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Regional Growth Models—An Analytical Approach in Missouri 1950 to 1970

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PREFACE

This research bulletin reports on the results of continuing research by the author to develop an improved method of projecting regional growth and change in rural economies. It gives the latest research procedure as well as the empirical results of an analysis of Missouri data for the census years of 1950, 1960 and 1970. The bulletin replaces Agricultural Economics Paper 51, entitled "Theoretical Basis for County Employment Projections." A new publication is currently under preparation entitled, "A Study of Regional Growth in Rural Missouri 1950 to 1970 with Projections and Planning Implications." This report will replace Agricultural Experiment Station Bulletin 885, "County Employment Trends—Projections to 1980 for Missouri Counties Using an Economic Base Analysis Technique."

Regional Growth Models—An Analytical Approach in Missouri 1950 to 1970

CURTIS BRASCHLER*#

INTRODUCTION

Regional population and employment distribution have become a matter of increasing public concern throughout the last decade. This concern has arisen from rapid growth of major metropolitan centers, accompanied by assumed stagnation and decline in substantial portions of the rural areas.

This report summarizes continuing research at the University of Missouri Agricultural Experiment Station to analyze forces that determine the level of regional economic activity so an improved prediction of regional change is possible.

The approach that has been developed for analyzing regional growth uses as its overall economic framework the concept of the community economic base. The economic base of a region is defined as those activities which are *not* closely tied to the level of *economic activity* of the local economy. A number of different variables can be specified to give concrete substance to the concept of regional *economic activity.* Among these are total and individual or per capita incomes, sales, employment, production, value added, and possibly others. For purposes of this report the economic variable considered was total area employment divided into industry groupings, as defined by U. S. Census Bureau classifications (10).

THEORIES OF REGIONAL ECONOMIC GROWTH

The various theories of regional growth will be reviewed briefly in this section. The purpose is to furnish a minimum basis for understanding the conflicting viewpoints of analysts regarding the highly complex processes of regional growth. Some of the more divergent viewpoints of analysts will be juxtaposed for expository reasons.

The concept of *balanced growth* is used frequently by regional analysts and may have two different connotations. The first requires that poor regions grow faster than rich regions so that incomes tend to equalize. The second indicates that the rate of growth in the poor regions keeps pace with that in the prosperous regions. Balanced growth, as used in this paper, will lean to the latter interpretation.

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Professor Bevins, West and McCamley read earlier drafts of this report and made substantial contributions thereto.

Equilibrium regional growth models have been patterned primarily upon macro-models of national economic growth (7). The Harrod-Domar aggregated growth model is a frequently used and popular Keynesian demand-oriented model. Richardson (7) argues that the Harrod-Domar model is particularly adaptable to explaining change in lagging regions, since it assumes that their problem can be attributed more to a lack of effective demand rather than to shortages of supply.

The Harrod-Domar Model

The Harrod-Domar model makes some very limiting, simplifying assumptions. These are the existence of a one-good economy, with the stipulation that this good can be used either in consumption or as an input. The only other input is labor. Constant returns to scale are assumed with no technical change. The H-D model adapted to regional equilibrium growth considers two questions. These are: (1) What conditions in the capital and labor markets are necessary to produce dynamic equilibrium growth rates within all regions of an economy and (2) when equilibrating conditions do not prevail, what is necessary in terms of capital and labor flows to bring about equilibrium regional growth rates?

Richardson's adaptation of the Harrod-Domar model to regional growth defines several equilibrium conditions which will be used in this discussion. The following variables are hereby defined:

1) S = Savings
2) Y = Income
3) s = Marginal propensity to save
4) I = Investment
5) K = Capital stock
6) v = Capital output ratio
7) g = Growth rate (measured in output)
8) n = Population growth rate

From these definitions, it follows under the assumptions that

9) $g = \frac{I}{K} = \frac{S}{K} = \frac{S}{Y} \cdot \frac{Y}{K} = \frac{s}{v}$

where v = the capital output ratio. For full employment equilibrium, this model requires that the output must grow at the same rate as the labor supply, i. e., g must be equal to n. Steady growth requires $g = n = \frac{s}{v}$. Adapted to the ith region of a system of regions, equilibrium growth rate for the ith region becomes $g_i = n_i = \frac{s_i}{v_i}$. Regions are open economies and when disequilibrium conditions exist between regions in a system, then inflows and outflows of goods, labor, and capital will take place in order to maintain equilibrium.

Richardson defines static equilibrium in an open economy:

10) $S+M=I+X$

where $S=$ Savings, $M=$Imports, $I=$Investment, and $X=$Exports. This can be written as:

11) $(s+m)Y=I+X$

where $m=$marginal propensity to import. Now $\frac{I}{Y}+\frac{X}{Y}=s+m$ and $\frac{I}{Y}=s+m-\frac{X}{Y}$. The equilibrium growth rate for the ith region becomes:

$$12)\quad g_i=\frac{s_i+m_i-\frac{X_i}{Y_i}}{v_i}$$

Disequilibrium conditions have usually been defined in a demand-oriented model in terms of the failure of future investment to equal current savings rate. On a regional basis a possible disequilibrium arising out of this contingency could be corrected by running an export surplus equal to the gap.

Equilibrium conditions in the labor market in the ith region can be maintained by importing or exporting labor so the condition equilibrium growth rate in the labor market in the ith region becomes $g_i=n_i\pm r_i$ where r is the rate of migration expressed as the number of migrants per time period as a percent of population.

The above developments do not allow for the impact of disequilibrium in the ith region on another region. Dynamic equilibrium requires that the rate of growth in capital stock be equated and the condition for this to occur in a two-region closed economy becomes:

$$13)\quad \frac{s_1+m_1-m_2\cdot\frac{Y_2}{Y_1}}{v_1}=\frac{s_2+m_2-m_1\cdot\frac{Y_1}{Y_2}}{v_2}$$

Now if *marginal propensities to save* and *capital output ratios* are equal in the two regions, then the condition of steady growth is that the balance of payments for the two regions remain the same.

The Harrod-Domar model can be further simplified by making restrictive assumptions about the relavant variables (s_1, s_2, m_1 and m_2) and the levels of income in the two regions until equilibrium conditions for equilibrium growth in the two regions is defined in terms of a balance of payments surplus between the two regions. This condition is that if one region starts out with a higher income than another, then equilibrium growth requires that the balance of payments surplus (outflow of savings) of the higher income region must equal the difference in the internal savings of the two regions weighted respectively by the ratio of the income of the other region to the income of the system as a whole.

