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METHODOLOGY OF THE ECONOMIC BASE ANALYSIS

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A THESIS

Presented to

The Faculty of the Graduate Division

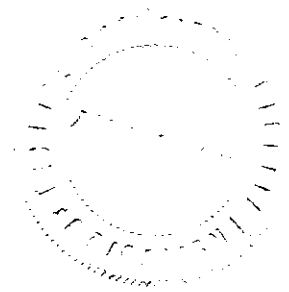
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THE ECONOMIC BASE ANALYSIS

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CHAPTER I

INTRODUCTION

The economic characteristics of a community stated as statistical indicators provide the planner with a scientific tool for meeting the challenge of urban dynamics. These characteristics help to explain those forces causing urban growth and influencing the rate of urbanization. They also indicate the economic potential of the community. The success of many planning projects depends upon the planners' ability to understand these characteristics. Land use plans, zoning ordinances, annexation studies, industrial development programs, redevelopment projects, traffic studies and tax base studies are a few examples of projects in which the economic characteristics of a community are basic considerations.

The need for understanding the economic characteristics of a community is greater today than at any time in history. In particular, the growing complexities of urban life are placing new and changing demands on planning. Today, planning has to take into account the social and economic changes taking place within and about the community and to project even decades ahead the impact of these dynamic trends. To meet these requirements more precise information is needed about the economic characteristics of the community. A device for giving this information, the economic base analysis, is in general use among city planners and is becoming increasingly important as a planning tool.

Because the future of any community is dependent upon its potential, determination of the economic potential is the most important part of the

economic base analysis. The effectiveness with which the potential is utilized not only determines whether or not a community will grow and prosper, but it also indicates the direction and expected rate of growth of that community.

Therefore, the economic base analysis can serve as a tool to guide the planner in carrying out many of his projects. A flexible land use plan and a zoning ordinance that will facilitate and protect land uses can be prepared if future changes are anticipated. This means that the physical plans can serve to help guide the development of the community and provide a more economical means of adjustment as changes occur. The analysis provides data for traffic and tax base studies. It also provides a guide for timing the annexing of specific areas into the community and the extension of municipal services into these areas. The analysis will reveal those areas in need of redevelopment because of deterioration or obsolescence. To insure economic stability in the community, the planner seeks to obtain a balance in economic activities. The economic base analysis can therefore serve to guide his industrial development program.

The concept of economic base came into use during the early 1920's. At first, interest centered primarily on discovering (a) the reasons for community growth and (b) the reasons why certain economic activities located in certain areas within the community. Later interest was focused on forecasting the future growth of the community.

The original techniques of economic base analysis consisted of separating all economic activities within the community into two classes or categories. The first category consisted of those activities that were considered to contribute directly to the growth of the community. Names

such as "basic," "primary," "town-growth," and "town-building" are used to identify these activities.¹ The second category was made up of those activities that were required in the community because they contributed to the support of the activities in the first category. These activities are identified by such names as "nonbasic," "ancillary," "service," and "secondary."² Today, these two classes are generally identified by the names "basic" and "nonbasic" or "service."

Interest in forecasting community growth brought about the development of the "basic-nonbasic" ratio or "multiplier." Researchers believed that by quantifying each activity through some medium of measurement common to all activities, usually employment, a forecasting tool could be developed.

The economic base concept has gained widespread use and acceptance among researchers interested in urban problems. The vast amount of research in this field has resulted in many modifications and refinements in the original technique.

In addition to the "basic-nonbasic" method of economic base analysis, other techniques of economic analysis have been developed. The "input-output" technique, spatial and locational analyses and various techniques of forecasting based on past economic trends are examples.

Each of the many techniques that have been devised to provide a basis for forecasting economic changes appears to have certain limitations. These limitations range from an inadequate theoretical framework to a lack of reliable data. A few techniques have been generally neglected because the collection of necessary data is expensive and time-consuming.

To date no single technique can supply all the required information

that is needed for a comprehensive economic analysis. Because of this major limitation one must conclude that the methodology of economic base analysis is still in the experimental stages. However, it is anticipated that in the future improved statistical data will be made available so that some day we shall be able to state the economic base of the community as a system of equations.

The objectives of the economic base analysis are: (a) to review all existing resources of the community; (b) to discover how efficiently these resources are being used and whether or not this efficiency can be improved and (c) to discover potential resources that can add to the further development of the economic base. These objectives, therefore, indicate that the economic base analysis should consist of three parts, namely, (a) a review, (b) an appraisal, and (c) a forecast. The first part consists of a review of all existing resources of the community. The second part consists of an appraisal of the importance and use of each of the resources. The forecast consists of an evaluation of the impact of potential resources on the existing economic base. Where possible each resource must be expressed in quantitative terms supplemented by qualitative statements to insure a more comprehensive analysis of the present and future economic base.

