is above the theoretical lower bound and has often been used as a valid approximation of the actual communality.

The reliability estimate of a variable has been used as an upper bound on the communality estimate. The unreliable portion of the

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[14]Gorsuch (11, p. 94).

variance of a variable is, by definition, random error, and may therefore not be ascribed to any factor, either common or specific. Therefore, the maximum communality of a variable may logically be considered its total variance minus the unreliable portion of its total variance, or the reliability estimate of the variable.

Another frequent procedure used in communality estimation is to ". . . select the largest correlation without regard to sign that each variable has with any other variable in the matrix."[15] The square of this correlation coefficient is a lower bound for the variance associated with a factor comprised of these two variables. The correlation coefficient is an estimate which is well above that minimum and yet less than 1.0.

Other communality estimates are also made, but R^2 and the highest correlation are most often used. However,

> . . . as the number of variables in the correlation matrix increases, the number of off-diagonal elements increases relative to the number of communality estimates in the diagonal elements. . . . After 30 or 40 variables are reached, the effects of using reasonable but different communality estimates in the diagonal of the correlation matrix are minimal.[16]

This being the case, the multiple R^2 was used as the initial estimate for the communalities in the common factor model. Gorsuch (11, pp. 92-103) discusses the method of iterating toward final communalities.

The factors may be rotated so that the pattern of factor loadings, as represented by the matrix P_{vf}, are more logical. The rotation may be constrained by maintaining orthogonality among the factors or a certain

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[15] Ibid., p. 95.

[16] Ibid., p. 98.

degree of obliqueness (i.e., factor correlation). An understandable mathematical treatment of rotation would be lengthy, and numerous texts adequately explain the methods (10, 16), particularly Chapters 10 and 11 of Gorsuch (11). Therefore, the topic of factor rotation will be presented in a general and cursory fashion.

The criteria used in both orthogonal and oblique types of rotation is that of simple structure. The idea behind simple structure is to obtain a rotated set of factors such that each variable loads on as few factors as possible. This criteria is in keeping with the idea that the simplest explanation should be used when possible. For example, Figure 8 contains the initial factors A and B, and the orthogonally rotated factors A' and B', which conceptually illustrates the idea behind simple structure. Note that in Figure 8 no variables correlate highly with more than one factor.

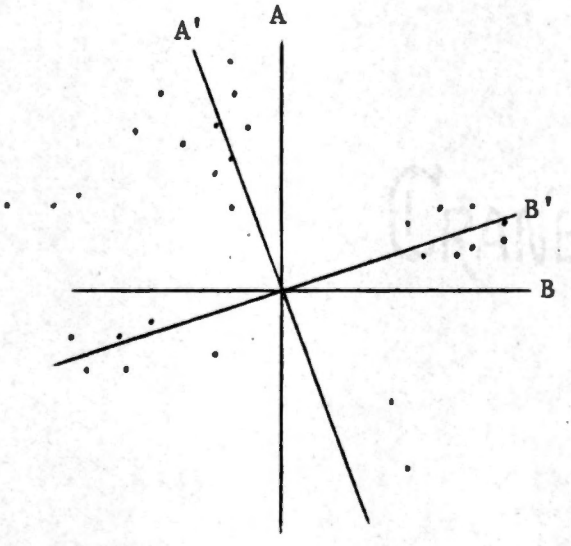
Two popular methods of orthogonal rotation and quartimax and varimax. Quartimax uses the maximization of the variance of the squared loadings for the variables as its criteria for rotation. The quartimax solution results in

> . . . one factor with all major loadings and no other major loadings in the rest of the matrix . . . while each variable's complexity is kept near the minimum, the complexity of the first factor is maximized rather than minimized.[17]

Since the objective of our exploratory study is to ". . . simplify a factor rather than a particular variable . . .", the varimax criteria of maximizing the variance of the squared loadings across a factor was used

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[17]Quotations in this paragraph are from Gorsuch (11, pp. 91-92).



Note: The dots are observations.

Figure 8. Rotating initial factors, A and B, to simple structure positions, A' and B'.

for orthogonal rotation in an attempt to find the simple structure of the factors.

4.2 EMPIRICAL RESULTS OF THE FACTOR ANALYSIS

The Significant Number of Factors

The principal axis method of using squared multiple correlations as initial communality estimates in equation (19), calculating a second set of communality estimates from the initial factor solution, using these to estimate a second factor solution, and iterating toward a final set of communality estimates and factor solution was used in estimating the final factor scores. This method is discussed in Gorsuch (11, pp. 92-103). Convergence was achieved after six iterations.

For theoretical, computational, and practical reasons, only a subset of the possible common factors are considered significant. In theory, some of the common factors may be representative of measurement errors and random influences and, as such, do not truly constitute common factors. If such is the case, the factor scores may not be expected to influence manufacturing employment in the econometric model. The computational and practical reasons for some factors being insignificant for further analysis are referred to by Gorsuch (11) in the following quote (p. 151):

> The information gained is reflected in the increased variance which is accounted for when an additional factor is extracted. The costs of that additional factor consist of increased complexity, more computational time and greater difficulties in replicating such small factors. If a new factor does not add very much to the information already extracted, it would not be worth extracting and interpreting.

A common method of determining the minimum number of factors associated with the extraction of an adequate amount of the common variance is the scree test, discussed by Cattell (5). This procedure basically consists of plotting the characteristic roots (eigenvalues) derived from equation (19) against the number of factors derived. Each characteristic root is a measure of the amount of common variance associated with the corresponding factor. Gorsuch (11, p. 152) notes the

> . . . rationale for the scree test is that the battery of variables is measuring a limited number of factors well and a larger number of trivial, specific, and error factors much less well. Therefore, the predominant factors account for most of the variance and are large, whereas the other factors are quite numerous, but small. Since the principal factor solution extracts factors by size, the substantive factors will be extracted first and the smaller trivial factors will be removed later. Since the smaller factors are so numerous and are taken out in order of size, it would be expected that plotting them on a graph would result in a straight line sloping downward. The dominant factors should not fall on this line since some of them will be much more dominant than others and they will be stronger than the trivial factors.

The scree test sets a lower bound on the number of factors. A pragmatic upper bound may be established by limiting the number of extracted factors to those which are interpretable.

The scree test is plotted in Figure 9. The eigenvalues corresponding to the correlation matrix with initial communality estimates are plotted against the number of factors. According to the plot, at least four factors were significant. However, only three factors were highly interpretable from the theoretical base developed in Chapter 3. As a compromise between these two criteria, four factors, accounting for 58.8 percent of the total variance in the data, were extracted.

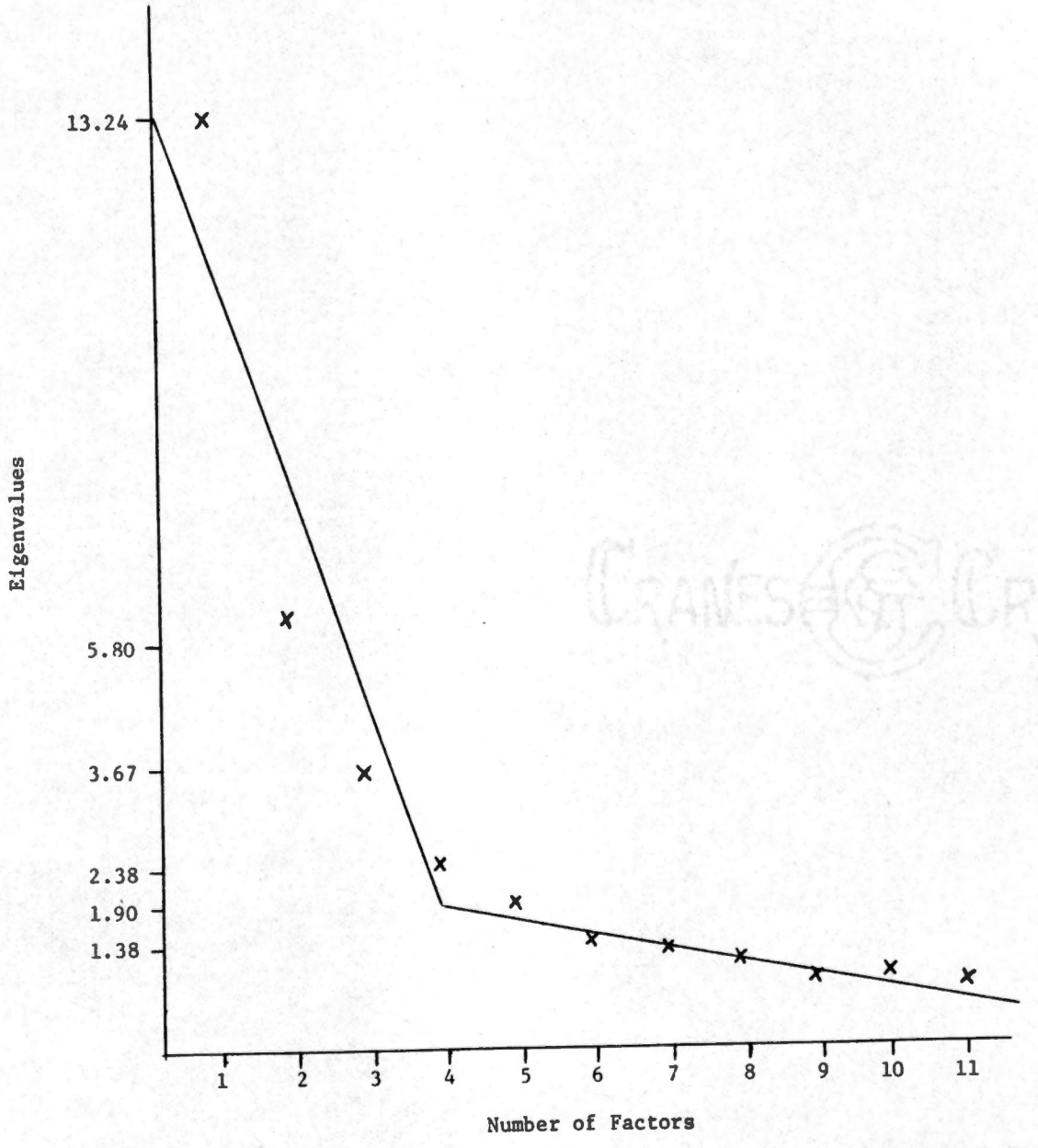


Figure 9. Scree plot of eigenvalues.

The Interpretation of Factors

The varimax rotated factor pattern matrix of correlations between variables and factors and the final communality estimates of the variables are presented in Table IV. The correlation coefficients measure the degree of association between the factor scores and the values of the original variables and provide the criteria for determining which variables tend to "cluster" together to make up a factor and hence a dimension of location or urbanization economies. The final communality estimate presents the percentage of each variable's variance which is reproduced by the four factors in this study. For example, 99 percent of the variance in retail trade employment (variable 2) is explained by the four common factors. The final communality of each variable may be computed by squaring the correlation coefficients associated with each factor and summing these. This procedure shows that 98 percent of the variance in retail trade employment is explained by factor 1, with the remaining 1 percent of the common variance being explained by the other three factors.

Factors are interpreted in the context of the variables which correlate significantly with the individual factors. A common criteria for considering a variable to correlate significantly with a factor is that the absolute value of its correlation with a factor be at least 0.3 and its communality 0.4, as was the criteria selected in this study. Because of their low communalities, variables 28 to 40 were not weighed heavily in interpreting the economic meaning of the factors.

In Chapter 2, five dimensions of localization and urbanization economies were hypothesized to exist. These dimensions were summarized in

TABLE IV

ROTATED FACTOR PATTERN MATRIX OF THE FOUR FACTORS EXTRACTED BY A COMMON FACTOR METHOD

Variable Name	Factors[a] 1	2	3	4	Communality (Final)
1. Population of county and contiguous counties	0.92	0.08	-0.18	0.17	0.92
Total Employment in the County and Contiguous Counties, By Type:					
2. Retail trade	0.99	0.13	-0.03	-0.01	0.99
3. Wholesale trade	0.96	0.04	-0.01	0.04	0.93
4. Financial services	0.97	0.06	0.05	0.04	0.96
5. Employment in other industries	0.95	0.11	0.02	-0.03	0.91
6. Food processing	0.92	0.06	-0.24	0.01	0.92
7. Construction	0.92	0.21	-0.01	-0.06	0.89
8. Communications and transportation services	0.87	-0.01	-0.05	0.08	0.76
9. Other durable goods	0.83	0.23	0.21	-0.04	0.79
10. Printing	0.79	0.24	-0.10	-0.21	0.73
11. Non-electrical machinery	0.79	0.31	0.25	0.17	0.75
12. Other non-durable goods	0.71	0.32	0.25	0.31	0.75
13. Textiles and apparel	0.51	0.27	0.24	-0.12	0.42
14. Electrical machinery	0.48	0.48	0.23	0.09	0.52

TABLE IV

(Continued)

Variable Name	Factors 1	2	3	4	Communality (Final)
15. Furniture, lumber, and wood products	0.60	0.11	-0.20	-0.34	0.52
16. Chemical	0.58	0.20	0.01	-0.54	0.67
17. Agriculture, forestry, and fisheries	0.11	0.01	-0.76	0.23	0.64
18. Mining	0.11	-0.10	0.03	-0.68	0.49
19. Percent urban population	0.02	0.76	-0.09	0.07	0.59
20. Bank deposits	0.12	0.89	0.16	0.09	0.85
21. Expenditures on public protection	0.12	0.78	0.10	-0.10	0.64
22. Highway expenditures	0.15	0.71	0.06	0.09	0.54
23. Population density	0.20	0.66	-0.18	-0.26	0.58
24. Size of the civilian labor force	0.14	0.77	-0.40	0.05	0.77
25. Per capita income	0.12	0.60	0.68	0.19	0.88
26. Percent of the civilian labor force over 25 years of age	0.20	0.76	0.37	0.16	0.77
27. Educational expenditures per pupil[b]	-0.05	0.17	0.67	0.17	0.51
28. Metal products	0.58	0.16	0.14	0.08	0.39
29. Transportation equipment employment	0.24	0.14	0.26	0.40	0.31
30. Distance from the county seat to the nearest SMSA	-0.39	-0.10	0.11	0.36	0.30

TABLE IV

(Continued)

Variable Name	Factors 1	2	3	4	Communality (Final)
31. Employment rate	0.04	0.19	0.41	0.29	0.29
32. Percent females in the civilian labor force	0.05	0.06	0.41	-0.06	0.18
33. Median age of population	-0.30	0.09	0.23	0.40	0.31
34. Number of doctors per 1000 population	-0.04	0.14	-0.49	-0.04	0.26
35. Number of hospital beds per 1000 population	0.01	0.27	-0.30	-0.01	0.16
36. Public welfare expenditures	0.11	0.51	0.01	0.01	0.28
37. Health and hospital expenditures	0.08	0.50	0.15	0.15	0.30
38. Expenditures on parks and natural resources	0.06	0.58	0.03	0.04	0.34
39. Financial expenditures	0.15	0.58	0.01	-0.01	0.36
40. Property tax rate	-0.17	-0.06	0.17	-0.55	0.37

[a]Factor 1: Localization Economies and Labor Availability
Factor 2: Availability of Infrastructure
Factor 3: Labor Production and Income
Factor 4: Unnamed

[b]All expenditures except those on education by local government are total expenditures.

Figure 6, p. 33. All variables representing localization economies were hypothesized to represent a single dimension and the variables representing urbanization economies were hypothesized to comprise four separate (i.e., orthogonal) dimensions. The results of the factor analysis, as represented by the correlations in Table IV, present qualified support of these hypotheses. Only a small quantity of literature (8, 12) has dealt with the development of community factors, and this literature has not developed a sound theoretical framework for evaluating the factors. Therefore, interpretation of the factors is considered conditional upon further research in this area.

Factor 1 is highly correlated with many of the variables comprising localization economies (variables 2-16) and with general labor availability (variable 1). Thus, it contains part of the urbanization economies dimension (variable 1) and basically describes a major part of the labor supply and demand situation of each county. The variables most highly correlated with this factor (2-7) appear to measure production of consumer goods and, with the exception of employment in the food processing industries, the magnitude of consumer markets existing in the region, since these variables measure employment in secondary industries. In addition, the distribution of employment in different manufacturing industries (variables 8-16) represents the availability of manufacturing markets, specialized labor availability, and the availability of organizations creating economies of scale external to individual plants.

The first interesting feature of factor 1 is that two of the employment variables (17 and 18) correlate exclusively with other factors (3 and 4 respectively). This characteristic is compatible with the

proposition found in the urban-industrial impact literature that industrial employment tends to concentrate in "matrices," with different types of industrial specialization being associated with different matrices. In fact, if county level data could be obtained for less aggregated levels of industrial employment, many different matrices might appear. In addition, three variables--employment in electrical machinery (14), furniture, lumber, and wood products (15), and chemicals (16)--significantly correlate with both factor 1 and other factors (2 and 4, respectively). This indicates that some industries may belong to more than one matrix of development.