Equilibrium growth in terms of the labor market requires migrants to move from the region with faster population growth to the region with a lower population growth. In summary, disequilibrium in the labor or capital market requires flows of labor and capital from low income to high income regions.

The Neoclassical Model

Another highly aggregated national model that has been adapted to a region is the so-called neoclassical model. The neoclassical model is a supply-oriented model rather than a demand-oriented model of the H-D type. A supply-oriented model assumes that resources will be fully employed and from a national employment standpoint full employment of resources is achieved by raising or lowering interest rates to equilibrate savings with investment at full employment levels. The neoclassical model allows changes in production technology and changing production coefficients to affect regional growth rates. It also focuses attention on internal forces within the region which affect the capital and labor force of the region and, thus, its capability to produce goods and services.

The Harrod-Domar and neoclassical models reach similar important overall conclusions about regional growth even though they start out with different assumptions and the former is demand-oriented while the latter is supply-oriented. The similar conclusions are (1) for equilibrium, growth rates between regions both capital and labor must move from high income regions to low income regions, and (2) for a region to grow faster than other regions, it must import more capital than is exported.

Export Base Theory

Export base theory is a substantially different hypothesis of cause regarding regional growth than the highly aggregated models discussed above. This theory views exports from an area as the primary cause of regional growth and holds that the service components of a regional economy exist only to supply the export base with secondary services.

Superficially, "expert base theory" appears to conflict with the Harrod-Domar and neoclassical models. This is true since the two latter models imply that regional growth above average rates results from imports whereas "export base theory" implies that above average regional growth rates occur because of expansion in exports.

This discrepancy is more apparent than real. The Harrod-Domar and neoclassical models focus attention on dynamic equilibrium whereas the "export base theory" focuses attention on disequilibrium in regional economies. It is true that for equilibrium growth rates to be above the average rate, the Harrod-Domar and neoclassical models require higher than average imports. However, "export base theory" asks the question which is implied one step earlier in the system and, that is, why did the high growth regions need to import at above average rates for all regions?

Export base theory would argue that high imports of capital suggest an expansion of demand for the region's exports at a time earlier than when the high imports were noted. Thus imports above average imply the readjustment to equilibrium that a region undergoes when its economy is disequilibrated by an increase in exports resulting from increases in demand outside the region for its exports. Only in the case of a regional economy operating at less than fully employed capital resources would this adjustment to equilibrium not be observed.

Another criticism of "export base theory" is that it requires a marginal propensity to spend locally above unity for regional growth to occur. This is true unless the region is operating at below full employment of its resources. Such a criticism assumes that a region grows only by internal capital investment decisions in exporting industries. This would appear to unduly restrict growth possibilities, particularly in distressed regions. Actually, plant location decisions, for example, are much more likely to be made by units external to the area than by internal ones.

Sector Approach

This view of regional growth hypothesizes that a rise in per capita income accompanies a decline in employment in agriculture and an increase in manufacturing activity, accompanied subsequently by an increase in service industry activity. This view of regional growth is closely related to the analogous argument that as an economy industrializes the relative amounts of resources employed in production of tangible goods declines and the service component becomes relatively more important. The latter is currently in vogue in describing the trends in the whole United States economy.

Share Analysis

Another empirical technique used to measure regional growth is known as share and shift analysis. Share analysis is simply a comparison of a region's percentage of industrial composition with that of other regions and the nation. A dynamic dimension can be interjected into this approach by comparison of industrial composition between two time periods and this is called shift analysis.

Shift analysis defines the total shift in a regional economy as the difference between the regional employment at a current time period and the regional employment that would exist in the region at the current time period had the region's total employment changed at the same rate as the national economy from the past time period. In this sense, the total shift is a comparison of "what is" in the local economy at the current time period with "what ought to be" relative to growth in the national economy.

Shift analysis carries this a step further by dividing this total shift into a proportional shift and a differential shift. The proportional shift is defined as the part of total shift in a region that is the result of differences in the proportionate growth rates of industries at the national level. The differential shift is defined as part of total shift that results from the fact that certain industries in the region are growing at above national rates.

Shift analysis appears to be primarily a descriptive tool which lends itself quite well to an empirical analysis describing local regional economies. Certainly relating the growth rates of different regions to the two distinctly different forces of proportional and differential shift should add substantially to an understanding of their relative importance in the regional growth process.

Growth Centers

Another view of regional growth is afforded by the concept of "growth centers." The concept of "growth centers" has been considered by various authors (1). Professor Hugh Denney (3) at the University of Missouri has recently completed a comprehensive study of the United States spatial economy using an adaptation of the "growth center" concept. Professor Denney develops his analysis in terms of hierarchy of increasing size centers at progressively increasing radii from a central point. With the use of the "growth center" concept as defined by Denney it is possible to specify approximate spatial locations of a hierarchy of cities of different sizes that provide a given level and quality of service, depending upon size and distance from other "growth centers."

THEORETICAL FRAMEWORK OF THIS STUDY

The various theories and empirical methods used in the analysis of regional growth are all important in understanding forces of change in regional economies. The Harrod-Domar and neoclassical theories provide more information for an improved understanding of the regional equilibrating effects of regional capital and labor movements than for a basis of a predictive model.

This study had as its major objectives: (1) the delineation and quantification of forces that determine the economic base of a region and thus the population and employment of a region, and (2) the development of procedures for using objective 1 in actual planning for regional change.

To accomplish these objectives it was necessary to choose a theoretical framework as well as empirical procedure for testing that framework. The overall choice of a theoretical framework was the concept of the community economic base as previously defined (those activities whose level of operation are determined primarily by the operation of economic forces outside of the community or region under consideration).

The concept of the community economic base as thus defined is a useful starting point for analysis; however, substantial development, both theoretically and empirically, is required before a useful analytical framework exists. The major implication of the definition of the concept of the community economic base is readily apparent: A meaningful empirical specification of the economic base would result in a useful starting point for further specification of the growth of a region in terms of the growth of its economic base.

EMPIRICAL METHODS OF DETERMINING AND ANALYZING THE ECONOMIC BASE

The economic base concept of regional growth has typically been investigated empirically by a sector market approach. In this context the industries of a region are defined in terms of traditional industry definitions such as agriculture, manufacturing, mining, etc., and markets these industries serve are divided into endogenous and exogenous markets. Endogenous activities include the sales of industries to each other. Exogenous activities include sales of output to exogenous markets. It's within the context of the exogenous markets that we can relate conceptually to the concept of an economic base of a region. It is the exogenous markets for industry output that are defined as the basic determining components of the local economy because they are the forces, independent of the local economic activity, that determine the level of local economic activity.