The purpose of this research is to explore the methodology employed in arriving at the "economic base" of a community; to appraise the usefulness of the various techniques used for analytical purposes; and, if possible, to suggest a more useful method of "economic base" analysis.

CHAPTER II

THE BASIC-NONBASIC METHOD OF
ECONOMIC ANALYSIS

In recent years, the "basic-nonbasic" method of economic analysis has gained widespread acceptance, as shown in part by the vast amount of literature on the subject. The method emphasizes the importance of a community's "exports." "Exports" are considered to be the cause of economic growth in the community and thus are termed the "foundation of the economy" or "basic" activities.¹ The "non-export" activities in the community are called "non-basic" or "service" because these activities are believed to exist solely for the purpose of serving the needs and interests of the people and firms residing within the community.²

In theory, "exports" generate economic activity because the sale of goods and services to persons and firms residing outside of the community results in the flow of new money into the community. In turn new money gives rise to "non-export" activities within the community because local consumption increases as local incomes rise. Therefore, in theory, each community has two distinct classes of economic activities, each differing from the other with respect to the forces that activate it and with respect to the contributions it makes to the urban economy.

The "basic-nonbasic" method of economic analysis was formulated in the early 1920's in the writings of M. Aurousseau³ and Frederick Law Olmstead.⁴ R. M. Haig, Homer Hoyt, Victor Roterus, and John W. Alexander are credited with developing the methodology of the concept.⁵ The most

comprehensive historical development of the current specialized meaning of "economic base," as well as the mechanics of the concept and its application to planning, was made by Richard B. Andrews in his twelve articles appearing in Land Economics, from May 1953 to February 1956.

Researchers using the "basic-nonbasic" technique were seeking a method that could do two things: (1) delineate "basic" industries from the "nonbasic" so plans can be made to encourage the stability and prosperity of the "basic" industries; (2) provide a simple and easily applied method for forecasting future employment and population in the community. Techniques for analyzing "basic-nonbasic" activities.--In general there are two approaches to identifying the "basic" and "nonbasic" activities. One is through the use of published statistics (or those locally compiled if no published data are available). The other is through the use of field surveys (personal interviews and questionnaires).

Employment⁶ is usually the medium used for ascertaining the extent of these activities in a community, although "value added"⁷ and "income"⁸ are other criteria used for quantifying the "basic" industries.

The methodology developed by Homer Hoyt makes use of published data and is based on the assumption that certain types of economic activities are inherently basic and others non-basic.⁹ Activities such as manufacturing, wholesale trade, non-local finance, resorts, state and federal government, colleges, non-local transportation and mining are considered basic. Hoyt states that "the production of capital goods, or machinery, tools or steel ingots are other activities which are practically entirely basic."¹⁰ Examples of non-basic activities are elementary and secondary schools, city police and fire departments, local transportation and telephones, local

doctors and lawyers, retail stores, local banking, local restaurants and printing. Many types of consumer goods are also in part non-basic.

After the various activities have been classified as "basic" and "nonbasic," the next step is to determine the amount of these activities so that the strength of the economy can be measured.

Employment is the suggested gauge for the quantitative analysis. Employment figures may be obtained from census publications or from local sources such as the Chamber of Commerce, local trade associations and employment offices or local establishments when published statistics are not readily available. The typical procedure for this analysis is as follows:

(1) The total number employed in each type of activity should be determined, separating the obvious "basic" activities from the "nonbasic."

(2) Whenever an activity is partly "basic" and partly "nonbasic," the basic workers may be estimated by finding that activity's "normal" condition and comparing this figure with the actual employment in the given line. A community's "normal" condition is computed by taking the percentage of the community's total income or population to the national income or population times the total national employment in the given line. Whenever the proportion of the total national employment in that line in a given community is greater than the community's "normal," that part of employment in excess of the proportion may be attributed to basic employment. The hypothetical case shown on the next page illustrates how this procedure is applied.

National employment in industry "X"	1,000,000
$\frac{\text{City's income}}{\text{National income}} \times 100 = 0.1\%$	
	$\times \underline{0.001}$
City's normal share of employment in industry "X"	1,000
City's actual employment in industry "X"	<u>1,500</u>
Basic workers in industry "X"	500

(3) After finding basic employment in each activity, these figures should be totaled to find total basic employment. Next compute the percentage which each type of basic employment represents of the total. These percentages will indicate the relative importance of each type of activity in the economic development of the city.

(4) Future employment and population may be forecast by computing certain ratios, usually referred to as the "multiplier."¹¹ (This "multiplier" should not be confused with the Keynesian "multiplier," $k = \frac{1}{1-b}$.¹²) The employment "multiplier" is derived by expressing the ratio of "nonbasic" workers to "basic" workers in terms of the number of "nonbasic" workers per "basic" worker. To illustrate, suppose a community has 1,000 "nonbasic" workers and 500 "basic" workers. Because there are two "nonbasic" workers per "basic" worker the ratio is 2:1 and consequently the employment "multiplier" is 2.