The second major feature of factor 1 is that per capita income does not correlate significantly with it, although factor 1 appears to represent a static labor supply-demand situation. This result indicates that per capita income, which correlates with factor 3, may be unrelated to the distribution of industrial employment, with the exception of employment in agriculture, forestry, and fisheries (variable 17). The variables correlating significantly with factor 1 represent a major facet of the regional labor demand-supply situation, and may not represent the labor demand-supply situation in a county for which the level of per capita income is computed. The structure of factor 3 sheds more light on this issue.

Factor 3 was interpreted to represent labor productivity and consumer income because it positively correlates with per capita income (variable 25), percent of the labor force over 25 years of age (variable 26), educational expenditure per pupil (variable 27), and negatively correlates with employment in agriculture, forestry, and fisheries

(variable 17), and size of the civilian labor force (variable 24). The negative correlation of the size of the civilian labor force with factor 3 suggests that some labor market tightness may be responsible for higher per capita incomes, although the correlation is quite low (-0.36) and it cannot be strongly argued that this variable accurately represents an unemployment rate. The computed employment rate (variable 31), which was not significantly reproduced, was positively correlated with factor 3, although also at a low level (0.40). Because of hidden unemployment in rural counties, the accuracy of this variable in representing an unemployment rate may also be questioned.[18] However, the loading of the variable representing the unemployment rate may provide weak evidence that labor market tightness may be partly responsible for higher per capita incomes.

The major reasons for high per capita incomes appear to reside in the association between per capita income and the other significant variables making up factor 3. An argument for causation may be made with employment in agriculture, forestry, and fisheries (variable 17) and the percent of labor force over 25 (variable 26), upon per capita income. The hidden unemployment in the rural labor force, particularly in agriculture, has been cited as a reason for low per capita incomes in rural counties (40, 41). It is also reasonable to suppose that an older labor force has acquired the necessary level of skills associated with a higher level of labor productivity that warrants higher incomes. The

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[18]The idea behind hidden unemployment has been elaborated on by Stoll (41) as being that proportion of the labor force capable of joining or leaving the labor force should they perceive the actual unemployment rate as falling or rising in order to supplement family incomes.

direction of causation between per capita incomes and educational expenditures per pupil (variable 27) cannot easily be made from cross-sectional data since the influence may run in either direction. Factor 2 may be interpreted as representing community infrastructure and general labor availability. Significant correlations exist between factor 2 and local government expenditures on highways (variable 22), public protection (variable 21), employment in electrical machinery manufacturing (variable 14), bank deposits (variable 20), population density (variable 23), size of the civilian labor force (variable 24), percent of the civilian labor force over 25 (variable 26), per capita income (variable 25), and the percent of urban population (variable 19). Three of these variables represent labor productivity and wage rates (variables 24-26), and four represent demand factors for infrastructural services (variables 14, 19, 20, and 22). In addition to being interpreted as demand factors for infrastructural services, the four variables were hypothesized to be supply factors for the further growth of rural industry. The property tax rate does not correlate with this factor, so it is difficult to interpret the source of funds for the infrastructural expenditures.

Factor 4 represents a separate dimension of localization economies, being negatively correlated with employment in mining (18), furniture, lumber, and wood products (15), and chemicals (16), and positively correlated with employment in other non-durable goods industries (12). The negative correlations mean that lower factor scores measure greater employment in those industries which are negatively correlated with the factor and less employment for those positively correlated. However, because of the inconsistent correlations, no economic interpretation was made of the factor.

No explicit reason can be advanced for the distribution of portions of the variance in some types of industrial employment among more than one factor, although this was not an unexpected result since the urban-industrial literature strongly implies the presence of different industrial matrices. The difficulty in making specific hypotheses or interpreting specific results in regard to the correlations between all variables and factors, but particularly in regard to industrial employment, is the lack of theoretical literature and previous factor analyses which are directly comparable. The Gunter study (12), for example, did not include any measure of industrial employment, while the broader variables base (136 variables) of the factor analysis carried out by Dorf and Emerson (8) was not strictly comparable to that done in the present study.

Regardless of the interpretability of the four factors, they are what exist for the rural counties of Tennessee and are hypothesized to affect employment in the basic and secondary industries. The rest of this section investigates the hypothesis that rural counties having high levels of localization and urbanization economies tend to be geographically clustered.

The Spatial Distribution of Factor Scores

An important characteristic of the factor scores is their spatial distribution. The staple theory of economic development, the theory of economic linkages, and the urban industrial impact model all suggest that economic development occurs more rapidly in some geographic regions than others because of the association of high levels of certain types

of urbanization and location economies with these regions. Since the factors are constrained to be orthogonal to one another, no spatial clustering among the scores of different factors would exist.

The actual values of the factor score (in normalized form) are presented in Table V and represent the relative distribution of the location and urbanization economies among rural counties. A more convenient way of providing insight into the spatial distribution of the factor scores is provided by Figure 10, which breaks the factor scores into quartiles. The first quartile represents the 25 percent of counties having the lowest factor scores, while the fourth quartile represents the 25 percent of counties having the highest factor scores. The maps reveal periodic clustering of counties belonging to the same quartile. These maps may be used by private and public sector policy makers in ascertaining the type of resource base characterizing a county or group of counties in rural Tennessee. Different types of industries are known to rely more intensively on different types of resource bases and to be optimally located in counties offering greater magnitudes of the appropriate resource bases. The importance of these factors in explaining the distribution of rural manufacturing employment in Tennessee from 1965 to 1976 is tested in Chapter 5.

While a great deal of space could be allocated to describing and measuring the degree of clustering and the reasons, and the tendency and reasons for a geographical shifting of the clustering over time, this was felt to be a significant branch of research better left to a more extensive investigation of the determinants of rural employment patterns than the present one.

TABLE V

NORMALIZED FACTOR SCORES FOR PERIODS 1 AND 2*

County	Factor 1	Factor 2	Factor 3	Factor 4
Bedford	-0.253600	0.224298	-0.876157	0.596797
	-0.120767	1.429592	0.735415	0.603084
Benton	-0.570297	-0.468148	-0.151766	0.549757
	-0.645992	0.195355	1.592487	0.684288
Bledsoe	1.152125	-1.427441	0.081331	-0.575547
	1.243615	-0.917820	0.730386	0.487541
Bradley	1.240447	0.636629	-0.629138	-0.870279
	1.814314	2.742828	0.565894	0.241975
Campbell	-0.505761	-0.162819	-0.305737	-3.137420
	-0.195945	0.578335	0.990038	-1.575555
Cannon	-0.168865	-0.844259	-0.199729	-0.059721
	0.158061	-0.350065	0.807999	0.744487
Carroll	-0.141153	-0.333231	-0.878770	0.827566
	0.142145	0.830631	1.038545	0.972628
Carter	0.600272	0.550709	-1.118457	-1.123936
	0.446718	1.644482	0.085512	-0.960401
Chester	-0.483206	-0.752225	-0.702298	0.171879
	-0.001585	-0.205279	0.844530	0.441508
Claiborne	-0.493968	-0.718471	-0.555751	-2.208476
	-0.560432	-0.021313	0.853144	-1.042612
Clay	-0.868088	-1.227260	-0.151184	-0.075523
	-1.061939	-0.799135	0.739621	0.298745
Cocke	-0.325972	-0.008200	-0.925711	-0.292305
	0.169285	0.823027	-0.123294	-0.612355
Coffee	-0.547830	0.361933	-0.415103	-0.680993
	-0.040890	1.339401	0.957068	-0.138003
Crockett	0.020772	-0.647643	-0.937426	0.923543
	0.371068	-0.120326	0.452383	0.799609
Cumberland	-0.617708	-0.437022	-0.272106	-1.018492
	-0.574068	0.446939	0.811086	-0.500874
Decatur	-0.833892	-0.722170	-0.272680	-0.125450
	-0.986409	-0.114968	1.386542	0.112101
Dekalb	-0.786489	-0.769315	-0.850990	-0.273362
	-1.013646	0.361726	0.553207	0.581230

TABLE V

(Continued)

County	Factor 1	Factor 2	Factor 3	Factor 4
Dyer	-0.004677	0.093460	-1.663118	0.770198
	-0.405241	1.836541	0.287477	0.822238
Fayette	4.105727	-1.487288	-2.155819	1.020569
	5.720956	-1.236757	-0.217571	2.197361
Fentress	-0.852952	-0.932487	-0.377815	-0.962293
	-0.901017	-0.283443	0.217705	-0.559487
Franklin	-0.240190	-0.123354	-0.359018	0.552261
	0.607829	0.440615	0.769386	0.842060
Gibson	-0.023016	0.759374	-2.292377	1.389854
	0.153011	2.504065	-0.061578	1.158658
Giles	0.331726	-0.044581	-1.230509	0.835861
	1.907516	0.452939	1.219879	2.014155
Grainger	1.357357	-0.878025	-0.935894	-1.343524
	2.385351	-0.668245	0.632249	-1.259864
Greene	0.412271	1.034154	-2.202579	-0.851638
	1.445511	2.583912	-0.387652	-0.776355
Grundy	-0.720122	-0.645434	-0.534312	-0.626727
	-0.639347	-0.832759	0.352083	-0.083816
Hamblin	-0.699548	0.887511	-1.504986	-0.816165
	-0.277264	2.193571	-0.050722	-1.326180
Hancock	-0.892623	-1.034967	-0.101239	-0.409766
	-0.807876	-0.767199	0.209011	-0.441659
Hardeman	-0.495396	0.392216	-3.841263	-0.001858
	0.196393	0.051000	-0.238892	0.553567
Hardin	-0.638407	-0.346649	-0.698951	-0.088971
	-0.177264	0.188645	0.942319	1.015629
Haywood	-0.505964	-0.237087	-1.117846	0.506106
	0.413481	-0.389887	0.007051	0.520869
Henderson	-0.438423	-0.553420	-0.530805	0.367798
	0.072775	0.077113	1.083253	0.715670
Henry	-0.585942	-0.092808	-0.603289	0.733555
	-0.917875	0.898775	1.052969	1.158667
Hickman	-0.653544	-0.545938	-0.101386	-0.041988
	0.397859	-0.152769	0.953615	0.405665

TABLE V

(Continued)

County	Factor 1	Factor 2	Factor 3	Factor 4
Houston	-0.431355	-1.128877	-0.171981	-0.070222
	-0.406209	-0.440070	1.345355	0.515783
Humphreys	-0.915733	-0.493989	-0.360994	0.257647
	-0.645758	-0.171879	1.521853	0.893993
Jackson	-0.836480	-1.000732	-0.311384	-0.015734
	-0.936265	-0.347035	0.859628	0.062511
Jefferson	1.542556	-0.464094	-1.332165	-1.030677
	2.725286	-0.474702	0.256488	-0.678542
Johnson	0.366922	-0.801765	-0.453954	-0.449412
	0.469900	-0.502461	0.717380	-0.204212
Lake	-0.155520	-1.023380	-0.848662	0.796406
	-0.259791	-0.547555	0.834568	0.851519
Lauderdale	-0.041605	-0.335195	-1.202798	1.307731
	0.324002	0.366910	-0.092528	0.711927
Lawrence	-0.418760	0.057813	-0.994087	0.287907
	0.033394	0.592107	0.604839	1.111592
Lewis	-0.628974	-0.697056	-0.214835	0.244714
	-0.543923	-0.364174	1.102884	0.589914
Lincoln	-0.144561	-0.040099	-1.159867	0.801115
	0.669779	0.562639	0.999956	1.978925
Loudon	1.933733	-0.395097	-0.432153	-1.653550
	2.573945	0.451096	1.464637	-1.173438
McMinn	-0.449086	0.431787	-0.963015	-0.995616
	-0.784046	1.894706	0.172293	-1.019091
McNairy	-0.619087	-0.566289	-0.912425	0.218214
	-0.556045	0.172214	0.553596	0.422518
Macon	-0.952548	-0.763700	-0.485252	0.376737
	-0.600879	-0.189494	1.194463	0.906938
Madison	-0.561691	1.814198	-2.152876	1.123387
	-0.329329	3.769203	-0.173216	0.549326
Marshall	-0.065369	-0.099286	-0.663370	0.738380
	0.785679	0.637161	1.147910	1.052376
Maury	-0.766313	1.093491	-1.565057	0.508765
	-0.356218	2.799577	0.113776	0.529089

TABLE V

(Continued)

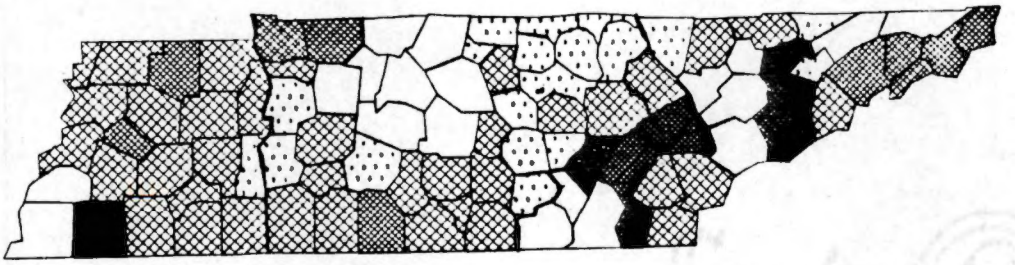
County	Factor 1	Factor 2	Factor 3	Factor 4
Meigs	1.877149	-1.383071	-0.067453	-0.663470
	2.237619	-0.911093	1.246357	-0.212859
Monroe	-0.115880	-0.420079	-0.715545	-0.564282
	-0.672945	0.550947	0.945826	-0.410801
Montgomery	0.088177	1.117296	-1.311136	0.555143
	-0.221347	3.321853	0.180006	0.320305
Moore	-0.524571	-1.070549	-0.311109	0.574115
	-0.896811	-0.536769	1.190722	0.952865
Morgan	-0.630090	-0.758233	-0.051274	-1.930408
	-0.488096	-0.071443	1.174283	-1.211710
Obion	-0.117451	0.118859	-1.490478	1.226585
	-0.625710	0.828260	0.501178	1.150441
Overton	-0.792744	-0.741918	-0.771222	-0.313746
	-0.815849	-0.469740	0.425549	-0.005264
Perry	-1.000835	-0.945071	-0.496198	-0.073926
	-1.072762	-0.645138	1.291286	0.431119
Pickett	-0.924713	-1.187690	-0.267479	-0.383748
	-0.721022	-0.793558	1.038470	0.175767
Polk	-0.302041	-0.434378	-0.082503	-1.098793
	-0.419259	0.141491	1.535039	-1.164741
Putnam	-0.762055	-0.003910	-0.932824	0.080105
	-0.706596	1.369149	1.328979	-0.122864
Rhea	1.258306	-0.830300	0.016088	-0.842363
	1.553401	-0.363809	1.179334	-0.483991
Roane	1.358026	0.278916	-0.991663	-1.923796
	2.039447	0.562630	1.442327	-1.674896
Scott	-0.722216	-0.622001	-0.023951	-2.758774
	-0.639947	0.048719	1.299221	-2.221476
Sevier	1.663832	-0.464423	-1.121989	-0.411131
	2.123250	0.278643	1.232563	-0.115485
Smith	-0.581672	-0.670020	-0.513440	0.429467
	-0.656812	-0.119007	1.278647	0.744360
Stewart	0.605297	-0.846295	-0.163745	0.220806
	0.779212	-0.917449	1.312007	0.544622

TABLE V

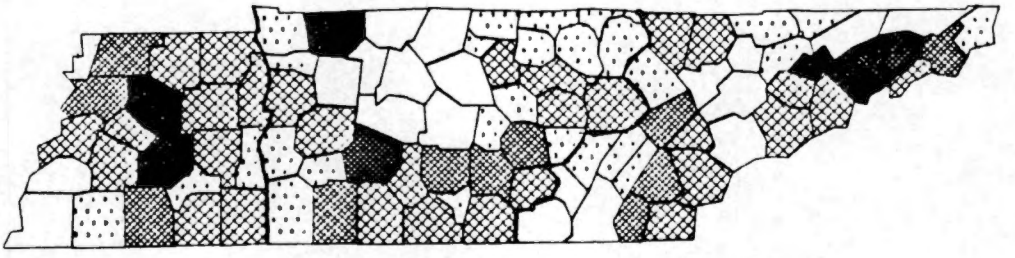
(Continued)

County	Factor 1	Factor 2	Factor 3	Factor 4
Trousdale	-0.703795	-1.076156	-0.434978	0.417035
	-0.378888	-0.828770	0.654711	0.578575
Unicoi	0.131239	-0.466046	-0.467358	-0.570643
	-0.033937	0.033552	1.037313	-0.621924
Van Buren	-0.683836	-1.273424	-0.415674	-0.355977
	-0.438400	-0.866359	0.669216	0.078460
Warren	-0.989550	0.128018	-0.571678	-0.400234
	-0.922101	0.425793	1.318355	-0.073357
Washington	0.668030	1.709191	-2.112743	-1.344952
	0.310556	2.821018	0.970417	-1.678222
Wayne	-0.475770	-0.727385	-0.659157	0.190153
	0.002309	-0.645428	1.046626	0.712712
Weakley	0.014839	-0.058476	-0.878510	1.411141
	0.093950	-0.116344	1.554073	1.368336
White	-0.631067	-0.497924	-0.657937	-0.067956
	-0.345067	-0.029671	0.870749	0.130446

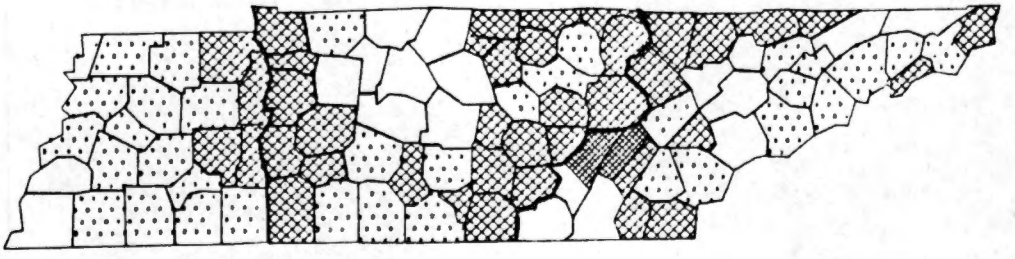
*The 1960 period is the first entry.