The concept of the community economic base as discussed above is generally implemented within the context of the Leontief input-output system. To discuss the relation between the Leontief input-output sytsem, the community economic base, and the procedure adopted in this research study, it will be necessary to discuss the relations mathematically.

Let us define an economy with N industries. First we define the following system:

13)
$$\begin{bmatrix} x_{11} + x_{12} + \ldots x_{1N} + E_1 \\ x_{21} + x_{22} + \ldots x_{2N} + E_2 \\ \cdot \quad \cdot \quad \cdot \quad \cdot \\ \cdot \quad \cdot \quad \cdot \quad \cdot \\ \cdot \quad \cdot \quad \cdot \quad \cdot \\ x_{N1} \quad x_{N2} + \ldots x_{NN} + E_N \end{bmatrix} \begin{matrix} = \\ = \\ \cdot \\ \cdot \\ \cdot \\ = \end{matrix} \begin{bmatrix} X_1 \\ X_2 \\ \\ \\ \\ X_N \end{bmatrix}$$

where

14) x_{ij} = The sales of the ith industry to the jth industry.

15) E_i = The sales of the i industry to final demand.

16) X_i = Total output of the ith industry.

This system is defined as the interindustry transactions matrix for the endogenous industries. Now we define a new matrix, A, whose ith element

17) $aij = \frac{x_{ij}}{X_j}$.

Then, shifting to matrix notation, the following system in generated:

18)
$$A = \begin{bmatrix} a_{11} & a_{12} \ldots a_{1N} \\ a_{21} & a_{22} \ldots a_{2N} \\ \cdot & \\ \cdot & \\ \cdot & \\ a_{N1} & a_{N2} \ldots a_{NN} \end{bmatrix}$$

19) $AX + E = X$

20) or $AX - X = E$

21) or $X - AX = E$

22) $(I - A)X = E$

23) and $(I - A)^{-1}E = X$

The matrix $(I - A)^{-1}$ generates the column vector of total industry output from the vector of final demand in this model. In most applied work it is the equation

24) $(I - A)X = E$

which is of interest. The solution to this system is

25) $X = (I - A)^{-1}E$

and it is the NxN matrix $(I - A)^{-1}$ which is of most interest to regional analysts. Before developing in more detail the particular uses of the matrix $(I - A)^{-1}$, it will be useful to consider the E vector in terms of the theoretical models of regional growth previously considered. The final demand vector E can be regarded in general as the economic base of a region or area so defined in terms of the concept of the community economic base. By definition the community economic base is considered to be those demands on the output of the local economy whose output is essentially exogenous to the local economy.

In practical regional or city growth studies using adaptations of the Leontief system to regions the E vector is generally disaggregated into several different vectors of final demand. (5, 8) The disaggregation of final demand is determined in individual research cases by the objectives of the investigator doing the study. Kalter's study provides a typical breakdown of final demand into exports, recreational exports, households, government, and investment. This study also illustrates the distinction which is made in the literature between the traditional input-output analysis and the from-to interindustry type of regional analysis. The from-to analysis differs primarily from the input-output in the use of employment rather than sales as the measure of economic activity.

Several early studies considered the relation between traditional input-output and from-to analysis. (4) The use of employment data as the basic measure of the local economy instead of input-output measured in dollars is justified primarily because of the availability of employment data. In addition, the cost of implementation using employment data is usually a fraction of the cost of data acquisition when the economy is measured in dollar terms.

It will now be useful to examine specifically the typical uses of a from-to regional analysis from an analytical and predictive standpoint. The analytical and predictive uses of a regional from-to analysis focus on the vector of final demands (the E vector) and the matrix previously defined as $(I - A)^{-1}$. Let us now consider these carefully. From an analytical viewpoint, the matrix $(I - A)^{-1}$ is the most useful in applied regional analysis. It allows for defining the specific change in total output of the regional economy that is a result of a per unit change in the final demand for the output of the endogenous industries.

Specifically, the column sums of $(I - A)^{-1}$ define the rates of increase in total output resulting from a one unit increase in final demand for the output of the jth industry. These quantities are called final demand multipliers for the endogenous industries of the local economy. Other multipliers can be generated from the $(I - A)^{-1}$ matrix and the different vectors of E (see Kalter p. 40), but it is the endogenous industry multipliers which will be the primary concern of this study.

Other relations of interest can be developed from the from-to analysis defined in terms of the matrix $(I - A)^{-1}$ and the final demand vectors E. A predictive model is automatically implied for a new column vector X_{t+1} where each element of X_{t+1} is the output of industry X_i at time $t+1$ that results from an overall increase in E from time t to time $t+1$. In matrix notation:

26) $X_{t+1} = (I - A)^{-1} E_{t+1}$.

The major concern is accurate projection of the vector E to time $t+1$ in this type of predictive framework. Finally, the product of AX_{t+1} would generate in row vector format the individual industries sales of the ith industry to the jth industry at time $t+1$, i.e., the interindustry transactions matrix at time $t+1$.

RELATIONSHIP OF THE ECONOMIC BASE ANALYSIS, FROM-TO MODELS AND EXPORT BASE THEORY

The export base theory of regional growth has previously been discussed as one specific theory of growth which holds that a region will grow or decline as its exports grow or decline. Export base theory then becomes a special case of economic base analysis where final demand or the economic base is defined entirely in terms of exports.

The export base theory of regional growth and its relation to the short-run economic base analysis has been recognized by writers in the field of regional science for several years. Tiebout recognizes this by stating that, "In the short-run other sectors besides exports can be considered as basic; local housing investment is an example of one such sector. Over the longer time span only the export sectors appear as basic. The locally oriented industries will grow or decline along with the growth or decline of the export sectors." (8)

The relationship between the various theories of regional growth and the different empirical models discussed above can now be considered in terms of a new formulation. *The column summation of the matrix $(I - A)^{-1}$ and the column vector X of the from-to model discussed above implies a single equation model of total output as a function of the vector of final demand E. (2)* This suggests a single equation linear specification of total output as a function of the level of final demand for the output of the endogenous industries in the local economy. When the level of final demand is assumed in the long run to be only the export demand for the output of the endogenous industries, then a formal mathematical model is specified in terms of export base theory of regional growth. In addition, this formal model is seen to be related to both the formal from-to analysis and the economic base analysis. Finally, an empirical test of the model is fairly readily accomplished subject to the specification of export levels of the local endogenous industries in a local economy.

FORMAL TEST OF THE MODEL MISSOURI DATA 1950-1970

The formal mathematical model discussed above suggested an empirical test using cross-sectional time series data on employment as a measure of economic activity in a local economy. It was decided initially to implement the test by the use of 10-year census data on employment by country and by the industrial classifications used by the United States Bureau of Census.

The following formal mathematical model was hypothesized to define the cross-sectional total employment for all counties to be included in the sample:

27) $T.E. = \beta_0 + \beta_1 E_1 + \beta_2 E_2 + \ldots \beta_k X_k + u$

where,

$T.E.$ = Total Employment

E_j = Export employment in the jth endogenous industry

u = A random error variable

β_0 = A constant whose value in population should theoretically be zero.

$\beta_1 \ldots . \beta_k$ = Population endogenous long-run export multipliers.

The theoretical framework of the analysis suggested that it would be necessary to group counties by population in order to determine reliable estimates of the population parameters β_1 to β_k. This is true because employment multipliers theoretically should be larger relative to a specific export level in an endogenous industry when the level of services available in a particular county is substantially higher. Initially, three groupings of counties were considered for the Missouri study. These classifications were as follows:

Class 1—Counties with population $<$ 15,000

Class 2—Counties with population 15,000 $\leq$ 100,000

Class 3—Counties with population $>$ 100,000

Missouri does not contain enough counties with population over 100,000 for a meaningful statistical analysis of the Class 3 grouping. Thus, a slightly different grouping of the state was necessary with metropolitan counties excluded from the sample. This will be developed in more detail later as the experimental results are reported.

Within the framework of the theoretical development, the most difficult empirical problem in testing the model is the generation of estimates from observed data on employment, the amount of export employment by industry. To make sample estimates of population parameters $\beta_1 \ldots \beta_k$ of the model, it is necessary to generate a set of sample data or an N·K matrix of observations on the values of E in the model. In this case N is equal to the number of observations and K is equal to the number of endogenous industries.

There are two methods of determining exports by industry in an economic area. These are classed as direct and indirect. Direct methods involve actually surveying firms operating in an area to determine the percent of total economic activity in each of the endogenous industries that is actually associated with exports. Indirect methods use a logical procedure to determine indirectly from a set of observed data the level of exports by industry. Because of the expense of the direct method of estimating exports, this was ruled out. The empirical problem was deemed one of making the "best" choice of an indirect method.

Three major methods have traditionally been used to make indirect estimates of export employment by industry in empirical studies. These are the assumption approach, location quotients, and minimum requirements. (8) The assumption approach simply assumes that all of a specific industry employment is associated with export employment. Location quotients are sometimes referred to as coefficients of localization or specialization. If an area is highly specialized relative to the nation in the production of product, then it seems logical to assume that a substantial portion of all employment in production of that product is associated with exports.

Location quotients based on national figures are determined by the following procedure: Let F_{eij} = the amount of employment in the ith region and jth industry that would be expected, assuming that the region had the same percent employment in jth industry as the nation as a whole. Then F_{eij} = (T.R.E.) national employment in industry j $\div$ total national employment where TRE = total regional employment in region i. Finally, let X_{ij} = actual employment in region i and industry j and E_{ij} = export employment in region i and industry j, then $E_{ij} = X_{ij} - F_{eij}$. The minimum requirements method is a variation of the location quotient method. This method is based on the idea that a certain amount of employment is required in each endogenous industry to supply local demand. Employment over and above the minimum requirement is then assumed to be export employment. Formally, a minimum requirements approach redefines the quantity $F^M{}_{eij}$ = the amount of employment in the ith region and jth industry expected on the basis of actual minimum satisfaction of local demand. The quantity $F^M{}_{eij}$ could be generated by multiplying T.R.E. by the quantity $P^M{}_{ij}$ where $P^M{}_{ij}$ = minimum percent of employment in the jth industry for $i = 1, \ldots, N$ regions. The quantity E_{ij} would then again be $E_{ij} = X_{ij} - F^M{}_{eij}$.

In the actual empirical implementation of the model considerable experimenting was necessary to establish an appropriate indirect procedure for generating the matrix of observed values E_{ij}. However, the method described was limited only to that actually used for analytical and projection purposes.

In practice a procedure was developed which can in general be described as a regional adaptation of the location quotient approach and the assumption approach. Instead of determining the values F_{eij} based on national figures, these values were generated by group-averaging the particular counties in a particular class. This procedure will be called by the group average requirements and the symbol G.A. will be used to designate it. In formal mathematical terms, the following formulas were used to generate E_{ij}.

28) X_{ij} = Employment in the ith county and jth industry.

29 T_{jh} = Total employment in the jth industry of the hth county class $= {}^{N}\Sigma_{i=1} X_{ij}$

30) T_h = Total employment in the kth county class; $= {}^{K}\Sigma_{j=1} {}^{N}\Sigma_{i=1} X_{ij}$

31) $G.A. = \dfrac{{}^{N}\Sigma_{i=1} X_{ij}}{T_h}$

32) $TC_i = {}^{K}\Sigma_{j=1} X_{ij}$ = Total county employment in the ith county.

33) $E_{ijh} = X_{ij}$ - (G.A.) TC_i is the export employment in the ith county, jth industry and hth county class.

Only nonnegative E_{ij} appeared in the observed export vectors used in determining estimates of employment multipliers. This was determined to be valid by substantial experimenting. This empirical approach suggests that some counties and cities supply a relatively low level of services in certain industries. However, these industries are represented in such areas and do supply some minimal service which shows empirically in this model as a less than group average employment in the industry. This justifies the suppression of negative values to zero in the model because a certain level of service is available and appears in the model in the total employment variable and is accounted for by the nonnegative export industries in the local area. Group averages for the endogenous industries defined in this study appear in Tables 1, 2, 3, 4, 5, and 6.*

CHOICE OF AREA OBSERVATION AND USE OF CENSUS DATA

The county was finally selected as the unit of observation in this study although some work has been done using the city and regional aggregations of counties. (6, 9) County data appeared to provide data as valid as aggregations of counties and substantially better results than those using cities as the unit of observation. From the standpoint of use in planning and projections work a case can be made for using the smallest area unit of observation providing sufficiently valid results. This is true since ultimately area planning in terms of land utilization and both public and private investment must be made on a very specific area basis. This is the smallest unit providing adequate data and appears to be the logical unit of choice.

Some criticism can be made of the use of census data because employment is given by county of residence rather than by county of employment. This would be expected to bias results when inter-county commuting of employment occurs to a measurable extent. This was not believed to be a major problem for the rural areas of Missouri for 1950 and 1960 but appears to be serious in the 1970 data. Finally, the critical question regarding the bias of inter-county commuting of employees would theoretically be determined on the basis of whether workers spend most of their income in county of residence or in county of employment. Should workers spend most of their income in their county of residence, then multipliers determined from such data should have little bias. After

*See tables in Appendix, starting on page 23.

all it is the multiplier impact on the local economy which is of interest to the investigator, planner, or policy maker. At any rate this question will need to be considered further when expanding to a more metropolitan type of regional setting.