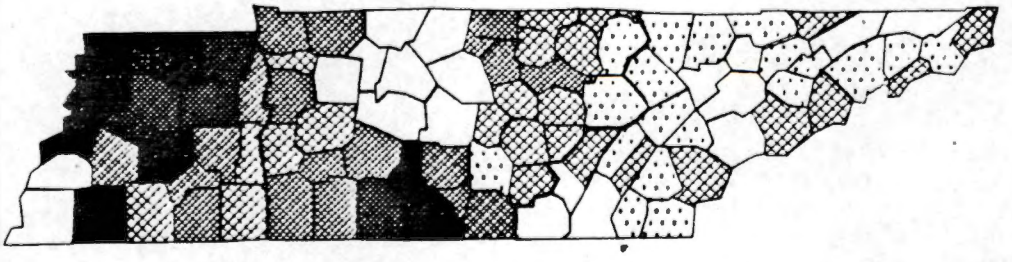
Panel a--Availability of Localization Economies in 1970



Panel b--Availability of Infrastructure in 1970



Panel c--Income and Labor Quality in 1970



Panel d--Miscellaneous Factor Scores in 1970



Figure 10. Spatial distribution of factors scores for 1960 and 1970 (by quartile).

Table VI tabulates the number of counties belonging to each grand division of the state according to which quartile they fall into on each factor in 1960 and 1970. The numbers under the column labeled N are the number of counties and the numbers under the column labeled P are the fraction of counties belonging to each grand division which fall into each quartile. A set of prior probabilities was developed giving the number of counties in each grand division that are expected to belong to each quartile. If the factor scores were randomly distributed among the counties in each year, 25 percent of the counties in each division would fall into each quartile. The number of counties expected to fall into each quartile under random distribution is 6.0 in the East, 8.25 in the Middle, and 4.75 in the West.

Over half the counties in East Tennessee rank in the third and fourth quartiles for the availability of localization economies (factor 1) for both time periods. West Tennessee ranks second in terms of the proportion of its counties falling into the third and fourth quartiles, and Middle Tennessee ranks last. Almost 42 percent of East Tennessee counties rank in the fourth quartile in 1970, making it the most favored region for industries which are intensive in their use of these resources.

In terms of infrastructural availability, West Tennessee appears to be relatively better off, particularly during the second period. During the second period, 63.2 percent of the counties belonging to that division ranked in the third and fourth quartiles, as compared to 62.6 percent and 39 percent, respectively, for East and Middle Tennessee. West Tennessee also appears to rank highest on the miscellaneous factor during both time periods.

TABLE VI

SPATIAL DISTRIBUTION OF FACTOR SCORES[a]

(By Quartile)

	East				Middle				West			
	1960		1970		1960		1970		1960		1970	
Quartile	N	P	N	P	N	P	N	P	N	P	N	P
Factor 1[b]												
1st	3	.125	2	.083	15	.455	10	.303	1	.053	2	.105
2nd	7	.293	8	.333	15	.455	14	.424	15	.790	8	.421
3rd	5	.208	4	.167	3	.091	6	.182	2	.105	8	.421
4th	9	.375	10	.417	0	---	3	.091	1	.053	1	.053
Factor 2[c]												
1st	8	.333	3	.125	12	.364	6	.182	3	.158	1	.053
2nd	9	.375	6	.250	14	.424	14	.424	11	.579	6	.316
3rd	4	.167	8	.333	6	.182	8	.242	3	.158	6	.316
4th	3	.125	7	.293	2	.061	5	.152	2	.105	6	.316
Factor 3[d]												
1st	11	.458	0	---	9	.364	0	.030	15	.790	0	---
2nd	11	.458	3	.125	24	.606	0	---	4	.211	5	.263
3rd	2	.083	6	.250	0	---	9	.212	0	---	5	.263
4th	0	---	15	.625	1	.036	24	.727	0	---	9	.474

TABLE VI

(Continued)

	East				Middle				West			
	1960		1970		1960		1970		1960		1970	
Quartile	N	P	N	P	N	P	N	P	N	P	N	P
Factor 4[e]												
1st	16	.667	14	.583	3	.091	0	---	0	---	0	---
2nd	8	.333	8	.333	13	.394	7	.212	3	.158	0	---
3rd	0	---	2	.083	13	.394	15	.455	5	.263	6	.316
4th	0	---	0	---	3	.091	11	.333	11	.579	13	.684

[a]N represents the number of counties and P the fraction of counties belonging to each grand division falling into each quartile.

[b]Factor 1: Availability of local economies.

[c]Factor 2: Availability of infrastructure.

[d]Factor 3: Income and labor quality.

[e]Factor 4: Miscellaneous factor.

The major shift in income and labor quality between the two time periods was between the first two and last two quartiles. However, during 1960, 79 percent of the counties in West Tennessee belonged to the first quartile (lowest labor quality), but only 45.8 percent and 36.4 percent, respectively, for East and Middle Tennessee, indicating that West Tennessee was characterized by the lowest quality of labor during this period. In 1970 a larger fraction of Middle Tennessee counties belonged to the fourth quartile than for the geographic regions, indicating Middle Tennessee to be characterized by the highest labor quality, followed by East and West Tennessee.

CHAPTER 5

SPECIFIC HYPOTHESES AND STATISTICAL RESULTS

Chapter 5 is divided into two sections. The first section discusses the specific hypotheses associated with the effects of the four orthogonal factors upon manufacturing employment and the behavioral assumptions underlying the mathematical structure of the equations in in the system. Section 5.2 presents the results of the structural and unrestricted reduced form equations, the reliability in projecting employment levels for the seven industries, and the influence that changes in local government expenditures would have had on manufacturing employment over the study period.

5.1 HYPOTHESES OF FACTOR INFLUENCES AND BEHAVIORAL ASSUMPTIONS

Hypotheses of Factor Influences

Factors 1 to 3 were hypothesized to positively influence the distribution of total manufacturing employment among the rural counties of Tennessee. Higher scores for factor 1 represented rural counties characterized by greater levels of labor and localization economies. The higher quantities of labor and employment levels in the myriad of industries making up factor 1 were hypothesized to provide the manufacturing sector with higher quantities and a greater diversity of labor, input and output markets, and collective organizations providing external economies.

Counties having higher scores on factor 2 were those in which local governments spent greater sums of money on the modifiable elements

of the local infrastructure, higher levels of nonmodifiable elements of the infrastructure existed, and the civilian labor force and available capital were greater. Although it was difficult to interpret the association of the latter two elements with factor 2 (instead of factor 1, where they seemed to logically fit), the major importance of factor 2 was that it represented the levels of infrastructural services provided for use to the manufacturing sector which could only be provided by the local governments.

Factor 3 represented labor productivity. Higher scores for factor 3 were hypothesized to elicit greater proportions of manufacturing employment because of the higher skill levels which they represented. No firm hypothesis was made with regard to factor 4 because of the ambiguity of its economic content. Only two industrial employment variables correlated moderately with this factor. Since they both were negatively correlated with the factor, a reasonable conclusion seemed to be that this factor may have a negative influence, if any.

Behavioral Assumptions

The behavioral assumption which gave rise to the mathematical form of the estimated manufacturing distribution equation was derived from a review of the distribution of total manufacturing employment between rural and SMSA counties over a portion of the study period. The fraction of state total employment existing in SMSA counties during the contractionary phase of the economic cycle between 1969 and 1971 and the expansionary phase between 1972 and 1974 was computed from Table 12.2 of the 1974 Tennessee Statistical Abstract (6). During the 1969 to 1971

period, the fraction of total employment going to SMSA counties increased from 0.5867 to 0.6151 and 0.618, respectively, for the three recessionary or slow growth years. During the first year of the expansionary phase, 1972, the fraction continued to increase to 0.6205. However, as the expansion got well underway, the fraction of total employment going to SMSA counties declined to 0.6198 in 1973 and to 0.5867 in 1974. On the basis of these data, there seems to be a tendency for employment in rural counties to increase proportionately more than employment in SMSA counties during an economic expansion, but to decrease more than proportionately during economic slowdowns. Since manufacturing employment is more volatile than secondary sector employment, the inference was drawn that this tendency was particularly true for manufacturing.

A typical method of explaining short- versus long-run movements is to apply a distributed lag model. These are usually of the form:

$$(a) \quad Y_t = a + B \cdot X_t^* + e_t,$$

where Y_t is the endogenous variable to be explained, X_t^* is the permanent value of the exogenous variable in period t, and e_t is a normally distributed disturbance term. The difference in the estimatable form of such models is dependent upon the specification of the adjustment process by which X_t^* is determined.

The most common and simplest adjustment process is to assume the current permanent value of the explanatory variable to be determined by a weighted average of the current actual value and the permanent value in the preceding period. That is,

$$(b) \quad X_t^* = (1 - \lambda) \cdot X_t + \lambda \cdot X_{t-1}^*,$$

where $0 \leq \lambda < 1$. By continuous substitution, equation (b) becomes

$$(c) \quad X_t^* = (1 - \lambda) \cdot (X_t + \lambda X_{t-1} + \lambda^2 \cdot X_{t-2} + \ldots).$$

Equation (c) defines the current permanent value, X_t^*, to be a weighted average of all previous actual values, with the weights declining in time, and functions to dampen the short-run fluctuations above and below trend. Kmenta (19, p. 475) derives the estimatable form of equation (a) to be

$$(d) \quad Y_t = a \cdot (1 - \lambda) + B \cdot (1 - \lambda) \cdot X_t + \lambda Y_{t-1} + e_t,$$

where the coefficient associated with X_t, $B \cdot (1 - \lambda)$, is a short-run parameter and B is the long-run parameter. A higher value of λ indicates that current values of X_t play a lesser role in influencing Y_t than if λ took on a lower value.

The manufacturing distribution equation was specified as:

$$(20) \quad M_{ct} = a + \sum_i^4 a_i \cdot F_{ct}^i \cdot (M_t^T - M_{t-1}^T)^*,$$

where the term in parenthesis refers to the permanent change in total state manufacturing employment. The permanent change in total manufacturing employment was assumed to continuously increase according to the growth rate g in the equation

$$(21) \quad M_t^T = g \cdot M_{t-1}^T.$$

The growth rate g was assumed to be constant over the long term but to exhibit short-term fluctuations, growing larger during periods of expansion and smaller or negative during contractionary periods. For a constant growth rate, the change in the permanent total level of manufacturing employment must increase, with the increase distributed to rural counties in proportion to their factor scores.

The compatability of this model with the tendency of the proportion of total manufacturing employment distributed to rural counties to rise during recessions and fall during expansions may be illustrated by taking the equation of observed data which gives the short-run equation:

$$(22) \quad M_{ct} = a + B' \cdot F \cdot (M_t^T - M_{t-1}^T),$$

where F is an index representing the effects of the factor scores and dividing it by M_t^T, which gives

$$(23) \quad \frac{M_{ct}}{M_t^T} = \frac{a}{M_t^T} + B' \cdot F - B' \cdot F \cdot \left(\frac{M_{t-1}^T}{M_t^T}\right).$$

Equation (23) shows that rural manufacturing growth, as a proportion of state total, declines over time when the growth rate, $\frac{M_{t-1}^T}{M_t^T}$, is constant because the first term in (23) declines. However, when the growth rate increases during expansionary periods, the last term, which is negative, may decline sufficiently such that the proportion of total manufacturing employment distributed to rural counties will increase. During recessionary periods when the growth rate declines and the last term becomes larger, the proportion of total manufacturing employment distributed to rural counties will definitely decrease.

The equations of the secondary sector were formulated by postulating secondary industry employment to be a linear function of the permanent level of employment in linked industries. The inclusion of manufacturing as a linked industry adds a higher degree of instability to the employment levels of the linked industry. However, the employment levels of all secondary industries were considered more stable because unemployment compensation benefits were assumed to contain income available to employees of the manufacturing industry to be at least some minimum level, thereby providing a minimum level of demand for products produced in the secondary sector. The general form of the six equations comprising the secondary sector may be represented as:

$$(e)\quad X^{i}_{ct} = a_{i1}\cdot(1 - \lambda_i) + a_{i2}\cdot(1 - \lambda_i)\cdot A_{ct} + (1 - \lambda_i)\cdot B_{i1}\cdot EX_{ct} + \lambda_i \cdot X^{i}_{ct-1}.$$

where $(i = 1,\ldots,6)$, λ_i, is the adjustment coefficient for the linked industries of the i^{th} secondary industry, and X^{i}_{ct} is the employment level of county c in period t.

Because of the inclusion of normalized factor scores in the employment distribution equation, the long- and short-run nature of the parameters are difficult to interpret without reference to the structure of underlying variables--which is a complex procedure. However, for the equations of the secondary sector, the short-run parameters refer to the immediate effect on employment in the respective equations, while the long-run effects refer to the ultimate effects in each equation.

5.2 STATISTICAL RESULTS

Structural Results

According to Kmenta (19, p. 586), the equations of a recursive system can be separately estimated, provided no correlation among the disturbances of the recursive equations exists, and still retain the property of asymptotic efficiency. The characteristic of simultaneity in the secondary sector equations requires a system method of estimation to be applied to the secondary block of equations.

The hypothesis of no correlation between the blocks of equations was tested by first estimating the manufacturing sector equation by ordinary least squares (OLS). A two-stage least squares estimation procedure (TSL2) was then used to estimate the six equations of the secondary sector block. Agricultural and manufacturing employment were treated as exogenous to these six equations. Next, a correlation matrix between the residuals of all eight equations was developed.

The matrix of correlations between the residuals of all seven equations is presented in Table VII. There is no statistical test for determining if correlations are sufficiently great to warrant the application of a systems estimation method to all equations. The usual criteria is the absolute magnitude of the correlation coefficients and any theoretical foundation for expecting correlation to exist. With regard to the magnitude of the correlations, the highest correlation coefficient between the manufacturing sector equation and any equation of the secondary sector is 0.26 between manufacturing and wholesale trade. This seems to be quite insignificant compared to possible correlations in the 0.8 to 0.99 range which are often encountered in econometric

TABLE VII

MATRIX OF RESIDUAL CORRELATIONS

	Manufac-turing	Agricul-ture	Wholesale Trade	Retail Trade	Construc-tion	Finance	Services	Other
Manufacturing	1.00							
Wholesale Trade	0.26		1.00					
Retail Trade	0.13		0.30	1.00				
Construction	0.10		0.15	0.38	1.00			
Finance	0.05		0.23	0.63	0.33	1.00		
Services	0.15		-0.09	0.22	-0.01	0.10	1.00	
Other	0.15		0.18	0.13	-0.03	0.13	-0.14	1.00

models. Secondly, no theoretical rationale could be thought of as to why correlation between the disturbances should exist between the manufacturing and secondary sector industries or between industries of the secondary sector. The statistical results presented in Table VIII are OLS estimates for the manufacturing sector equation and TSL2 estimates for the six equations of the secondary sector.

The statistical results for the manufacturing distribution equation were generally as hypothesized. However, the product of factor 4 and the change in total employment was not statistically significant, and because no firm hypothesis was associated with this term it was dropped from the equation. The product of factor 1 and the change in total manufacturing employment was also not statistically significant, but this term was considered to have adequate theoretical rationale for being included in the equation and was therefore left in.

The parameter associated with the lagged amount of local manufacturing employment describes the rapidity of adjustment of the change in permanent employment. The value of 0.98 indicates that the permanent change in employment is only slightly influenced by the temporary, but precipitous changes in employment which occur during economic contractions and expansions. Instead, it is a weighted average of changes which have occurred in the past. Similarly, increases in the factor scores caused by increases in government expenditures on infrastructure will have only very small immediate effects on rural manufacturing employment, with the full effects extending many years into the future.

The coefficients for the equations in the secondary sector were generally as hypothesized. Statistical tests <u>per se</u> are not valid for

TABLE VIII

STRUCTURAL RESULTS

Industry	Statistical Estimate[a]
Manufacturing	$M_{ct} = \underset{(3.08)}{132.01^{*}}{}^{b} + [\underset{(1.45)}{0.000944} \cdot F_c + \underset{(9.25)}{0.00607^{*}} \cdot F_c^2 + \underset{(4.25)}{0.0035^{*}} \cdot F_c^3] \cdot [M_t^T - M_{t-1}^T] + \underset{(100.54)}{0.982^{*}} \cdot M_{ct-1}$
Construction	$C_{ct} = \underset{(-0.29)}{-3.77} + \underset{(0.99)}{0.01} \cdot A_{ct} + \underset{(4.75)}{0.01^{*}} \cdot EC_{ct} + \underset{(25.94)}{0.82^{*}} \cdot C_{ct-1}$ $LR^{c} = 0 \quad LR = 0.056$
Finance	$F_{ct} = \underset{(1.12)}{6.31} - \underset{(-1.41)}{0.006} \cdot A_{ct} + \underset{(7.66)}{0.008^{*}} \cdot EF_{ct} + \underset{(32.78)}{0.79^{*}} \cdot F_{ct-1}$ $LR = 0 \quad LR = 0.073$
Retail Trade	$R_{ct} = \underset{(-0.32)}{-2.72} - \underset{(-0.59)}{0.004} \cdot A_{ct} + \underset{(0.99)}{0.0020} \cdot ER_{ct} + \underset{(97.99)}{1.04^{*}} \cdot R_{ct-1}$ $LR = 0 \quad LR = 0$
Wholesale Trade	$W_{ct} = \underset{(-0.56)}{-3.43} + \underset{(0.61)}{0.003} \cdot A_{ct} + \underset{(4.26)}{0.014^{*}} \cdot EW_{ct} + \underset{(56.5)}{0.95^{*}} \cdot W_{ct-1}$ $LR = 0 \quad LR = 0.28$
Services	$S_{ct} = \underset{(-0.09)}{-3.37} - \underset{(-0.34)}{0.010} \cdot A_{ct} + \underset{(4.63)}{0.027^{*}} \cdot ES_{ct} + \underset{(31.82)}{0.84^{*}} \cdot S_{ct-1}$ $LR = 0 \quad LR = 0.17$

TABLE VIII

(Continued)

Industry	Statistical Estimate
Miscellaneous	$O_{ct} = \underset{(-0.76)}{-10.01} + \underset{(0.38)}{0.004 \cdot A_{ct}} - \underset{(-0.02)}{0.0001 \cdot EO_{ct}} + \underset{(26.86)}{1.02 \cdot O^{*}_{ct-1}}$ LR = 0 LR = 0

[a]The values in parentheses are t values.

[b]An asterisk (*) indicates the parameter is statistically significant at the 1.0 percent level in the manufacturing employment distribution equation or is at least twice the size of its standard error in the secondary sector equations.

[c]LR is the value of the long-run parameter computed by dividing the short-run parameter by $(1 - \lambda)$. A value of zero was attributed to the long-run parameter when the coefficient was not at least twice the size of its standard error.

two-stage least squares procedures, but the comparison of the ratio of the absolute value of the parameter estimate with its standard error is generally used as a rule of thumb test, with a ratio greater than two usually taken to be "statistically significant."

Using the above rule of thumb as a guideline, the influence of agricultural employment was found to be insignificant in all equations. One explanation was that agricultural income and agricultural employment vary in opposite directions, with the effect of increases in agricultural income "washing out" the effect of decreases in agricultural employment. Measurement problems with agricultural employment may also be responsible.

The effect of employment in linked industries is positive for the wholesale trade, construction, finance, and service industries. However, the effect of employment in linked industries was not "statistically significant." The only "statistically significant" variable in the retail trade and miscellaneous industry equations was parameter associated with lagged employment. The closeness of these parameters to 1.0 indicates that employment in these industries was constant over time and equal to previous levels of employment in the respective counties. In the four secondary sector equations in which linked industries show a "statistically significant" effect on employment, the parameters associated with the lagged employment variable are significant and less than one, which was consistent with the hypothesis that employment in linked industries exerts a partial influence upon the immediate level of employment in these industries, with the longer term effects being picked up by the parameter λ_i.

Long-run multipliers were computed for the exogenous variables in the set of secondary sector structural equations. These multipliers give the ultimate long-run effects on employment in the various industries of a unit change in the explanatory variable included only in each respective equation. However, these are not ultimate multipliers because they do not take into account the simultaneity of the secondary industries. In other words, the long-run multiplier of 0.034 associated with manufacturing in the construction equation accounts only for the long-run direct effects of changes in manufacturing employment on construction employment, but not the induced effects which flow through other industries. The computation of ultimate long-run multipliers in the secondary sector would involve the computation of "final form" dynamic equations and final form multipliers, a procedure that is quite complicated for small systems with few lagged variables, as illustrated in Kmenta (19, p. 591).

Unrestricted Reduced Form Equations and Model Evaluation

The employment projections for the 59 of the 76 rural Tennessee counties not having missing values in each of the seven industries was derived from the unrestricted form equations. The coefficient estimates for the unrestricted form equations of the manufacturing sector are the same as the structural coefficients for this sector and have the same interpretation. The coefficient estimates for the unrestricted reduced form equations of the secondary industries were made by applying an ordinary least squares (OLS) regression to the dependent variables using manufacturing and agricultural employment and the lagged endogenous variables of the secondary sector as explanatory variables.

Restricted reduced equations take into account more of the information contained in the structure of the system and provide unbiased estimates of ultimate system effects. In constrast, the unrestricted reduced forms are ordinary least squares procedures applied directly to the set of exogenous variables and provide unbiased, but inefficient, results. Unrestricted reduced forms, however, were chosen for analysis because 1) any specification error contained in the hypothesized model would tend to bias the calculated reduced form coefficients, 2) difficulty in judging whether to include or exclude statistically insignificant variables, which are theoretically justified for inclusion in the structural model, but which would tend to compound the effects of specification error in the resulting parameters, and 3) since efficiency is a property of large samples, the lack of this property in the small sample used for the present study is not important.

The level of agricultural employment in each rural county is held constant for the five-year forecasting period at its 1976 level. There were three reasons for doing this. The most important reason was that the decline of agricultural employment in the state appears to have leveled off during the period from 1973 to 1976, as indicated by the state totals. Secondly, the measurement problems associated with agricultural employment, particularly the change in the method of computing agricultural employment in 1971, have resulted in downward bias on the parameter of the agricultural employment distribution equation. Lastly, the Tennessee Econometric Model used a different method of measuring agricultural employment which gives values higher than the pre-1973 levels provided by the Tennessee Department of Employment Security.

The 1977 forecast for manufacturing employment was made by substituting the state total employment projections made by the Tennessee Econometric Model for 1977 and the observed county level employment figures for 1976 into equation (20) of Chapter 5. The forecast value for 1977 was then fed into each of the six unrestricted reduced form equations for the secondary sector, along with the observed county level agricultural employment data for 1976, and the appropriate lagged secondary sector employment data. The observed values in 1976 were used as initializing values of the system in order to maximize the number of counties for which forecasts were made, since counties with missing values were excluded from the forecasting system, and the proportion of counties with missing values was the lowest in 1976.

The forecasts for manufacturing employment for the years after 1977 were made by substituting the forecasted local manufacturing employment and the projections made by the Tennessee Econometric Model into equation (20). Similarly, the forecasts for the secondary sector industries were made by substituting the forecasted values for manufacturing employment in year t, the previously forecasted values of the lagged secondary industry employment data, and the constant level of local agricultural employment as measured by the 1976 data.

The set of unrestricted reduced form equations that was used for making the secondary sector forecasts is presented in Table IX. The employment forecasts for the seven industries for the years 1977 to 1981 may be found in Appendix C. The ultimate test for an econometric model is its ability to forecast, as well as its ability to explain the variation in data over the time period in which is was developed, and its

TABLE IX

UNRESTRICTED REDUCED FORM EQUATIONS FOR THE SECONDARY SECTOR

	Industry[a]					
	Construc-tion	Finance	Retail Trade	Wholesale Trade	Services	Miscella-neous
	$R^2 = 0.85$	$R^2 = 0.93$	$R^2 = 0.99$	$R^2 = 0.96$	$R^2 = 0.83$	$R^2 = 0.75$
Intercept	-5.61 (-0.40)	8.01 (1.45)	0.194 (0.021)	3.65 (-0.55)	14.57 (0.36)	-10.05 (-0.69)
A_{ct}	0.007 (0.65)	-0.013*[b] (-3.24)	-0.004 (-0.63)	0.0006 (0.11)	(-0.024) (-0.81)	0.004 (0.35)
M_{ct}	0.003 (0.91)	-0.002 (-1.26)	0.003 (1.35)	-0.006* (-3.61)	0.005 (-0.49)	0.006 (1.72)
C_{ct}	0.710* (18.10)	0.073* (4.72)	-0.026 (-0.98)	0.040* (2.19)	-0.030 (-0.27)	-0.031 (0.44)
F_{ct}	0.045 (0.55)	0.500* (15.65)	0.100 (1.84)	0.034 (0.88)	-0.293 (-0.12)	0.050 (0.60)
R_{ct-1}	0.074* (2.76)	0.081* (7.705)	1.018* (56.99)	0.034* (2.71)	0.190* (2.46)	-0.026 (-0.95)
W_{ct-1}	0.045 (1.01)	0.042* (2.40)	0.021 (0.70)	0.900* (42.82)	0.071 (0.55)	0.030 (0.65)

TABLE IX

(Continued)

Source	Industry					
	Construc-tion	Finance	Retail Trade	Wholesale Trade	Services	Miscella-neous
S_{ct-1}	-0.014 (-1.41)	0.001 (0.090)	-0.003 (-0.54)	0.005 (1.10)	0.817* (29.37)	-0.011 (-1.12)
O_{ct-1}	0.017 (0.43)	0.0140 (0.84)	-0.001 (-0.036)	0.015 (0.79)	-0.169 (-1.43)	1.041* (24.71)

[a]Values in parentheses are t-values.

[b]Significant at the $\alpha = 0.05$ level.

compatibility with hypothesized economic structure. The tests of hypotheses above did not reject the explanatory theory which formed the groundwork for the model.

Forecast errors were computed for each of the seven industries for which employment projections were made in order to evaluate the model's forecasting ability. These were computed as the percentage by which projected employment in 1977 exceeded or fell short of actual employment for each of the 59 counties for which projections were made. The actual forecast error for 1977 is shown for each county in Appendix D. Forecast errors were computed using both the projected total employment in manufacturing by the Tennessee Econometric Model of 502,900, and the actual 1977 total of 486,878. The projected total by the Tennessee Econometric Model overestimated actual total manufacturing employment by 3.3 percent. The distribution of the mean average predicted error (MAPE) statistics are presented in Table X, while the distribution of the average forecast errors are presented in Table XI.

The degree of accuracy of the forecasts is a relative matter in which the adequacy of alternative models dealing with similar data must be considered, although obtainment of an overall norm should also be pursued when possible. The time series models for small individual SMSA regions, developed by Ballard and Glickman (2), Glickman (10), and Latham, Lewis, and London (20) used MAPE statistics in testing the reliability of their models in making backcasts (i.e., over the time interval for which their models were developed. In general, their MAPE statistics for aggregated and disaggregated employment are less than 10 percent, with many being less than 5 percent.

TABLE X

MAPE STATISTICS FOR INDUSTRIAL EMPLOYMENT

Industry	Driving Force: Change in Total Manufacturing Employment Projected by the Tennessee Econometric Model (1977)	Driving Force: Actual Change in Total Manufacturing Employment (1977)
Manufacturing	14.78	14.02
Wholesale Trade	30.21	30.82
Retail Trade	9.82	9.85
Services	25.76	25.74
Finance	24.09	24.11
Construction	39.03	39.04
Miscellaneous	49.22	48.61

TABLE XI

THE DISTRIBUTION OF PROJECTED RURAL EMPLOYMENT AS A PERCENT OF OVER- OR UNDERESTIMATES OF ACTUAL 1977 RURAL EMPLOYMENT

Industry	Mean	Standard Deviation	Standard Error	Skewness	Kurtosis	Minimum	Maximum
			Change in Total Manufacturing Employment Projected by the Tennessee Econometric Model (1977)				
Manufacturing	11.84	21.72	2.83	3.53	18.92	-17.16	137.51
Wholesale Trade	-10.75	95.20	12.34	-6.82	50.19	-702.56	66.41
Retail Trade	3.79	22.39	2.92	5.03	25.39	-48.60	153.18
Services	-8.47	51.51	6.71	-4.32	26.66	-330.75	73.59
Finance	-7.09	40.42	5.26	-1.77	10.69	-204.09	122.36
Construction	27.59	78.15	10.17	4.22	22.70	-36.74	496.49
Miscellaneous	-10.02	107.59	14.01	-3.22	14.47	-531.36	188.99

TABLE XI

(Continued)

Industry	Mean	Standard Deviation	Standard Error	Skewness	Kurtosis	Minimum	Maximum
			Actual Change in Total Manufacturing Employment (1977)				
Manufacturing	10.36	20.43	2.66	2.76	11.70	-15.63	117.75
Wholesale Trade	-11.12	99.27	12.92	-6.88	50.79	-734.54	66.42
Retail Trade	3.81	22.63	2.95	5.08	35.84	-48.60	155.30
Services	-8.48	51.56	6.71	-4.34	26.76	-331.42	73.27
Finance	-7.06	40.50	5.27	-1.78	10.72	-204.61	122.63
Construction	27.60	78.22	10.18	4.22	22.64	-36.92	496.48
Miscellaneous	-10.69	106.48	13.86	-3.34	14.93	-531.53	185.87

In comparison to these models, the statistics in Table XI suggest the model developed in this research is rather weak at forecasting. However, models making backcasts would be expected to perform somewhat better than a model making forecasts. More importantly, though, the model developed was tested over a relatively large number of counties. Each county had a small employment base when compared to the SMSA models. As Latham, Lewis, and London (20) note, MAPE statistics based on large aggregates may be relatively smaller because of the presence of compensating random variation which may not be present in the counties over which the present research was done. In addition, the data used for the SMSA models were annual averages, which may be more stable than the first quarter averages which were drawn from the County Business Patterns (37) publication for development of the multi-industry rural model. The first quarter is known to be a volatile time of the year because weather may significantly influence normal economic processes. Finally, the MAPE statistics for the largest sector, manufacturing, with an average employment of 3413 (see Appendix B), and the second largest industry, retail trade, with an average employment of 1014, which together account for about 70 percent of total rural employment, were not considerably different from the MAPE statistics in the SMSA studies. In view of these limitations, the projective capability of the multi-industry rural model was considered adequate.

The first point to note about the statistics in Table XI is that the means of the forecast errors for all industries are very close, regardless of whether actual total manufacturing employment or the projected total by the Tennessee Econometric Model were used as driving

forces. Most importantly, the means of the forecast errors for manufacturing differ by only 0.76 percent, although actual total manufacturing employment was overestimated 3.3 percent by the Tennessee Econometric Model. It appears that the inherent inaccuracies of the projections taken from the Tennessee Econometric Model may make only minor differences in the degree of accuracy with which county level employment projections are made.

The second point worth observing is that employment in some industries is consistently overestimated or underestimated, as evidenced by the means. The only pattern appears to be that overestimation occurs for three of the industries having the highest employment levels--manufacturing, retail trade, and construction--while employment in the three industries with the smallest employment levels is underestimated. The overestimate in manufacturing may have to do with the post-1974 decline in the short-run growth path of total manufacturing employment, although the distributed lag nature of the model was intended to take care of this problem. A more reasonable solution appears when the other statistics in Table XI are examined.

The important point to note about the other statistics in Table XI is the wide range in the forecast errors and the tendency for these errors to be non-normally distributed. A more positive value for skewness indicates the forecast error to be more clustered to the left of the mean, with the most extreme values to the right. A negative value for skewness indicates the contrary. A value of zero would indicate a symmetric, bell-shaped curve. Kurtosis was used to measure the relative peakedness of the distribution. A normal distribution would have a kurtosis of

zero, while a more peaked (narrow) distribution would have a higher value. While a distribution may be bell-shaped, it need not be normal.

The distribution of the forecast errors for all industries is non-normal, with a consistent pattern emerging. The distribution of forecast errors for those industries in which employment is overestimated contains extreme values larger than the mean, while the distribution of forecast errors for those industries in which employment is underestimated contains extreme values smaller than the mean, as evidenced by both the statistics for skewness and the minimum and maximum values. The most obvious reason for the skewness is that over- or underestimates for those counties having small industrial bases may result in rather large percentage deviations. For example, Bledsoe county had an actual manufacturing employment level of 136 in 1977, but the parameters of the model, based generally on counties with larger manufacturing bases, projected 293.42 and 323.02, which resulted in average forecast errors of 137.51 and 117.75. Similarly, Pickett county had an actual employment level of 10 for finance, but negative levels of employment projected by both models, which resulted in negative forecast errors of -204.09 and -204.61, respectively.