The analysis of Missouri County employment data was completed for the three census years, 1950, 1960, and 1970. The data included total employment by counties as well as disaggregation into various different industrial classifications. Because of the different industry classifications for the three census years, it was necessary to define conforming industry classifications so that intertemporal comparison could be made. Initially, nine industry categories were defined as follows:

1. Agriculture, Fisheries and Forestry
2. Manufacturing
3. Mining
4. Construction
5. Transportation and Communication
6. Wholesale and Retail Trade
7. Business Services
8. Education and Related Services
9. Public Administration

It should be noted that the last five categories represent substantial regrouping of standard census classification of industries. This appeared necessary for two reasons: (1) many of the initial groupings of industries did not appear to contain enough employment to result in a meaningful statistical analysis in the small rural counties; and (2) the classifications of industries differed for the different census years making it necessary to reclassify to make comparisons across the time periods.

As indicated earlier, Missouri counties were classified into two groups: Class 1 counties, with 15,000 or less people as of the 1970 census, which included 60 counties out of the state total of 114, and Class 2 counties, which included 47 counties with population over 15,000, but excluded seven of the state's large counties and the city of St. Louis. The eight observations on the large counties and the city of St. Louis did not provide a large enough sample for a meaningful statistical analysis. In order to test the model on larger population counties it will be necessary to expand the sample beyond Missouri boundaries.

Two basic models were used in the analysis. These were a cross-section model and a cross-sectional first difference model. The cross-section model was applied to each of the two data sets for the three census years, generating six different sets of results. The first difference model was of the following form:

34) $\Delta TE = \beta_0 + \beta_1 \Delta E_1 + \beta_2 \Delta E_2 + \ldots \beta_k \Delta E_k + u$

where Δ_{vi} = observed variable at time t - observed variable at time t - 1. The first difference analysis resulted in four different sets of results for the two different county groupings and the three census years.

STATISTICAL RESULTS OF THE CROSS-SECTIONAL ANALYSIS

The results of the cross-sectional analysis for the three census years and two county groupings of data are shown in Table 1 to 10. The most striking statistical result of the cross-sectional analysis of Class 1 counties was the remarkably high level of the Multiple Coefficient of Determination (Tables 1, 2 and 3). The value of .97 or higher in all cases indicates the sigh explanatory ability of the model in accounting for variation of total county employment within the county grouping.

Most of the "t" values were significant for the export employment defined by the endogenous industries in the model for the three census years (Tables 1, 2 and 3). The striking statistical results as far as individual industries were concerned were the relatively high "t" values for manufacturing and agricultural employment (Tables 1, 2 and 3). The very small standard error of the regression coefficients relative to these two industries attests to the high degree of stability of the multiplier effects of these two industries on total employment by county.

The cross section analysis of Class 2 counties showed the same general pattern as for Class 1 counties (Tables 4, 5, and 6). The Coefficient of Determination was .99 for all three sets of census year data included in the study (Tables 4, 5, and 6). The relative importance of multipliers for agriculture and manufacturing employment was again indicated by the small distributions of the computed statistics determined by the sample data (Tables 4, 5, and 6).

As indicated previously, a first difference analysis of the 1960—1950 and 1970—1960 data was done using the same basic model as the cross-section analysis. Coefficients of Determination for the four data sets were not as high as for the cross-section analysis (Tables 7, 8, 9, and 10). However, the lowest value of .72 for Class 1 counties using 1970—1960 data was still a significant figure statistically and t values were generally significant for individual export industries (Table 8). The first difference analysis, even more than the cross-sectional analysis indicated the model's relatively good predictive ability, assuming accurate projections of export changes can be made.

MAJOR ECONOMIC CONSIDERATIONS RELATIVE TO MODEL

One of the most pervasive measures in economics is the concept of a "multiplier" whose primary debt for genesis is owed to the aftermath of Keyne's work on aggregate economic analysis. As a general definition the multiplier is the amount an endogenous variable in a model changes in response to a one-unit change in an exogenous variable. From a policy standpoint, the usefulness of multipliers is determined by their validity as a predictive device. It is from this standpoint that the various multipliers used by regional analysts will now be considered relative to the measures determined by this study.

No attempt will be made to review exhaustively the regional economic literature which has been written concerning the many multipliers that can be developed, conceptually and empirically, from regional growth models. These have already been discussed to some extent in the theoretical framework of the study and for the interested reader some sample references have been cited. This discussion will be restricted to advantages and disadvantages of long-term regional employment multipliers developed by the technique described by this study.

The most important concern of the practicing regional planner and policy maker in use of a regional employment multiplier should be the accuracy of the multiplier in predicting the regional total employment variable. In order to consider the accuracy of the endogenous industry export multipliers generated by this study, it is first necessary to consider the method used to empirically estimate county export employment for each of the industry classifications. Several variations of the various indirect methods for estimating export employment were experimented with in early tests of the model. However, the combinations of assumptions and location quotients based on group averages provided by far the best empirical results. One extremely important point should be noted. Overestimation of export employment in particular industries results in underestimation by a least-squares procedure of the magnitude of individual employment multipliers. On the other hand, underestimation of exports would result in overestimation of the relevant multipliers. Thus, it is possible to state the direction of possible magnitude bias if not its absolute value. This is an extremely important consideration to keep in mind when considering the results of such studies as well as the use of multiplier values in predictive work.

The point made above leads directly to another important consideration relative to estimated multiplier values. The stability of estimated regional employment multipliers for a particular grouping of counties is as important in practical usage as the magnitude of the multiplier itself. The measure of the stability in this study of course is the standard deviation of the sampling distribution of each export variable or the values of $S\hat{\beta}$ reported in the statistical results of the study. To see this, consider the employment multipliers estimated relative to agriculture and manufacturing. Cross-sectional estimates of the agricultural multiplier ranges from 1.50 in 1950 Class 1 counties to 3.25 for Class 2 counties in 1970 (Table 6). Both time and area change produced a maximum range of only 1.75 in the estimate of agricultural employment multipliers. Now consider the same values for manufacturing. The range in manufacturing was even less for the various estimates going from 1.55 for Class 1 counties in 1950 to 2.20 for Class 2 counties in 1970 (Table 1 and 6). The values were actually estimated by assumption that all employment in these two industries was export employment. Suppose that some constant portion, say 75 percent, of the observed employment in these two sectors was actually export employment. What effect would this have on estimated export employment multipliers? The effect would simply be to increase the multiplier by some constant. Yet in the case of these two obviously very basic industries the increase in total employment resulting from an increase in the endogenous industry is just as valuable if not more valuable to the applied user of such material. The estimated multiplier for both manufacturing and agriculture can then be regarded as the minimum value of the long-term export employment multiplier, but it is a very important minimum estimate of that theoretical quantity or parameter.