Problems of this nature generally manifest themselves on data at the extremes of distribution, but are particularly serious when they are at the low end of the distribution because small deviations can become very large percentage deviations. When perceived in this context, the model becomes even more acceptable as a predictive device. It appears not to be useful in application to counties with small employment bases in general.

Sensitivity of Manufacturing Employment to Changes in Expenditures on Infrastructure

A rough measure of the effect of changes in the level of infrastructural expenditures upon manufacturing employment was derived by computing elasticities of the percentage change in local manufacturing employment divided by the percentage change in each type of government expenditure (variables 33-39), evaluated at the means. The absolute magnitude of these changes was also included. The elasticities and absolute magnitudes were derived by combining $R^{-1} \cdot P$ into a 40 by 4 factor score coefficient matrix, W, which is presented in Appendix E, where w_{ij} represented the weight associated with the i^{th} normalized variable and the j^{th} factor, and computing

$$\frac{dE^c_{ct}}{dX_i} \frac{\bar{X}_i}{\bar{E}^c_{ct}} = \left[b_{21} \frac{\bar{X}_i}{\bar{E}^c_{ct}} \frac{W_{i1}}{\sigma_i} + b_{22} \frac{\bar{X}_i}{\bar{E}^c_{ct}} \frac{W_{i2}}{\sigma_i} + b_{23} \frac{\bar{X}_i}{\bar{E}^c_{ct}} \frac{W_{i3}}{\sigma_i} + b_{24} \frac{\bar{X}_i}{\bar{E}^c_{ct}} \frac{W_{i4}}{\sigma_i}\right] \left[\overline{M^T_t - M^T_{t-1}}\right],$$

where $\bar{X}_i$ is the mean of the i^{th} policy variable and σ is its standard deviation, $\bar{E}^c_{ct}$ is the mean value of employment, and $\left[\overline{M^T_t - M^T_{t-1}}\right]$ is the mean value of the change in total manufacturing employment. The elasticities and their corresponding absolute magnitude are presented in Table XII.

The elasticities suggest that expenditures on highways may be the most efficient means of increasing employment in the manufacturing sector, followed by expenditures on public protection, parks and natural

TABLE XII

PERCENT CHANGE IN EMPLOYMENT/PERCENT CHANGE IN INDEPENDENT VARIABLES, EVALUATED AT THE MEANS

Independent Variables With a 1-Percent Change	Factor 1	Factor 2	Factor 3	Net Percent/ (Employment Change)
33. Education expenditures per pupil--$4.08	-0.0012000	-0.002800	0.00350	0.00
34. Highway expenditures--$3,748	-0.0001800	0.002600	-0.00050	0.0019 (0.065)
35. Public welfare expenditures--$512.20	0.0000400	0.000220	-0.00015	0.00011 (0.0038)
36. Health and hospital expenditures--$3,540	0.0000078	0.000349	-0.00043	-0.000073 (0.0025)
37. Expenditures on public protection--$282.40	0.0001480	0.001500	0.00062	0.0023 (0.079)
38. Expenditures on parks and natural resources--$112.40	-0.0002000	0.001500	-0.00019	0.0011 (0.038)
39. Financial expenditures--$1,038	0.0001300	0.000160	0.00086	0.0012 (0.041)

resources, and financial expenditures. Expenditures on these items appear to have the potential of creating at least the impact shown in Table XII, since the elasticities have been computed with short-run multipliers and have avoided analyzing any secondary impact in the secondary industries.

CHAPTER 6

SUMMARY, LIMITATIONS OF THE STUDY, AND SUGGESTIONS FOR FURTHER RESEARCH

6.1 SUMMARY

Theories of rural industrial development suggest that growth in rural employment is strongly influenced by growth in manufacturing employment, particularly in those regions where agriculture is a declining industry. The growth in manufacturing contributes directly to employment through the local labor it hires. In addition, jobs in secondary industries are created through expenditures by the basic sector employees for consumer products and for inputs furnished by the secondary sector. Induced employment effects are created by the expenditures of secondary industries and their employees upon producer and consumer products of other secondary industries.

The objectives of this study were to: 1) develop and operationalize the concepts of urbanization and localization economies; 2) incorporate the measures of these economies into an econometric model explaining the distribution of manufacturing and secondary sector employment among the 76 rural (i.e., non-SMSA) counties of Tennessee. The concepts of urbanization and localization economies were operationalized into four orthogonal dimensions by factor analysis. The resulting factor scores were then incorporated into an econometric model consisting of seven behavioral equations and six identities defining the composition of industries linked to the secondary sector.

Greater levels of market availability for a myriad of conventional and unconventional inputs and labor availability made up factor 1. Factor 2 was composed of variables measuring general labor and infrastructural availability. Factor 3 represented labor productivity and income levels, while factor 4 represented another dimension of market availability for conventional and non-conventional inputs. The first three factors were hypothesized to positively influence manufacturing growth, while no hypothesis was made regarding the influence of factor 4 because of its interpretive ambiguity.

An examination of rural manufacturing employment relative to total manufacturing employment in Tennessee against time revealed considerable instability in the proportion of total manufacturing employment in rural counties and implied the existence of several short-run growth paths. A distributed lag model capable of handling long-run growth processes was then developed. The econometric model specified manufacturing employment to be a linear function of the permanent change in total manufacturing employment weighted by the factor scores. The employment levels in the secondary sector were specified to be linear functions of the permanent levels of employment in industries linked through consumer and industrial expenditures.

The empirical results of the manufacturing distribution equation (6) generally supported the argument that the distribution of total manufacturing employment in the state of Tennessee among rural counties is influenced by their past industrial and infrastructural characteristics. Greater industrialization of rural counties did not appear to provide any influence upon the distribution of manufacturing. The role of government

expenditures on local infrastructure, represented by factor 2, in generating a higher proportion of manufacturing employment, was substantiated by equation (6). The most important means of government influence were expenditures on public protection, highways, financial expenditures, parks and natural resources, and education expenditures per pupil, which was an important variable comprising factor 3. The coefficient of adjustment in the manufacturing distribution equation was quite high, indicating that long-run employment in the industry was influenced more strongly by past changes in the growth of total manufacturing than by recent changes.

The level of employment in agriculture was not a "statistically significant" determinant of employment in the secondary sector. This may be due to measurement problems associated with agricultural employment and/or the influence being total agricultural income, which was not necessarily measured by using an employment variable. A "statistically significant" positive relationship existed between the other linked industries and secondary industrial employment except for the retail trade and miscellaneous industries, where the coefficient was not "statistically significant." The adjustment parameter in these two equations was close enough to unity to suggest the conclusion that employment in these industries did not vary significantly from year to year in the rural counties.

6.2 LIMITATIONS OF THE STUDY AND SUGGESTIONS FOR FURTHER RESEARCH

Limitations of this study were both conceptual and empirical. Both factor scores and the econometric model were developed largely as heuristic devices for explaining the distribution of employment among rural

counties. Many dimensions of the economies may exist, with some being conceptually distinct (i.e., orthogonal) and others being mutually correlated to some extent. The factor analysis model constrained these economies to be orthogonal and only developed four dimensions, of which only three were highly interpretable. Further research is needed for determining the expected number and types of economies that influence industrial growth, as well as the degree of correlation to expect among them. A corollary to this requirement is that the specific variables to be included on each dimension needs to be further investigated. Lastly, many of the variables comprising the dimensions influence one another in both temporal and spatial manners which are very complex. In view of these limitations, however, it was felt that the dimensions developed in Chapter 4 were based on reasonably sound, although underdeveloped, theoretical framework.

The structure of the econometric model was developed in a much more ad hoc manner. A relatively sound system of industrial interrelationships was developed, but the distinction between the influences caused by industrial purchases and sales to one another and consumer demand, and most importantly the effects of income levels, were submerged in favor of a model with simplified relationships. Income projections and the explicit influences of income on industrial growth are also important pieces of information to decision-makers and need to be included in future models. Also, the hypothesis of permanent changes in the growth of total manufacturing employment and the permanent levels of employment in industries needs to be further investigated, since this was the most heuristic part of the model. Lastly, the effects of the distribution of urbanization

and localization economies on the direct effects of linked industries on the employment levels of secondary industries needs to be further investigated because it is reasonable to expect the coefficients of these variables to vary among counties.

The normative projections of employment in the seven industries comprising the model are constrained by parameters manifesting the past structure of rural employment growth, and, as such, the projections are conditional upon the persistence of that structure into the future. The use of annual data suggests that an average of previous structures was estimated and that the influence of the most current structure on future employment is biased by the inclusion of past structures such that future observed employment may lie outside the normative forecast range provided by the model. This is a common problem in economic analysis where a long time series is used.

In summary, existing conceptual information needs to be integrated into improved theoretical models and empirical testing in a variety of socio-economic environments is necessary to determine the factors responsible for rural industrial growth. Testing in a range of environments will enable the factors which are most general in their effect to be identified.

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APPENDICES

APPENDIX A

TABLE A-1

DATA SOURCES FOR URBANIZATION AND LOCALIZATION ECONOMIES

Variables	1960 Observations	1970 Observations
URBANIZATION:		
1. Number of doctors per 1000 population	1969 TSI,[a] Table 10.17	1971 TSI, Table 20.19
2. Number of hospital beds per 1000 population	1969 TSI, Table 10.17	1971 TSI, Table 20.19
3. Bank deposits	1962 C&C,[b] Item 40	1972 C&C, Item 118
4. Distance from the county seat to the nearest SMSA		
5. County population	1971 TSI, Table 16.4	1971 TSI, Table 16.4
6. Population in contiguous counties	1962 C&C, Item 1	1972 C&C, Item 3
7. Population density	1969 TSI, Table 16.12	1971 TSI, Table 16.12
8. Percent urban population	1969 TSI, Table 16.12	1971 TSI, Table 16.10
9. Unemployment rate	1969 TSI, Table 12.14 (computed)	1971 TSI, Table 12.13
10. Size of the civilian labor force	1969 TSI, Table 12.14	1972 C&C, Item 34
Government Expenditures	1969 TSI, Table 10.17	1974 TSI, Table 10.23
11. Educational		
12. Highways		
13. Public welfare		
14. Health and hospital		

TABLE A-1

(Continued)

Variables	1960 Observations	1970 Observations
15. Police protection		
16. Parks and natural resources		
17. Finance		
18. Property tax rate		
19. Percent females in labor force	1969 TSI, Table 12.14 (computed)	1972 C&C, Items 34 & 35 (computed)
20. Percent labor force over 25 with a high school education	1962 C&C, Item 28	1972 C&C, Item 26
21. Median age of population	1962 C&C, Item 13	1971 TSI, Table 16.8
22. County per capita income	1967 C&C, Item 28	1972 C&C, Item 58
LOCALIZATION[c]		

[a]TSI refers to Tennessee Statistical Abstract (6).

[b]C&C refers to City and County Data Book (36).

[c]Data for the 1960 and 1970 periods were taken from the 1960 and 1970 County Business Patterns (37).

Note: Because of the nature of census data, some observations were not made exactly in 1960 and 1970, but rather were made in years that were close enough to represent economic circumstances in these periods.

APPENDIX B

TABLE B-1

DESCRIPTIVE STATISTICS OF THE DATA

	Data Used to Estimate Factor Scores		
	Mean	Standard Deviation Error	Skewness
Population of County and Contiguous Counties	189,247	10,166	2.17
Total Employment in the County and Contiguous Counties by Type:			
Retail trade	9,904	578	2.19
Wholesale trade	2,031	197	4.01
Financial services	1,945	169	2.19
Employment in other industries:			
Food Processing	1,396	107	2.60
Construction	5,101	242	1.47
Communications	4,401	417	6.46
Other durable goods	1,493	107	1.13
Printing	667	58	1.86
Non-electrical machinery	802	66	2.07
Other non-durable goods	2,426	152	1.83
Textiles and apparel	6,048	310	2.34
Electrical machinery	1,237	113	1.68
Furniture, lumber, and wood products	2,237	109	1.83
Chemical	2,602	297	1.74
Agriculture, forestry, and fisheries	6,993	362	1.42
Mining	603	52	2.29
Metal products	2,374	222	1.69
Transportation equipment	696	61	2.08
Other	17,768	1,155	1.97

TABLE B-1

(Continued)

	Data Used to Estimate Factor Scores		
	Mean	Standard Deviation Error	Skewness
Percent urban population	20.90	1.57	0.37
Bank deposits ($ in millions)	19.60	1.58	2.19
Expenditures on public protection	28.24	2.64	2.14
Highway expenditures	374.80	17.46	1.11
Population density	51.46	3.14	2.74
Size of the civilian labor force	6,717	427	1.23
Per capita income	1,417	46.60	0.23
Percent of the civilian labor force over 25 years of age			
Education expenditures per pupil	408.96	6.56	0.87
Distance from the county seat to the nearest SMSA	62.63	2.32	0.08
Employment rate	94.71	0.35	-4.17
Percent females in the civilian labor force	70.41	8.67	2.60
Median age of population	29.34	0.27	-0.34
Number of doctors per 1000 population	64.40	18.81	9.80
Number of hospital beds per 1000 population	117.41	25.40	7.10
Public welfare expenditures	51.22	5.79	6.57
Health and hospital expenditures	354	53	3.00
Expenditures on parks and natural resources	11.24	1.02	2.33
Financial expenditures	103.72	11.53	6.94
Property tax rate	4.48	0.13	1.60

TABLE B-2

COUNTY LEVEL EMPLOYMENT

Industry	Mean	Standard Deviation
Agriculture	965	676
Manufacturing	3413	2920
Construction	313	357
Finance	203	215
Retail Trade	1014	915
Wholesale Trade	244	342
Miscellaneous	272	291

APPENDIX C

TABLE C-1

PROJECTIONS OF RURAL EMPLOYMENT FOR 1977 TO 1981

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
BEDFORD							
1977	4371.70	299.04	1053.44	800.57	276.24	523.49	314.69
1978	4819.17	310.28	1117.60	931.90	276.03	483.88	318.84
1979	5356.57	317.92	1184.72	873.71	277.84	462.22	326.05
1980	5986.74	322.77	1255.23	923.76	281.94	453.75	336.27
1981	6584.37	326.13	1329.22	979.83	288.40	454.75	348.87
BENTON							
1977	1308.49	65.28	469.44	169.87	75.58	83.10	180.00
1978	1634.38	70.52	490.43	215.24	89.62	102.44	177.44
1979	2008.44	75.13	514.34	257.97	99.33	119.21	176.34
1980	2432.25	78.74	540.95	299.28	106.81	134.38	176.86
1981	2836.74	81.52	569.99	339.60	113.29	148.43	178.79
BLEDSOE							
1977	293.42	56.50	125.96	83.17	39.28	47.94	12.54
1978	354.84	53.06	133.43	102.55	40.69	43.89	3.95
1979	398.90	49.83	141.18	121.30	41.37	41.19	-5.04
1980	425.17	46.92	149.10	139.57	41.85	39.39	-14.63
1981	454.47	44.29	157.19	157.60	42.30	38.26	-24.85
BRADLEY							
1977	11298.33	726.57	3753.78	2542.69	717.09	1081.92	364.48
1978	11946.80	788.81	3936.00	2797.52	764.30	1121.70	342.54
1979	12762.62	849.96	4129.25	3049.95	806.66	1167.30	320.18
1980	13750.92	909.54	4333.75	3303.36	847.56	1218.19	297.75
1981	14682.71	968.61	4549.36	3559.20	889.05	1273.36	274.29

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
CAMPBELL							
1977	2365.97	199.82	1258.83	663.82	194.89	236.64	807.33
1978	2695.63	233.51	1309.93	670.87	273.73	289.45	816.34
1979	3079.05	266.85	1368.11	686.30	268.10	335.69	828.24
1980	3518.00	299.20	1432.40	710.24	292.24	377.30	842.78
1981	3936.13	330.67	1502.16	742.02	313.44	415.61	859.49
CANNON							
1977	850.48	59.31	231.90	183.85	66.56	57.10	82.99
1978	997.21	58.19	245.63	195.19	63.48	61.64	78.67
1979	1148.75	56.81	259.73	208.42	63.02	65.97	74.30
1980	1305.35	55.29	274.45	223.23	63.86	70.28	70.02
1981	1457.50	53.72	289.93	239.34	65.40	74.63	65.83
CARROLL							
1977	3197.42	224.71	926.37	497.39	164.62	216.21	62.16
1978	3583.61	225.33	972.96	604.06	182.92	242.28	56.39
1979	4040.33	226.86	1023.31	702.03	196.97	265.13	50.97
1980	4569.85	228.56	1077.34	794.21	208.87	286.15	46.29
1981	5073.07	230.54	1134.84	882.23	219.91	306.06	42.13
CARTER							
1977	4042.80	155.36	1470.05	848.01	284.59	424.30	112.14
1978	4480.97	191.19	1538.87	977.41	299.88	431.82	93.09
1979	5005.46	223.65	1612.44	1103.91	314.06	444.19	74.89
1980	5618.98	252.86	1690.96	1228.89	328.14	460.50	57.75
1981	6201.09	279.70	1774.33	1352.90	342.79	479.79	41.16

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
CHESTER							
1977	1153.70	80.24	364.64	269.71	74.00	115.83	124.33
1978	1325.27	83.08	383.12	287.49	84.66	114.55	118.09
1979	1508.73	85.45	403.59	307.42	91.13	115.85	112.72
1980	1704.55	87.38	425.68	329.43	95.83	118.96	107.96
1981	1893.59	89.05	449.20	353.28	99.89	123.34	103.56
CLAIBORNE							
1977	2036.79	163.03	505.24	600.71	120.38	121.01	857.63
1978	2214.35	171.10	533.64	470.07	131.84	145.66	884.64
1979	2409.15	179.26	564.90	364.71	142.01	169.13	914.77
1980	2621.79	187.58	598.92	280/19	151.71	191.69	947.87
1981	2826.19	196.27	635.60	212.71	161.39	213.53	983.72
CLAY							
1977	510.50	14.13	104.30	146.55	27.13	8.64	23.05
1978	517.58	11.83	110.07	150.61	29.59	10.82	14.69
1979	495.75	10.17	116.07	156.02	31.28	12.54	5.63
1980	444.21	9.20	122.13	162.63	32.64	13.82	-4.36
1981	399.83	8.79	128.27	170.50	33.81	14.78	-15.28
COCKE							
1977	3436.66	147.69	1130.50	638.43	187.05	233.85	77.56
1978	3674.06	165.03	1182.08	754.57	211.72	264.72	63.53
1979	3948.78	183.11	1237.90	862.55	230.63	291.52	48.80
1980	4262.02	201.35	1297.63	965.33	246.66	315.75	33.42
1981	4560.63	219.71	1361.01	1064.82	261.39	338.30	17.16

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
COFFEE							
1977	4967.74	340.08	1813.65	1923.41	312.06	403.27	2371.90
1978	5415.14	401.52	1893.20	1479.13	378.71	480.44	2439.73
1979	5955.15	460.67	1984.96	1204.47	426.68	554.85	2518.33
1980	6590.65	517.39	2087.30	988.13	465.99	626.79	2606.71
1981	7192.95	572.52	2199.16	819.77	501.72	696.53	2703.71
CUMBERLAND							
1977	2201.82	221.97	965.13	827.95	215.22	227.05	221.63
1978	2471.41	237.81	1006.73	814.02	198.51	258.90	218.03
1979	2780.19	252.15	1048.76	813.37	195.90	285.82	213.93
1980	3129.46	265.27	1092.69	823.57	199.91	309.75	210.22
1981	3462.90	277.61	1139.12	842.66	207.15	331.75	207.03
DECATUR							
1977	2356.57	61.36	387.83	84.04	55.29	91.22	241.38
1978	2559.97	59.58	402.91	93.03	55.62	114.99	253.72
1979	2787.99	58.34	418.92	101.45	58.43	133.84	266.74
1980	3041.49	57.35	436.24	109.71	62.20	149.50	280.90
1981	3284.30	56.61	454.96	117.94	66.36	163.01	296.30
DEKALB							
1977	1846.94	63.90	324.02	487.55	72.58	93.22	93.65
1978	2058.02	63.07	337.39	435.23	59.94	102.05	94.32
1979	2293.20	61.06	350.65	396.16	54.87	110.22	95.79
1980	2553.33	58.13	364.56	367.61	53.46	118.13	98.48
1981	2802.74	54.67	379.40	347.34	53.93	125.85	102.40

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
DYER							
1977	4666.03	539.02	1641.98	801.98	411.12	792.22	247.07
1978	5130.74	558.69	1731.68	937.30	405.83	743.25	244.50
1979	5690.69	574.02	1824.16	1071.16	406.71	715.46	243.28
1980	6348.86	586.50	1920.34	1203.52	412.15	703.48	243.59
1981	6972.77	597.57	2020.56	1334.11	421.28	703.07	244.83
FAYETTE							
1977	1609.60	173.19	481.28	379.54	76.86	125.74	83.49
1978	1611.10	169.64	499.63	385.70	83.88	141.16	80.04
1979	1587.32	168.07	518.83	393.75	89.86	153.46	75.52
1980	1537.58	168.27	538.77	403.84	95.28	163.51	69.78
1981	1494.20	169.95	559.44	416.17	100.36	172.04	62.86
FENTRESS							
1977	1683.69	38.06	359.16	105.27	50.92	68.11	153.98
1978	1721.27	40.33	371.20	120.54	51.96	88.91	156.81
1979	1742.23	43.65	383.62	134.44	55.07	104.71	158.88
1980	1746.14	47.86	396.61	147.48	58.97	117.07	160.35
1981	1753.43	52.74	410.28	160.20	63.06	127.09	161.37
FRANKLIN							
1977	2424.28	237.04	1363.66	994.53	253.22	269.83	222.28
1978	2722.85	267.42	1418.28	1028.57	260.00	319.49	209.00
1979	3068.28	296.28	1475.18	1071.50	266.95	360.65	194.73
1980	3462.12	323.59	1535.52	1122.36	278.41	396.30	180.30
1981	3837.56	349.70	1599.68	1180.23	291.97	428.25	165.77

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
GIBSON							
1977	9196.95	455.90	1977.45	1377.61	417.16	917.09	703.98
1978	9672.34	483.02	2083.89	1406.74	439.79	868.79	727.73
1979	10298.86	506.48	2196.93	1452.69	456.63	846.46	756.72
1980	11053.33	527.13	2316.37	1512.52	472.69	843.02	790.40
1981	11765.42	546.62	2442.02	1583.13	490.28	853.14	827.67
GILES							
1977	3868.25	463.75	1032.90	602.89	203.24	231.63	212.36
1978	4242.58	444.21	1088.41	684.56	212.60	282.41	224.56
1979	4687.72	428.88	1146.56	758.80	224.10	322.87	236.03
1980	5205.93	416.59	1207.95	828.53	236.16	356.75	247.74
1981	5698.04	407.03	1272.70	895.41	248.47	386.34	259.83
GRAINGER							
1977	928.79	12.95	260.42	72.59	47.59	54.74	11.12
1978	1058.42	15.35	269.14	101.00	42.98	64.75	5.31
1979	1189.27	17.31	277.92	127.50	41.90	72.37	-0.95
1980	1321.47	18.89	287.14	152.47	42.41	78.46	-7.39
1981	1450.51	20.13	296.93	176.27	43.61	83.55	-13.92
GREENE							
1977	7263.09	605.26	2251.73	1706.34	403.54	504.71	389.74
1978	7819.94	616.18	2363.79	1826.31	447.71	575.87	389.46
1979	8504.92	630.62	2484.27	1946.44	483.47	638.03	389.55
1980	9322.00	647.06	2612.95	2069.67	514.93	694.61	390.57
1981	10094.49	665.49	2749.46	2197.06	544.69	747.54	392.05

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
GRUNDY							
1977	678.60	31.52	237.37	186.41	61.19	58.36	15.61
1978	641.60	34.37	249.95	211.27	62.71	57.62	4.13
1979	566.28	37.76	262.64	235.71	64.55	57.44	-8.73
1980	451.55	41.90	275.38	259.86	66.67	57.55	-23.25
1981	347.32	46.64	288.25	284.16	68.94	57.93	-39.40
HAYWOOD							
1977	1152.19	165.62	739.56	324.88	146.76	162.39	175.97
1978	1194.37	179.36	765.93	356.48	137.50	193.73	171.65
1979	1218.60	193.46	792.11	388.45	137.77	217.84	165.22
1980	1224.42	207.98	818.99	420.91	142.30	237.12	157.21
1981	1233.85	222.81	847.03	454.25	148.67	253.18	147.91
HENDERSON							
1977	2922.75	161.10	679.50	283.04	95.10	153.12	61.87
1978	3155.11	157.50	706.14	342.18	101.23	184.85	64.62
1979	3421.32	155.40	734.42	395.03	108.21	209.70	67.01
1980	3722.49	154.22	764.64	443.57	115.26	230.05	69.59
1981	4010.01	153.81	796.83	489.08	122.23	247.40	72.43
HENRY							
1977	3873.58	298.79	1202.28	545.67	209.86	453.36	286.05
1978	4228.55	312.74	1255.05	621.80	230.59	452.98	288.66
1979	4649.91	325.59	1312.19	696.11	245.15	458.55	293.25
1980	5139.76	337.26	1373.38	769.68	257.27	468.64	299.73
1981	5605.04	348.28	1438.34	842.83	268.84	482.07	307.62

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
HICKMAN							
1977	1408.92	25.64	218.86	95.45	35.50	69.91	109.47
1978	1614.02	24.18	224.50	82.04	26.47	80.41	113.97
1979	1839.89	21.83	230.07	72.39	22.76	88.84	119.25
1980	2087.26	18.68	236.13	65.61	21.50	96.03	125.76
1981	2324.88	14.96	242.87	60.92	21.41	102.40	133.56
HOUSTAN							
1977	556.35	9.81	107.24	113.79	11.06	37.34	19.72
1978	736.66	8.03	105.56	88.24	3.08	42.07	16.83
1979	928.19	5.00	103.71	68.47	-1.17	45.80	14.75
1980	1131.41	0.88	102.05	53.15	-3.70	48.89	13.71
1981	1327.83	-4.09	100.71	41.17	-5.42	51.51	13.74
HUMPREYS							
1977	2848.90	113.52	696.28	368.18	129.19	250.24	92.82
1978	3059.30	121.79	726.53	410.45	130.04	251.52	90.83
1979	3298.16	129.05	758.19	452.78	132.93	255.25	89.24
1980	3566.42	135.45	791.56	495.32	137.05	260.97	88.22
1981	3822.87	141.35	826.75	538.04	142.07	268.24	87.62
JACKSON							
1977	614.52	23.30	145.99	101.63	30.88	59.65	68.74
1978	735.97	23.38	149.51	89.77	25.89	59.87	65.75
1979	855.33	22.59	153.02	82.00	23.44	60.57	63.16
1980	972.65	21.18	156.74	77.35	22.27	61.62	61.03
1981	1087.84	19.29	160.76	75.11	21.77	62.92	59.35

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
JEFFERSON							
1977	2754.46	187.30	836.13	554.58	158.94	231.55	858.34
1978	2857.62	205.70	877.41	497.96	187.19	254.05	880.14
1979	2964.09	224.84	923.14	456.25	207.22	276.77	904.34
1980	3074.03	244.62	972.57	427.44	223.56	299.49	930.37
1981	3180.87	265.09	1025.35	409.72	238.43	322.21	957.89
JOHNSON							
1977	2482.56	47.99	310.50	209.94	70.14	80.03	91.50
1978	2566.28	42.51	331.57	241.56	73.06	86.90	93.36
1979	2647.60	38.40	353.35	270.82	76.40	93.11	94.67
1980	2726.53	35.51	375.91	298.46	80.02	99.01	95.48
1981	2804.22	33.73	399.32	325.09	83.85	104.81	95.83
McMINN							
1977	8564.94	354.41	1808.68	1489.50	337.68	490.96	254.02
1978	8944.85	363.01	1903.20	1566.49	354.32	505.21	261.76
1979	9417.95	373.94	2002.49	1647.22	373.24	545.56	269.18
1980	9987.10	386.46	2107.20	1732.67	393.32	583.94	277.00
1981	10524.37	400.78	2217.45	1822.91	414.41	621.28	285.01
McNAIRY							
1977	3179.85	134.84	492.02	265.58	97.49	184.45	135.19
1978	3341.46	128.18	521.05	308.60	105.80	186.54	140.85
1979	3521.77	122.75	551.70	348.46	111.89	189.64	146.83
1980	3721.41	118.35	583.89	386.19	117.18	194.36	153.10
1981	3912.78	115.01	617.56	422.43	122.36	200.37	159.56

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
MACON							
1977	2193.99	61.09	351.45	232.33	78.12	113.87	177.76
1978	2373.42	60.08	371.69	241.33	79.24	118.56	182.04
1979	2571.24	59.01	392.98	252.55	81.46	124.01	186.98
1980	2788.07	57.91	415.49	265.73	84.34	130.16	192.72
1981	2996.33	56.93	439.27	280.50	87.73	136.89	199.19
MADISON							
1977	8494.48	2262.49	5376.45	3986.32	1197.09	1504.37	929.57
1978	9251.11	2284.04	5654.29	4260.96	1246.70	1615.21	911.76
1979	10187.46	2314.40	5944.55	4542.58	1301.35	1717.10	888.44
1980	11309.07	2351.71	6248.71	4834.87	1358.85	1814.57	860.93
1981	12368.68	2396.01	6567.23	5139.46	1418.94	1909.91	828.67
MARSHALL							
1977	4281.22	128.68	579.45	500.17	121.14	149.22	114.41
1978	4641.29	117.81	617.31	536.40	124.55	165.90	123.10
1979	5070.74	107.90	657.19	572.51	129.46	181.33	132.79
1980	5571.77	98.50	699.52	609.18	135.14	196.38	144.06
1981	6047.38	89.82	744.36	646.39	141.45	211.33	156.80
MAURY							
1977	5879.98	697.93	2595.96	1565.37	674.95	956.72	946.79
1978	6509.97	753.74	2739.05	1661.08	658.54	948.03	956.41
1979	7278.74	803.68	2886.33	1773.45	662.45	955.54	967.52
1980	8190.61	849.10	3040.19	1899.19	677.60	975.86	981.14
1981	9053.60	891.98	3201.56	2035.39	699.80	1005.80	996.79

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
MEIGS							
1977	604.06	7.84	85.52	26.43	22.24	17.71	147.87
1978	758.38	5.55	91.78	30.70	28.40	19.42	146.99
1979	918.15	3.05	99.21	35.94	31.74	21.72	147.05
1980	1083.64	0.30	107.56	42.10	33.80	24.42	147.93
1981	1244.37	-2.61	116.70	49.06	35.32	27.38	149.50
MORGAN							
1977	1024.89	31.98	191.48	36.84	20.98	102.68	216.80
1978	1252.09	33.65	191.17	-8.47	12.25	107.78	226.01
1979	1503.42	33.47	190.95	-45.59	7.96	112.68	237.14
1980	1779.74	31.68	191.29	-76.47	5.78	117.56	250.52
1981	2044.98	28.67	192.32	-102.75	4.71	122.41	266.15
OVERTON							
1977	1730.32	70.22	401.10	280.49	70.18	192.01	117.50
1978	1755.57	76.79	412.51	256.11	64.20	185.40	117.14
1979	1761.56	82.42	423.77	239.32	61.90	181.90	116.88
1980	1747.80	87.63	435.13	228.29	61.66	180.56	116.57
1981	1738.34	92.61	446.79	221.87	62.59	180.79	116.20
PERRY							
1977	865.94	8.13	96.55	53.18	-3.75	39.10	103.53
1978	967.60	5.58	92.11	13.29	-10.27	47.83	107.34
1979	1063.74	2.56	87.33	-20.55	-13.50	54.26	111.81
1980	1154.30	-0.80	82.47	-49.70	-15.28	59.04	117.08
1981	1244.02	-4.44	77.66	-75.20	-16.46	62.65	123.25

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Trade	Service	Finance	Construc-tion	Other
PICKETT							
1977	790.73	5.16	60.50	-0.02	-10.41	24.41	18.24
1978	842.32	0.15	54.05	-25.70	-20.24	33.86	19.74
1979	876.51	-4.82	46.59	-48.34	-25.26	39.94	21.04
1980	892.88	-9.63	38.52	-68.77	-28.17	43.68	22.36
1981	912.50	-14.36	30.05	-87.48	-30.24	45.76	23.88
POLK							
1977	1982.84	27.89	221.29	-161.52	66.18	75.27	1338.68
1978	2285.45	40.69	232.22	-330.44	58.79	112.76	1402.46
1979	2633.89	51.83	244.49	-475.31	59.44	145.14	1471.53
1980	3029.65	61.50	258.98	-601.15	63.78	174.18	1546.62
1981	3407.19	70.21	275.92	-712.23	69.98	200.88	1627.83
PUTNAM							
1977	5881.63	532.61	2203.34	1318.25	505.91	633.47	475.99
1978	6342.69	567.08	2314.34	1435.39	488.44	676.16	479.40
1979	6903.59	600.11	2427.67	1556.10	492.36	715.91	481.09
1980	7567.46	631.93	2545.81	1680.34	506.72	754.89	482.63
1981	8195.99	663.36	2669.73	1807.85	526.65	793.92	484.17
RHEA							
1977	3924.51	39.96	794.18	352.96	120.92	130.21	136.04
1978	4105.38	48.49	826.74	411.08	119.47	174.35	141.46
1979	4312.72	58.10	860.36	464.17	124.70	208.57	145.73
1980	4547.40	68.32	895.87	513.88	132.62	236.28	149.67
1981	4771.43	79.03	933.55	561.34	141.61	259.63	153.54