Finally, the relatively small standard error associated with each multiplier appears very important for two major reasons: (1) Comparative static predictions should be quite accurate and the relatively highly aggregated level of industry classifications appeared to be justified and (2) disaggregation of manufacturing into the various classifications does not appear necessary because, had substantially different values of multiplier for different classes of manufacturing existed in the sample counties, then a much larger variance would have been expected in the cross-sectional estimate of the aggregated manufacturing employment multipliers.

Now to consider multipliers estimated for the other endogenous industries. "A priori" industries other than manufacturing and agriculture would be expected to have substantially locally oriented employment and thus the decision to measure this locally oriented employment as average for the group. Export employment multipliers, as estimated by this procedure for all G.A. industries, can be interpreted as the increase in total employment that results from a one unit increase in employment in the industry that is over and above what is included as average for that particular grouping. This last definition is important to keep in mind for those planners who use such estimates for projection purpose. This point will be considered in more detail from a practical sense in a publication using the model for projection purposes.

Finally, another general point regarding multipliers should be considered by policy makers. Much has appeared in the literature regarding regional multiplier estimates in recent years which might be regarded as oriented to showing that one endogenous industry is more important than another because it has a larger or the largest multiplier of any endogenous industry included in the study. Such implications appear most frequently in relation to studies concerning rural development. The multipliers related to agricultural production and processing are many times touted as being larger than those for any other endogenous industry. The policy implication is that rural areas should emphasize the acquisition of agricultural processing industries and/or increase their agricultural production industry in order to enhance rural development. Even if one assumes that the primary objective of rural development is regional growth in population and employment the policy implication of relatively large employment multipliers is in many cases misleading. Why is this true? The more important question is the potential of the industry to expand export employment in the region. From this standpoint manufacturing as an aggregation appears to be very important both in terms of its relative magnitude and in terms of its multiplier impact on the local economy. Insofar as individual rural areas may acquire particular agricultural processing firms, substantial bolstering of the local economy could be expected. However, a general policy for rural development does not appear to follow logically.

The same consideration might be argued relative to the various "service industries" of this study whose export employment was defined in terms of group averages. Multiplier impacts on total employment relative to these service oriented industries can also be cast in a microeconomic policy context from a rural development standpoint. Those cities and counties whose export employment in service industries was substantially above average showed very significant and important multiplier effects on the local economy. This suggests that those areas growing above the average for the areas studied may actually be providing a substantially more improved service industry than those whose service industry is at about average for the group. This may be particularly true in service industries such as transportation, communication, wholesale and retail trade, business service, i. e., specifically the privately controlled service components of the local economy. This suggests that a locality whose citizens desire to grow at the expense of adjacent areas might adopt the approach of doing a better service job than their neighbors and thus expanding their privately controlled service industries.

Such a bootstrap approach could not be applied directly to the service industry components whose level of activity is primarily determined by the government and, thus, the political process. These categories would include public education, public administration, research, and others. Local decision makers certainly need to recognize the multiplier potential of these publicly controlled components of the local economy. But to take advantage of the substantial multiplier impact from this type of "service employment," areas will need to influence public decision makers to locate such activities in their area.

RELATION AND COMPARISON TO REGIONAL GROWTH THEORY

The conclusions and comparisons of this study in relation to the various theories of regional growth considered at the outset of the report must be restricted to what are normally considered rural areas in the rural-urban dichotomy. This is true since most counties included in the two county classifications were nonmetropolitan, with less than 50,000 people. Studies of county classifications with more than 50,000 people definitely appear in order.

Nevertheless, some important conclusions relative to regional growth models appear in order for this restricted classification. The first and obvious conclusion is that export base theory was substantially verified empirically by this study for rural regions. This is true if the analyst is willing to accept the definition of the export base used by this study. Also validated is Tiebout's argument that in the long run the export base is essentially the sole determinant of regional growth, although in the short run several other growth markets may be validly defined.

This conclusion is in direct opposition to those of analysts who argue that "export base theory" is essentially valid if at all only in the short run. This study actually suggests strongly that a ten-year planning horizon may be very valid. This may particularly be true in those very rural areas whose maximum population per county is less than 15,000 and whose agricultural production employment is a very substantial part of the export base. Here it should be noted, however, that as of the 1970 census, manufacturing accounted for over 21 percent of total employment in the area as a whole, while employment in agricultural production accounted for slightly over 18 percent of total employment.

Export base theory should be regarded as complementary to the other theories of regional growth discussed here and in cited references. The view expressed, particularly by Richardson, that export base theory is not compatible with other highly aggregated growth theories except under very restrictive assumptions appears an observation with little practical significance for rural areas in midwestern United States for the post-World War II period. At the least, the restrictive assumptions can be regarded as practical and operational.

Some considerations of the relationship between the empirical estimation of employment multipliers by least-squares and from-to input-output type models have previously been discussed by this author (2). Thus, comments in this report will be made primarily in terms of expanding on the previous discussion. The determination of sector multipliers or endogenous industry multipliers by column summation of the matrix $(I - A)^{-1}$ was discussed previously. The explicit mathematical relation between these multipliers and those determined by a least-squares cross-section analysis of employment was shown to be equivalent to assuming that the export base is the relevant growth force in the long run. Multipliers determined by from-to models and least-squares analysis would theoretically yield equivalent sector or endogenous industry multipliers under the same assumptions about the value of the export components of the endogenous industries. Obviously, in practice, multipliers could not be expected to be equivalent for a number of reasons. Differences in data, definitions of industries, sampling errors and other variables would operate to prevent empirically determined equivalent multiplier values.

In addition to the multipliers determined as noted above, another set of multipliers can be obtained from an industry from-to analysis which is probably not attainable from a least-squares analysis, at least with data currently available. These are called final demand multiplier values that relate the effect of final demand changes as a whole to the total output instead of final demand changes upon the individual industry. Such multipliers are short-run in their interpretation and depend upon the disaggregation or definition of final demand into categories other than exports. Several other important measures relative to local economy can be determined from case studies of local economies using input-output adaptations that are not obtainable by least-squares procedures discussed in this study (Kalter). In these terms then the least-squares determination of sector multiplier must be given a long-term interpretation, whereas multiplier-determined from-to models can be interpreted both in short-run and long-run terms.

Other matters of importance may be considered in comparing regional analyses accomplished by least-squares relative to determinations by case study approaches. These may be summarized in the following points.

1. Case studies provide more information regarding the local economy, particularly short-run. These studies are much more expensive because of their requirements for data generated from primary sources.

2. Least-squares procedures appear to provide reasonably accurate estimates of long-run export employment multipliers that can be used for long-term regional planning and projections at much lower cost in time and money. A separate report develops the use of these values for long-run regional planning and projection.

3. This research suggests that a least-squares analysis lends itself to less refined disaggregation than case study procedures. This may not be as apparent if applied to regions with denser concentration of employment and population.

4. Least-squares methodology lends itself more readily to a general test of particular theories of regional growth than does a case study procedure. Generalizations about cause and effect are more easily believable and in particular in reference to the export base theory of regional growth.

SUMMARY AND CONCLUSIONS

This study considered the various theories of regional growth and reports the results of a study of rural Missouri for the period from 1950 to 1970. The empirical analysis uses as its theoretical framework the export base theory of regional growth. The least-squares regression model was used to test the theory and cross-sectional time series data were used with both a space and time dimension implied.

The following major and important conclusions appear to be validated by the study:

1. The export base theory appeared to provide an empirically valid explanatory model of regional growth in rural Missouri during the post-World War II period using employment as the measure of county economic activity.

2. Although least-squares estimates of employment multipliers are less comprehensive in scope than those determined from case study approaches, this study suggests that estimates of long-term multipliers by this procedure can

provide reasonably accurate values with much less time and expense than those determined from case studies. The determination of such values for use in long-term regional planning for rural regions holds particular appeal because of the cost advantage over alternative methods. In addition, and related, is the flexibility of updating estimates through use of interim census estimates of employment now obtainable from the Employment Security Division for most rural counties. This is a particularly appealing advantage because technological change can be expected to induce substantial time changes in the multiplier impact of different industries.

3. "A priori," substantial differences in multiplier impacts of different industries would be expected through time and in different classifications of counties grouping by population size. This hypothesis was very effectively validated by this study. For example, the 1950 estimate of the long-run export employment multiplier for agriculture in Class 1 counties was 1.50 whereas the same value for Class 2 counties in 1970 was 3.25. The very low standard error of the coefficient in both cases indicates a significant difference both in time and space. In addition, the direction of magnitude in value was quite consistent with the theory. This was in general true for estimated multipliers.

4. Further testing of the procedure appears to be fully justified. Such testing will move in several directions. The most obvious and logical direction of test expansion would be to a sample including denser concentrations of economic activity as measured by population and employment. In addition, further experimentation with the particular industry aggregation and definition of observation unit appears in order. Neither of these will limit the implementation of the study or its usefulness for actual planning and projections purposes in rural Missouri.

APPENDIX

TABLE 1

Cross Section Results of Class 1 Counties
1950 Employment Data

Industry	Long-run Export Employment Multiplier ($\hat{\beta}$)	Standard Error of $\hat{\beta}$	t Value	Ind. Group Avg.	Export Employment Determinant
1. Agriculture, Fisheries & Forestry	1.50	.07	21.4	50.01	A.
2. Manufacturing	1.55	.11	14.1	9.24	A.
3. Mining	1.48	.65	2.3	0.90	G.A.
4. Construction	1.90	1.48	1.3	4.87	G.A.
5. Transportation & Communication	1.98	.69	2.9	4.52	G.A.
6. Wholesale & Retail Trade	2.74	.69	4.0	12.55	G.A.
7. Business Services	1.99	.89	2.2	8.63	G.A.
8. Education & Related Services	2.29	1.53	1.5	4.39	G.A.
9. Public Administration	2.03	.85	2.3	4.88	G.A.
10. Constant ($\hat{\beta}_0$)	27.50	138.54	.2		
$R^2y.1 \ldots 9 = .97$	N = 60				

TABLE 2

Cross-Section Analysis of Class 1 Counties
1960 County Employment Data

Industry	Long-run Export Employment Multiplier ($\hat{\beta}$)	Standard Error of $\hat{\beta}$	t Value	Ind. Group Avg.	Export Employment Determinant
1. Agriculture, Fisheries & Forestry	1.83	.08	22.9	31.70	A.
2. Manufacturing	1.76	.07	25.1	15.82	A.
3. Mining	2.03	.48	4.2	0.94	G.A.
4. Construction	1.43	.94	1.5	6.20	G.A.
5. Transportation & Communication	2.45	.63	3.9	4.45	G.A.
6. Wholesale & Retail Trade	3.01	.64	4.7	16.97	G.A.
7. Business Services	2.55	.50	5.1	10.58	G.A.
8. Education & Related Services	3.84	.76	5.1	7.25	G.A.
9. Public Administration	.88	.71	1.2	6.09	G.A.
10. Constant ($\hat{\beta}_0$)	84.28	97.16	.9		
$R^2y . 1 \ldots .9 = .98$	N=60				

TABLE 3

Cross-Sectional Analysis of Class 1 Counties
1970 County Employment Data

Industry	Long-run Export Employment Multiplier ($\hat{\beta}$)	Standard Error of $\hat{\beta}$	t Value	Ind. Group Avg.	Export Employment Determinant
1. Agriculture, Fisheries & Forestry	2.28	.14	16.3	18.80	A.
2. Manufacturing	1.99	.08	24.9	21.01	A.
3. Mining	2.75	.44	6.3	1.50	G.A.
4. Construction	2.64	.78	3.4	7.53	G.A.
5. Transportation & Communication	2.94	1.00	2.9	3.98	G.A.
6. Trade	2.50	.66	3.8	19.07	G.A.
7. Business Services	3.53	.68	5.2	14.73	G.A.
8. Education & Related Services	2.49	.41	6.1	9.70	G.A.
9. Public Administration	1.34	1.04	1.3	3.66	
10. Constant ($\hat{\beta}_0$)	-46.5	117.38	.40		
$R^2y . 1 . . . 9 = .97$	N = 60				