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Trade
ROANE							
1977	9643.34	351.26	1817.93	1470.62	352.49	408.68	679.74
1978	9968.92	358.79	1919.15	1499.54	369.22	476.69	711.92
1979	10380.00	370.45	2025.18	1537.06	390.84	535.35	744.00
1980	10879.18	385.25	2136.93	1583.40	414.63	588.26	776.96
1981	11349.63	403.15	2254.68	1638.09	439.76	637.53	810.80
SCOTT							
1977	930.28	131.56	464.14	62.96	133.92	104.85	890.07
1978	1195.40	145.20	491.48	12.56	136.02	134.26	919.02
1979	1492.98	157.99	520.89	-26.77	141.87	160.17	950.48
1980	1824.11	169.99	552.84	-56.96	149.46	183.85	984.87
1981	2141.23	181.50	587.46	-79.83	157.99	206.05	1022.18
STEWART							
1977	458.31	12.01	171.53	39.88	35.22	31.52	47.68
1978	573.26	13.38	176.36	52.09	30.42	39.85	42.75
1979	683.93	14.26	181.13	64.34	28.82	46.11	37.58
1980	790.29	14.76	186.15	76.59	28.64	50.99	32.35
1981	895.22	14.93	191.55	88.85	29.09	54.94	27.15
TROUSDALE							
1977	1251.76	87.20	213.59	145.56	46.99	32.63	71.59
1978	1251.42	79.38	223.86	151.69	42.69	48.59	72.27
1979	1223.78	73.42	233.60	157.48	42.25	60.03	71.52
1980	1168.09	69.22	243.16	163.15	43.50	68.37	69.52
1981	1119.31	66.45	252.75	169.10	54.39	74.63	66.49

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
UNICOI							
1977	1666.68	19.67	441.45	253.53	90.29	107.12	62.48
1978	1903.10	27.59	460.45	279.99	84.38	117.96	57.50
1979	2168.67	34.04	480.13	307.80	83.56	127.62	52.80
1980	2464.37	39.14	501.06	336.73	85.15	136.72	48.79
1981	2747.52	43.23	523.42	366.48	87.98	145.52	45.47
VAN BUREN							
1977	721.11	-6.03	20.25	9.81	3.39	11.17	-2.89
1978	722.08	-11.64	19.73	9.93	-0.12	11.41	-6.45
1979	693.66	-16.67	18.65	10.08	-2.14	10.97	-10.67
1980	635.06	-21.01	17.05	10.13	-3.44	10.00	-15.64
1981	583.85	-24.81	15.05	10.21	-4.45	8.68	-21.27
WARREN							
1977	5371.96	286.57	1410.20	747.81	282.41	580.30	397.38
1978	5630.89	310.18	1481.28	830.07	303.74	559.31	401.63
1979	5940.79	332.22	1556.95	913.31	319.22	551.56	407.64
1980	6303.26	353.06	1636.84	997.86	332.96	553.45	414.94
1981	6647.17	373.45	1720.77	1083.65	346.88	562.37	422.90
WASHINGTON							
1977	9800.70	1798.56	4919.36	4012.98	1060.12	1653.52	970.80
1978	10492.78	1848.31	5166.07	4142.97	1120.48	1670.37	951.85
1979	11355.56	1899.14	5426.59	4304.91	1172.39	1706.31	933.58
1980	12394.28	1951.00	5700.78	4496.07	1222.32	1756.72	915.44
1981	13374.69	2005.26	5988.43	4713.09	1273.60	1817.85	895.85

TABLE C-1

(Continued)

County/Year	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
WAYNE							
1977	1922.18	32.99	270.04	138.30	70.05	294.21	-79.48
1978	2010.38	37.23	285.06	173.31	72.27	238.07	-90.24
1979	2094.70	38.86	300.82	208.95	70.40	198.98	-99.73
1980	2175.11	38.76	316.86	244.42	67.70	171.82	-108.76
1981	2254.57	37.59	333.04	279.27	65.41	153.10	-117.78
WEAKLEY							
1977	3251.06	379.97	1087.46	510.22	234.93	260.11	446.33
1978	3494.86	380.51	1145.16	579.99	242.25	304.15	459.57
1979	3776.61	383.84	1205.28	645.63	253.55	340.42	471.86
1980	4097.56	389.30	1268.45	709.03	266.51	371.79	483.91
1981	4403.57	396.70	1334.90	771.39	280.31	400.04	495.86
WHITE							
1977	3149.29	216.31	522.99	243.47	120.29	187.62	331.73
1978	3314.35	206.08	556.14	266.97	125.38	199.10	348.51
1979	3498.75	197.94	590.67	289.35	130.93	210.10	365.62
1980	3703.16	191.60	626.75	311.28	136.86	221.05	383.26
1981	3899.06	187.00	664.46	333.11	143.19	232.16	401.44

APPENDIX D

TABLE D-1

PROJECTIONS OF RURAL EMPLOYMENT USING DRIVING FORCES A AND B*

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
BEDFORD							
Actual	4555.00	298.00	929.00	796.00	262.00	608.00	300.00
A	4371.70	299.04	1053.44	800.57	276.24	523.49	314.69
Percent	-4.02	0.35	13.40	0.57	5.43	-13.90	4.90
B	4193.25	300.11	1052.87	799.68	276.55	522.91	313.57
Percent	-7.94	0.71	13.33	0.46	5.55	-13.99	4.52
BENTON							
Actual	1018.00	60.00	446.00	170.00	60.00	70.00	207.00
A	1308.49	65.28	469.44	169.87	75.58	83.10	180.00
Percent	28.54	8.79	5.26	-0.08	25.96	18.71	-13.05
B	1210.09	65.86	469.13	169.37	75.75	82.78	179.38
Percent	18.87	9.77	5.19	-0.37	26.25	18.25	-13.34
BLEDSOE							
Actual	136.00	34.00	128.00	48.00	43.00	73.00	74.00
A	293.42	56.50	125.96	83.17	39.28	47.94	12.54
Percent	115.75	66.16	-1.60	73.27	-8.65	-34.33	-83.06
B	323.02	56.32	126.05	83.32	39.23	48.04	12.72
Percent	137.51	65.64	-1.52	73.59	-8.77	-34.19	-82.81
BRADLEY							
Actual	11418.00	641.00	3534.00	2286.00	649.00	983.00	422.00
A	11298.33	726.57	3753.78	2542.69	717.09	1081.92	364.48
Percent	-1.05	13.35	6.22	11.23	10.49	10.06	-13.63
B	10972.31	728.52	3752.74	2541.05	717.66	1080.86	362.43
Percent	-3.90	13.65	6.19	11.16	10.58	9.96	-14.12

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
CAMPBELL							
Actual	2075.00	145.00	1230.00	728.00	177.00	223.00	883.00
A	2365.97	199.82	1258.83	663.82	194.89	236.64	807.33
Percent	14.02	37.81	2.34	-8.82	10.11	6.12	-8.57
B	2257.23	200.47	1258.49	663.28	195.08	236.29	806.64
Percent	8.78	38.26	2.32	-8.89	10.21	5.96	-8.65
CANNON							
Actual	849.00	41.00	213.00	216.00	73.00	66.00	29.00
A	850.48	59.31	231.90	183.85	66.56	57.10	82.99
Percent	0.17	44.65	8.87	-14.88	-8.82	-13.49	186.17
B	836.91	59.39	231.86	183.78	66.58	57.05	82.90
Percent	-1.42	44.85	8.85	-14.92	-8.79	-13.56	185.87
CARROLL							
Actual	2732.00	209.00	969.00	442.00	163.00	228.00	53.00
A	3197.42	224.71	926.37	497.39	164.62	216.21	62.16
Percent	17.04	7.51	-4.40	12.53	0.99	-5.17	17.28
B	3056.29	225.55	925.93	496.68	164.87	215.75	61.27
Percent	11.87	7.92	-4.45	12.37	1.15	-5.37	15.60
CARTER							
Actual	3351.00	121.00	1530.00	799.00	282.00	388.00	181.00
A	4042.80	155.36	1470.05	848.01	284.59	424.30	112.14
Percent	20.64	28.39	-3.92	6.13	0.92	9.36	-38.05
B	3871.24	156.38	1469.50	847.15	284.89	423.75	111.06
Percent	15.52	29.24	-3.95	6.03	1.03	9.21	-38.64

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
CHESTER							
Actual	952.00	82.00	347.00	272.00	51.00	82.00	99.00
A	1153.70	80.24	364.64	269.71	74.00	115.83	124.33
Percent	21.19	-2.14	5.08	-0.84	45.09	41.26	25.58
B	1126.41	80.41	364.55	269.58	74.04	115.75	124.16
Percent	18.32	-1.94	5.06	-0.89	45.19	41.15	25.41
CLAIBORNE							
Actual	2077.00	165.00	558.00	678.00	151.00	130.00	736.00
A	2036.79	163.03	505.24	600.71	120.38	121.01	857.63
Percent	-1.94	-1.20	-9.46	-11.40	-20.28	-6.91	16.53
B	1999.58	163.25	505.12	600.52	120.45	120.89	857.39
Percent	-3.73	-1.06	-9.48	-11.43	-20.23	-7.01	16.49
CLAY							
Actual	518.00	18.00	106.00	167.00	34.00	13.00	31.00
A	510.50	14.13	104.30	146.55	27.13	8.64	23.05
Percent	-1.45	-21.51	-1.60	-12.25	-20.20	-33.53	-25.65
B	562.91	13.81	104.47	146.81	27.04	8.81	23.38
Percent	8.67	-23.76	-1.45	-12.09	-20.47	-32.22	-24.58
COCKE							
Actual	3244.00	104.00	1057.00	473.00	163.00	169.00	83.00
A	3436.66	147.69	1130.50	638.43	187.05	233.85	77.56
Percent	5.94	42.01	6.95	34.98	14.76	38.37	-6.56
B	3360.92	148.14	1130.26	638.05	187.19	233.61	77.08
Percent	3.60	42.45	6.93	34.89	14.84	38.23	-7.13

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
COFFEE							
Actual	4720.00	278.00	1750.00	3750.00	302.00	371.00	1502.00
A	4967.74	340.08	1813.65	1823.41	312.06	403.27	2371.90
Percent	5.25	22.33	3.64	-51.38	3.33	8.70	57.92
B	4784.44	341.18	1813.06	1822.49	312.38	402.68	2370.74
Percent	1.37	22.73	3.60	-51.40	3.44	8.54	57.84
CUMBERLAND							
Actual	1991.00	221.00	935.00	976.00	385.00	340.00	284.00
A	2201.82	221.97	965.13	827.95	215.22	227.05	221.63
Percent	10.59	0.44	3.22	-15.17	-44.10	-33.22	-21.96
B	2121.60	222.45	964.88	827.55	215.36	226.79	221.13
Percent	6.56	0.65	3.20	-15.21	-44.06	-33.30	-22.14
DECATUR							
Actual	2062.00	60.00	356.00	112.00	73.00	96.00	168.00
A	2356.57	61.36	387.83	84.04	55.29	91.22	241.38
Percent	14.29	2.26	8.94	-24.97	-24.26	-4.97	43.68
B	2305.04	61.67	387.67	83.78	55.38	91.06	241.06
Percent	11.79	2.78	8.90	-25.20	-24.13	-5.15	43.49
DEKALB							
Actual	1638.00	65.00	304.00	1080.00	108.00	60.00	190.00
A	1846.94	63.90	324.02	487.55	72.58	93.22	93.65
Percent	12.76	-1.70	6.58	-54.86	-32.79	55.37	-50.71
B	1796.10	64.20	323.86	487.29	72.67	93.06	93.33
Percent	9.65	-1.23	6.53	-54.88	-32.71	55.10	-50.88

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
DYER							
Actual	4512.00	563.00	1566.00	824.00	424.00	793.00	307.00
A	4666.03	539.52	1641.98	801.98	411.12	792.22	247.07
Percent	3.41	-4.17	4.85	-2.67	-3.04	-0.10	-19.52
B	4477.37	540.65	1641.38	801.03	411.45	791.61	245.88
Percent	-0.77	-3.97	4.81	-2.79	-2.96	-0.18	-19.91
FAYETTE							
Actual	1339.00	148.00	391.00	402.00	67.00	98.00	69.00
A	1609.60	173.19	481.28	379.54	76.86	125.74	83.49
Percent	20.21	17.02	23.09	-5.59	14.72	28.31	21.00
B	1655.56	172.91	481.43	379.77	76.78	125.89	83.78
Percent	23.64	16.83	23.13	-5.53	14.60	28.46	21.42
FENTRESS							
Actual	1087.00	60.00	412.00	122.00	59.00	58.00	74.00
A	1683.69	38.06	359.16	105.27	50.92	68.11	153.98
Percent	54.89	-36.57	-12.83	-13.71	-13.69	17.43	108.08
B	1712.71	37.88	359.25	105.42	50.87	68.20	154.17
Percent	57.56	-36.86	-12.80	-13.59	-13.77	17.59	108.33
FRANKLIN							
Actual	2018.00	193.00	1127.00	808.00	209.00	262.00	257.00
A	2424.28	237.04	1363.66	994.53	253.22	269.83	222.28
Percent	20.13	22.82	21.00	23.08	25.94	2.99	-13.51
B	2329.13	237.61	1363.36	994.05	263.38	269.52	221.68
Percent	15.42	23.11	20.97	23.03	26.02	2.87	-13.74

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
GIBSON							
Actual	8048.00	476.00	1910.00	1338.00	399.00	1127.00	658.00
A	9169.95	455.90	1977.45	1377.61	417.16	917.09	703.98
Percent	13.94	-4.22	3.53	2.96	4.55	-18.63	6.99
B	8927.43	457.35	1976.68	1376.39	417.58	916.31	702.46
Percent	10.93	-3.92	3.49	2.87	4.66	-18.70	6.76
GILES							
Actual	3785.00	490.00	939.00	497.00	230.00	95.00	157.00
A	3868.25	463.75	1032.90	602.89	203.24	231.63	212.36
Percent	2.20	-5.36	10.00	21.31	-11.64	143.82	35.26
B	3727.01	464.60	1032.45	602.17	203.48	231.17	211.47
Percent	-1.53	-5.18	9.95	21.16	-11.53	143.34	34.69
GRAINGER							
Actual	733.00	58.00	234.00	55.00	60.00	61.00	-3.00
A	928.79	12.95	260.42	72.59	47.59	54.74	11.12
Percent	26.71	-77.67	11.29	31.99	-20.68	-10.26	-470.72
B	922.32	12.99	260.40	72.56	47.60	54.72	11.08
Percent	25.83	-77.61	11.28	31.93	-20.66	-10.29	-469.36
GREENE							
Actual	7613.00	616.00	2117.00	1981.00	318.00	446.00	366.00
A	7263.09	605.26	2251.73	1706.34	403.54	504.71	389.74
Percent	-4.60	-1.74	6.36	-13.86	26.90	13.16	6.49
B	7011.51	606.76	2250.93	1705.07	403.98	503.90	388.16
Percent	-7.90	-1.50	6.33	-13.93	27.04	12.98	6.05

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
GRUNDY							
Actual	488.00	32.00	254.00	127.00	44.00	60.00	53.00
A	687.60	31.52	237.37	186.41	61.19	58.36	15.61
Percent	39.06	-1.49	-6.55	46.78	39.07	-2.73	-70.55
B	749.59	31.10	237.60	186.77	61.07	58.59	16.05
Percent	53.60	-2.82	-6.46	47.06	38.79	-2.35	-69.71
HAYWOOD							
Actual	1200.00	182.00	750.00	367.00	189.00	159.00	145.00
A	1152.19	165.62	739.56	324.88	146.76	162.39	175.97
Percent	-3.98	-9.00	-1.39	-11.48	-22.35	2.13	21.36
B	1183.48	165.43	739.66	325.03	146.71	162.49	176.17
Percent	-1.38	-9.10	-1.38	-11.43	-22.38	2.19	21.50
HENDERSON							
Actual	2636.00	141.00	665.00	264.00	87.00	164.00	65.00
A	2922.75	161.10	679.50	283.04	95.10	153.12	61.87
Percent	10.88	14.26	2.18	7.21	9.32	-6.64	-4.81
B	2853.49	161.52	679.28	282.69	95.23	152.89	61.44
Percent	8.25	14.55	2.15	7.08	9.46	-6.77	-5.48
HENRY							
Actual	3945.00	343.00	1207.00	962.00	175.00	418.00	285.00
A	3873.58	298.79	1202.28	545.67	209.86	453.36	286.05
Percent	-1.81	-12.89	-0.39	-43.28	19.92	8.46	0.37
B	3741.05	299.58	1201.86	545.00	210.09	452.93	285.21
Percent	-5.17	-12.66	-0.43	-43.35	20.05	8.36	0.08

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
HICKMAN							
Actual	1395.00	60.00	205.00	100.00	71.00	63.00	94.00
A	1408.92	25.64	218.86	95.45	35.50	69.91	109.47
Percent	1.00	-57.26	6.76	-4.55	-50.00	10.96	16.46
B	1364.37	25.91	218.72	95.23	35.58	69.76	109.19
Percent	-2.20	-56.82	6.69	-4.77	-49.89	10.73	16.16
HOUSTAN							
Actual	416.00	10.00	113.00	176.00	10.00	40.00	22.00
A	556.35	9.81	107.24	113.79	11.06	37.34	19.72
Percent	33.74	-1.94	-5.10	-35.35	10.59	-6.64	-10.34
B	529.99	9.96	107.15	113.65	11.11	37.26	19.56
Percent	27.40	-0.36	-5.17	-35.42	11.05	-6.86	-11.10
HUMPREYS							
Actual	2615.00	133.00	699.00	352.00	134.00	262.00	90.00
A	2848.90	113.52	696.28	368.18	129.19	250.24	92.82
Percent	8.94	-14.65	-0.39	4.60	-3.59	-4.49	-1.25
B	2790.18	113.87	696.09	367.89	129.29	250.05	92.45
Percent	6.70	-14.38	-0.42	4.51	-3.51	-4.56	-1.64
JACKSON							
Actual	476.00	14.00	284.00	175.00	40.00	10.00	121.00
A	614.52	23.30	145.99	101.63	30.88	59.65	68.74
Percent	29.10	66.41	-48.60	-41.93	-22.80	496.49	-43.19
B	614.32	23.30	145.99	101.63	30.88	59.65	68.74
Percent	29.06	66.42	-48.60	-41.93	-22.79	496.48	-43.19

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
JEFFERSON							
Actual	2473.00	212.00	851.00	623.00	155.00	327.00	733.00
A	2754.46	287.30	836.13	554.58	158.94	231.55	858.34
Percent	11.38	-11.65	01.75	-10.98	2.54	-29.19	17.10
B	2745.06	187.36	836.10	554.53	158.96	231.52	858.28
Percent	11.00	-11.62	-1.75	-10.99	2.55	-29.20	17.09
JOHNSON							
Actual	2178.00	49.00	298.00	251.00	57.00	69.00	93.00
A	2482.56	47.99	310.50	209.94	70.14	80.03	91.50
Percent	13.98	-2.06	4.19	-16.36	23.05	15.98	-1.61
B	2484.17	47.98	310.50	209.94	70.14	80.03	91.51
Percent	14.06	-2.08	4.20	-16.36	23.05	15.99	-1.60
McMINN							
Actual	8631.00	456.00	1785.00	1319.00	340.00	372.00	220.00
A	8564.94	453.41	1808.68	1489.50	337.68	460.96	254.02
Percent	-0.77	-22.28	1.33	12.93	-0.68	23.91	15.46
B	8382.79	355.50	1808.10	1488.58	338.00	460.37	252.88
Percent	-2.88	-22.04	1.29	12.86	-0.59	23.76	14.94
McNAIRY							
Actual	3351.00	161.00	534.00	257.00	91.00	246.00	122.00
A	3179.85	134.84	492.02	265.58	97.49	185.45	135.19
Percent	-5.11	-16.25	-7.86	3.34	7.13	-24.61	10.81
B	3140.50	135.07	491.90	265.38	97.56	185.32	134.94
Percent	-6.28	-16.11	-7.88	3.26	7.21	-24.67	10.61

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
MACON							
Actual	1897.00	67.00	391.00	260.00	84.00	148.00	166.00
A	2193.99	61.09	351.45	232.33	78.12	113.87	177.76
Percent	15.66	-8.82	-10.11	-10.64	-7.00	-23.06	7.09
B	2154.63	61.33	351.33	232.14	78.19	113.75	177.52
Percent	13.58	-8.47	-10.15	-10.72	-6.92	-23.14	6.94
MADISON							
Actual	8552.00	2155.00	5304.00	3910.00	1153.00	1742.00	1039.00
A	8494.48	2262.49	5376.45	3986.32	1197.09	1504.37	929.57
Percent	-0.67	4.99	3.31	1.95	3.82	-13.64	-10.53
B	8142.41	2264.60	5375.33	3984.54	1197.71	1503.23	927.36
Percent	-4.79	5.09	3.29	1.91	3.88	-13.71	-10.75
MARSHALL							
Actual	4026.00	142.00	688.00	633.00	143.00	127.00	145.00
A	4281.22	128.68	579.45	500.17	121.14	149.22	114.41
Percent	6.34	-9.38	-15.78	-20.98	015.28	17.50	-21.10
B	4143.05	129.50	579.01	499.47	121.39	148.77	113.54
Percent	2.91	-8.80	-15.84	-21.09	-15.11	17.14	-21.70
MAURY							
Actual	6097.00	691.00	2576.00	1630.00	770.00	937.00	1066.00
A	5879.98	697.93	2595.96	1565.37	674.95	956.72	946.79
Percent	-3.56	1.00	0.77	-3.96	-12.34	2.11	-11.18
B	5606.60	699.57	2595.09	1563.99	675.43	955.84	945.08
Percent	-8.04	1.24	0.74	-4.05	-12.28	2.01	-11.34

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
MEIGS							
Actual	462.00	10.00	86.00	26.00	10.00	28.00	137.00
A	604.06	7.84	85.52	26.43	22.24	17.71	147.87
Percent	30.75	-21.64	-0.56	1.66	122.36	-36.74	7.93
B	589.07	7.93	85.47	26.36	22.26	17.66	147.77
Percent	27.50	-20.75	-0.61	1.37	122.63	-36.92	7.86
MORGAN							
Actual	926.00	44.00	176.00	48.00	60.00	60.00	172.00
A	1024.89	31.98	191.48	36.84	20.98	102.68	216.80
Percent	10.68	-27.33	8.80	-23.26	-65.03	71.14	26.05
B	973.47	32.28	191.32	36.58	21.07	102.51	216.48
Percent	5.13	-26.63	8.70	-23.80	-64.88	70.86	25.86
OVERTON							
Actual	1476.00	69.00	358.00	297.00	87.00	146.00	133.00
A	1730.32	70.22	401.10	280.49	70.18	192.01	117.50
Percent	17.23	1.77	12.04	-5.56	-19.34	31.52	-11.65
B	1764.55	70.02	401.21	280.66	70.12	192.12	117.72
Percent	19.55	1.47	12.07	-5.50	-19.41	31.59	-11.49
PERRY							
Actual	997.00	12.00	96.00	65.00	60.00	39.00	-24.00
A	865.94	8.13	96.55	53.18	-3.75	39.10	103.53
Percent	-13.15	-32.22	0.58	-18.19	-106.25	0.26	-531.36
B	872.64	8.09	96.57	53.21	-3.76	39.12	103.57
Percent	-12.47	-32.55	0.60	-18.14	-106.27	0.32	-531.53

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
PICKETT							
Actual	718.00	10.00	78.00	29.00	10.00	10.00	17.00
A	790.73	5.16	60.50	-0.02	-10.41	24.41	18.24
Percent	10.13	-48.39	-22.43	-100.09	-204.09	144.13	7.32
B	820.70	4.98	60.60	0.13	-10.46	24.51	18.43
Percent	14.30	-50.18	-22.31	-99.56	-204.61	145.10	8.43
POLK							
Actual	1750.00	24.00	230.00	70.00	101.00	45.00	629.00
A	1982.84	27.89	221.29	-161.52	66.18	75.27	1338.68
Percent	13.30	16.20	-3.78	-330.75	-34.47	67.27	112.83
B	1889.46	28.45	221.00	-161.99	66.35	74.97	1338.09
Percent	7.97	18.53	-3.91	-331.42	-34.31	66.60	112.73
PUTNAM							
Actual	5597.00	526.00	2183.00	1597.00	443.00	596.00	384.00
A	5881.63	532.62	2203.34	1318.25	505.91	633.47	475.99
Percent	5.09	1.26	0.93	-17.45	14.20	6.29	23.95
B	5684.69	533.80	2202.71	1317.26	506.25	632.83	474.75
Percent	1.57	1.48	0.90	-17.52	14.28	6.18	23.63
RHEA							
Actual	3732.00	31.00	720.00	288.00	158.00	81.00	193.00
A	3924.51	39.96	794.18	352.96	120.92	130.21	136.04
Percent	5.16	28.89	10.30	22.56	-23.47	60.76	-29.52
B	3870.37	40.28	794.01	352.69	121.01	130.04	135.70
Percent	3.71	29.94	10.28	22.46	-23.41	60.54	-29.69

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
ROANE							
Actual	9669.00	300.00	1635.00	1074.00	335.00	296.00	403.00
A	9643.34	351.26	1817.93	1470.62	352.49	408.68	679.74
Percent	-0.27	17.09	11.19	36.93	5.22	38.07	68.67
B	9476.97	352.26	1817.41	1469.78	352.79	408.14	678.70
Percent	-1.99	17.42	11.16	36.85	5.31	37.88	68.41
SCOTT							
Actual	726.00	103.00	473.00	183.00	156.00	108.00	736.00
A	930.28	131.56	464.14	62.96	133.92	104.85	890.07
Percent	28.14	27.73	-1.87	-65.60	-14.16	-2.92	20.93
B	862.48	131.97	463.92	62.61	134.04	104.63	889.65
Percent	18.80	28.12	-1.92	-65.78	-14.08	-3.12	20.88
STEWART							
Actual	326.00	10.00	185.00	26.00	50.00	15.00	45.00
A	458.31	12.01	171.53	39.88	35.22	31.52	47.68
Percent	40.58	20.13	-7.28	53.40	-29.57	110.12	5.97
B	462.32	11.99	171.55	39.90	35.21	31.53	47.71
Percent	41.82	19.89	-7.27	53.48	-29.58	110.21	6.02
TROUSDALE							
Actual	1511.00	97.00	238.00	161.00	42.00	10.00	93.00
A	1251.76	87.20	213.59	145.56	46.99	32.63	71.59
Percent	-17.16	-10.10	-10.26	-9.59	11.89	226.33	-23.02
B	1301.48	86.91	213.75	145.81	46.91	32.79	71.91
Percent	-13.87	-10.40	-10.19	-9.43	11.68	227.94	-22.68

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
UNICOI							
Actual	1565.00	23.00	398.00	178.00	82.00	59.00	72.00
A	1666.68	19.67	441.45	253.53	90.29	107.12	62.48
Percent	6.50	-14.48	10.92	42.43	10.11	81.55	-13.23
B	1605.85	20.03	441.26	253.22	90.40	106.92	62.09
Percent	2.61	-12.90	10.87	42.26	10.24	81.22	-13.76
VAN BUREN							
Actual	643.00	0.00	8.00	10.00	10.00	10.00	-1.00
A	721.11	-6.03	20.25	9.81	3.39	11.17	-2.89
Percent	13.74	-702.56	153.18	-1.87	-66.13	11.68	188.99
B	774.58	-6.35	20.42	10.08	3.29	11.34	-2.55
Percent	22.17	-734.54	155.30	0.83	-67.07	13.41	155.38
WARREN							
Actual	6247.00	322.00	1334.00	781.00	244.00	661.00	433.00
A	5371.96	286.57	1410.20	747.81	282.41	580.30	397.88
Percent	-14.01	-11.00	5.71	-4.25	15.74	-12.21	-8.23
B	5270.66	287.18	1409.88	747.30	282.59	579.97	396.74
Percent	-15.63	-10.81	5.69	-4.31	15.82	-12.26	-8.37
WASHINGTON							
Actual	10046.00	1775.00	4863.00	4126.00	1066.00	1607.00	1007.00
A	9800.70	1798.56	4919.36	4012.98	1060.12	1653.52	970.80
Percent	-2.44	1.33	1.16	-2.74	-0.55	2.89	-3.59
B	9467.17	1800.55	4918.30	4011.30	1060.70	1652.44	968.71
Percent	-5.76	1.44	1.14	-2.78	-0.50	2.83	-3.80

TABLE D-1

(Continued)

County/Parameter	Manufac-turing	Wholesale Trade	Retail Trade	Service	Finance	Construc-tion	Other
WAYNE							
Actual	1693.00	26.00	249.00	126.00	60.00	175.00	94.00
A	1922.18	32.99	270.04	138.30	70.05	294.21	-79.48
Percent	13.54	26.88	8.45	9.76	16.76	68.12	-184.55
B	1926.34	32.96	270.05	138.32	70.05	294.23	-79.45
Percent	13.78	26.79	8.46	9.78	16.74	68.13	-184.52
WEAKLEY							
Actual	3234.00	457.00	1062.00	371.00	267.00	175.00	456.00
A	3251.06	379.97	1087.46	510.22	234.93	260.11	446.33
Percent	0.53	-16.86	2.40	37.52	-12.01	48.63	-2.12
B	3173.94	380.43	1087.22	509.83	235.07	259.86	445.85
Percent	-1.86	-16.76	2.37	37.42	-11.96	48.49	-2.23
WHITE							
Actual	3283.00	165.00	490.00	220.00	123.00	149.00	189.00
A	3149.29	216.31	522.99	243.47	120.29	187.62	331.73
Percent	-4.07	31.10	6.73	10.67	-2.20	25.92	75.52
B	3108.64	216.55	522.86	243.27	120.37	187.49	331.47
Percent	-5.31	31.24	6.71	10.58	-2.14	25.83	75.38

*Driving Force A: Projected Total Manufacturing Employment by the Tennessee Econometric Model.

Driving Force B: Actual Total Manufacturing Employment.

APPENDIX E

TABLE E-1

FACTOR SCORE COEFFICIENT MATRIX

Variable	Factor 1	Factor 2	Factor 3	Factor 4
1	0.02539	-0.01321	-0.54340	-1.00517
2	4.72221	-0.79600	0.14153	0.75368
3	-0.49753	-0.26994	-0.70126	0.37037
4	0.71514	-0.22703	0.65230	0.41153
5	-1.56076	0.37123	0.20788	-0.98037
6	-0.57224	0.05588	-0.38257	0.43775
7	-0.55339	0.20601	0.29559	-0.06010
8	-0.78279	0.32110	0.29445	-0.17983
9	0.18586	0.02430	0.05046	0.06994
10	-0.14570	0.08871	-0.11329	-0.08130
11	-0.00775	-0.01277	0.08160	0.28713
12	-0.28856	0.06739	0.04123	0.16808
13	-0.29896	0.07797	0.05905	0.07168
14	0.10868	-0.01708	-0.17646	-0.16548
15	-0.03055	0.08945	0.02158	-0.25960
16	-0.24399	0.04519	0.11641	-0.12152
17	-0.28226	0.11071	-0.00852	0.36870
18	-0.07183	-0.01208	0.07844	-0.19650
19	-0.00848	0.03952	-0.04483	0.05564
20	-0.11449	0.38866	0.14222	-0.04790
21	0.05740	0.08622	0.06165	-0.04491
22	-0.03462	0.07320	-0.02640	0.03688
23	0.02178	0.01402	-0.00877	-0.06502
24	0.01101	0.24476	-0.53951	0.00804
25	-0.05006	0.20449	0.89889	0.19510
26	-0.06958	0.07512	-0.24141	0.00734
27	-0.08212	-0.02778	-0.06765	-0.02854
28	-0.21482	-0.02737	0.01506	0.09490
29	-0.10082	0.01731	-0.15381	0.07868
30	0.03259	-0.01999	0.10218	0.06702
31	0.06186	-0.09586	0.18400	-0.05049
32	0.05962	-0.00445	-0.15565	-0.05856
33	0.03196	-0.00589	-0.07314	0.02496
34	0.05855	-0.03720	0.04770	-0.05957
35	-0.00996	0.01387	-0.12491	-0.02160
36	0.01932	0.01505	-0.01790	-0.04345
37	0.00486	0.03217	-0.06933	-0.10748
38	-0.07602	0.08483	-0.01871	0.00931
39	0.06126	0.01101	0.10189	0.05328
40	-0.04463	0.02844	0.07431	-0.13194

VITA

Dale Leuck was born in 1950 in Boswell, Indiana and grew up on a central Indiana grain farm where his hobbies were trapping fur-bearing animals and farm work. Upon graduation from Hemington High School in 1968, he enrolled at Purdue University, graduating with a B.S. in Industrial Management in 1972. After studying graduate-level Social Psychology for two semesters, he entered the M.S. program in Agricultural Economics at Purdue and graduated in the summer of 1976, writing a thesis on the firm and household interactive aspect in Brazilian small farm decision-making, under George Patrick. His residence at The University of Tennessee resulted in the research in this dissertation and an associated article in the Southern Journal of Agricultural Economics.

Prior to graduation from The University of Tennessee, he became associated with the International Economics Division of USDA in Washington, D.C., where he was assigned to collaborate in the development of a United States-United Kingdom Agricultural Trade Model.