TABLE 4

Cross-Section Results of Class 2 Counties
1950 Employment Data

Industry	Long-run Export Employment Multiplier ($\hat{\beta}$)	Standard Error of $\hat{\beta}$	t Value	Ind. Group Avg.	Export Employment Determinant
1. Agriculture, Fisheries & Forestry	1.55	.13	11.9	30.25	A.
2. Manufacturing	1.66	.21	7.9	14.65	A.
3. Mining	2.09	.37	5.6	1.40	G.A.
4. Construction	6.64	2.76	2.4	5.72	G.A.
5. Transportation & Communication	3.00	.71	4.2	6.15	G.A.
6. Wholesale & Retail Trade	3.33	1.00	3.3	17.70	G.A.
7. Business Services	2.05	1.57	1.3	13.26	G.A.
8. Education & Related Services	2.12	.45	4.7	5.62	G.A.
9. Public Administration	1.58	.88	1.8	5.23	G.A.
10. Constant ($\hat{\beta}_0$)	883.44	463.98	1.8		
$R^2y . 1 . . . 9 = .99$	N = 47				

TABLE 6

Cross Sectional Analysis of Class 2 Counties
1970 County Employment Data

Industry	Long-run Export Employment Multiplier ($\hat{\beta}$)	Standard Error of $\hat{\beta}$	t Value	Ind. Group Avg.	Export Employment Determinant
1. Agriculture, Fisheries & Forestry	3.25	.55	5.9	9.03	A.
2. Manufacturing	2.20	.14	15.7	21.19	A.
3. Mining	3.18	.71	4.5	1.07	G.A.
4. Construction	.39	1.65	.2	6.93	G.A.
5. Transportation & Communication	4.15	1.18	3.5	4.75	G.A.
6. Wholesale & Retail Trade	5.55	.79	7.0	20.54	G.A.
7. Business Services	3.36	.65	5.2	18.52	G.A.
8. Education & Related Services	2.51	.20	12.6	13.47	G.A.
9. Public Administration	3.99	.53	7.5	4.49	G.A.
10. Constant ($\hat{\beta}_0$)	-407.98	549.97	.7		
$R^2y . 1 . . . 9 = .99$	N = 47				

TABLE 5

Cross Section Analysis of Class 2 Counties
1960 County Employment Data

Industry	Long-run Export Employment Multiplier ($\hat{\beta}$)	Standard Error of $\hat{\beta}$	t Value	Ind. Group Avg.	Export Employment Determinant
1. Agriculture, Fisheries & Forestry	1.87	.22	8.5	17.67	A.
2. Manufacturing	2.16	.13	16.6	18.92	A.
3. Mining	2.33	.47	5.0	1.02	G.A.
4. Construction	-.38	2.73	.2	5.95	G.A.
5. Transportation & Communication	2.58	.81	3.2	5.44	G.A.
6. Wholesale & Retail Trade	4.68	.73	6.4	19.07	G.A.
7. Business Services	2.52	.88	2.9	14.55	G.A.
8. Education & Related Services	2.48	.31	8.0	9.64	G.A.
9. Public Administration	3.32	.79	4.2	7.73	G.A.
10. Constant ($\hat{\beta}_0$)	543.93	448.85	1.2		
$R^2y . 1 . . . 9 = .99$	N = 47				

TABLE 7

First Difference Analysis of Class 1 Counties
1950-1960 County Employment Data

Industry	Long-run Export Employment Multiplier ($\hat{\beta}$)	Standard Error of $\hat{\beta}$	t Value	Export Employment Determinant
1. Agriculture, Fisheries & Forestry	1.17	.09	13.0	A.
2. Manufacturing	1.75	.20	8.8	A.
3. Mining	1.61	1.45	1.1	G.A.
4. Construction	.56	.79	.7	G.A.
5. Transportation & Communication	1.01	.87	1.2	G.A.
6. Wholesale & Retail Trade	1.02	.47	2.2	G.A.
7. Business Services	2.11	.58	3.6	G.A.
8. Education & Related Services	2.46	1.05	2.3	G.A.
9. Public Administration	1.50	.47	3.2	G.A.
10. Constant ($\hat{\beta}_0$)	188.53	75.80	2.5	
$R^2y . 1 . . . 9 = .89$	N = 60			

TABLE 8

First Difference Analysis of Class 1 Counties
1960-1970 County Employment Data

Industry	Long-run Export Employment Multiplier ($\hat{\beta}$)	Standard Error of $\hat{\beta}$	t Value	Export Employment Determinant
1. Agriculture, Fishery & Forestry	1.24	.24	5.2	A.
2. Manufacturing	1.32	.31	4.3	A.
3. Mining	1.84	.42	4.4	G.A.
4. Construction	2.16	.80	2.7	G.A.
5. Transportation & Communication	2.09	1.33	1.6	G.A.
6. Wholesale & Retail Trade	1.61	.77	2.1	G.A.
7. Business Services	1.92	.81	2.4	G.A.
8. Education & Related Services	2.99	.80	3.7	G.A.
9. Public Administration	1.57	.89	1.8	G.A.
10. Constant ($\hat{\beta}_0$)	187.81	119.76	1.6	
$R^2y . 1 . . . 9 = .72$	N = 60			

TABLE 9

First Difference Analysis of Class 2 Counties
1950-1960 County Employment Data

Industry	Long-run Export Employment Multiplier ($\hat{\beta}$)	Standard Error of $\hat{\beta}$	t Value	Export Employment Determinant
1. Agriculture, Fisheries & Forestry	1.13	.16	7.1	A.
2. Manufacturing	1.68	.23	7.3	A.
3. Mining	.54	.83	.7	G.A.
4. Construction	1.36	1.87	.7	G.A.
5. Transportation & Communication	.99	1.39	.7	G.A.
6. Wholesale & Retail Trade	.74	.52	1.4	G.A.
7. Business Services	1.15	.82	1.4	G.A.
8. Education & Related Services	3.58	.62	5.8	G.A.
9. Public Administration	2.50	.92	2.7	G.A.
10. Constant ($\hat{\beta}_0$)	445.46	229.29	1.94	
$R^2y . 1 . . . 9 = .90$	N = 47			

TABLE 10

First Difference Analysis of Class 1 Counties
1960-1970 County Employment Data

Industry	Long-run Export Employment Multiplier ($\hat{\beta}$)	Standard Error of $\hat{\beta}$	t Value	Export Employment Determinant
1. Agriculture, Fishery & Forestry	1.70	.27	6.3	A.
2. Manufacturing	1.61	.33	4.9	A.
3. Mining	.66	1.17	.6	G.A.
4. Construction	4.00	1.70	2.4	G.A.
5. Transportation & Communication	2.01	1.51	1.3	G.A.
6. Wholesale & Retail Trade	3.91	1.17	3.3	G.A.
7. Business Services	1.18	.88	1.3	G.A.
8. Education & Related Services	3.28	.30	10.9	G.A.
9. Public Administration	3.86	1.25	3.1	G.A.
10. Constant ($\hat{\beta}_0$)	919.17	281.49	3.26	
$R^2y . 1 . . . 9 = .93$	N = 47			

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