To estimate total future employment in the community, first forecast the future prospects of the principal industry or industries as indicated in (3) above. "Nonbasic" workers are then predicted by multiplying total "basic" employment by the "multiplier." Total future employment is then determined by adding total "basic" and "nonbasic" workers.

The population "multiplier" is the ratio of total population to total employment. Future population is derived by multiplying the population "multiplier" by the computed total future employment.¹³

In addition to Hoyt's method, certain indices have been used to classify "basic" and "nonbasic" activities and to measure the degree of concentration of a particular type of activity in an area.

Localization Factor.--An index called the "localization factor" was used in the Cincinnati Planning Commission Report on the Economy of the Area. The purpose of this factor was to show "the degree of representation of the various types of manufacturing in the Cincinnati Industrial Area as compared with the average manufacturing pattern for the U. S."¹⁴

The formula used for deriving this factor was:

$$\frac{\frac{\text{Mfg. Type Employment (Cin. Indus. Area)}}{\text{Total Mfg. Employment (Cin. Indus. Area)}}}{\frac{\text{Mfg. Type Employment (U. S.)}}{\text{Total Mfg. Employment (U. S.)}}} = \text{Localization Factor (National Average is 1.0)}$$

A factor of 1.0 indicates that the activity in the area is equal to the national average. A factor greater than 1.0 indicates more concentration in the area than on the national average, and conversely, less than average concentration is indicated when the factor is smaller than 1.0.

A high "localization factor" for a particular type of industry is interpreted as indicating that the area has locational factors that are highly favorable to the location and survival of that activity. Because of this it is felt that "other types of industry with the same locational

requirements (with respect to labor, materials, markets and other factors) would thrive equally as well in the same location."¹⁵ Thus, this factor can serve as a starting point for determining the kinds of activities that might be attracted to the area because of locational advantages.

However, this factor has little or no usefulness as an indicator of the significance of an activity in the total urban economy.¹⁶ An industry accounting for only a small percentage of total employment can have a high "localization factor" whereas a major industry in the community can have a much smaller factor. The significance of the individual activity to the total economy must be determined by other means. One such method was outlined in item (3) of the discussion of Hoyt's methodology.

Coefficient of Specialization.--A second index referred to as either the "coefficient of specialization"¹⁷ or the "location quotient"¹⁸ differs slightly from the "localization factor." The primary difference is that "total local and national employment" replace "total manufacturing in the city and the United States" in the formula. The following formula is used to find this factor:

$$\frac{\frac{\text{Local employment in industry "X"}}{\text{Total local employment}}}{\frac{\text{National employment in industry "X"}}{\text{Total national employment}}} = \begin{array}{l} \text{"Coefficient of} \\ \text{specialization"} \\ \text{or} \\ \text{"Location quotient"} \end{array}$$

The procedure for determining the degree of concentration is the same as that followed by using the "localization factor." Namely, the degree of specialization in the local economy is the same as the degree of specialization in the national economy when the index is equal to 1.0. If the index is less than 1.0 the degree of specialization is greater in the national economy and, conversely, if the index exceeds 1.0 the degree of specialization is greater in the local economy.

This index is a convenient device for analyzing the market area for individual industries, and at the same time it furnishes a serviceable standard for grouping industries as basic and nonbasic.¹⁹

Much effort has been expended in refining the techniques using published data for analyzing the economy of an area but without much success. The standard industrial classifications are of necessity general in nature and broad in scope. These classifications result in the grouping together of industries producing dissimilar products. Therefore, the standard classifications are considered by some to be inadequate sources of data for the classification of "basic" and "nonbasic" activities.²⁰

Many analysts believe that the economic base studies can be improved if necessary information is obtained directly from individual enterprises, through the use of personal interviews and questionnaires.²¹ The procedure usually employed in making a field survey is to ascertain from records of manufacturers of other business enterprises the percentage of total sales of goods and services made to markets outside of the city. This percentage times the total number of workers will indicate "basic" employment in each establishment. This separation of the proportion of the product used locally and that exported is perhaps a more accurate technique than taking total employment in any industry that is predominantly "basic" as entirely "basic."

A few applications.--In addition to the above uses for forecasting employment and population and describing the relative importance of the varying "export" activities, the "basic-nonbasic" analyses afford a means for estimating future residential and industrial land-use requirements. The number of new families requiring residential land and housing can be

estimated by dividing the estimated population increase by the average family size. By calculating present floor area and yard space requirements per worker in each industry and multiplying this average by the expected employment increases in each industry, future industrial land-use requirements can be estimated.²²

The analysis of the "coefficient of specialization" is a useful tool in studying the market areas of individual industries and their competitive advantages and disadvantages.²³

Four other merits of the "basic-nonbasic" concept are emphasized by the following:²⁴

- (1) The concept provides a view of economic ties which bind a city to other areas. . . . The rationale of the basic-nonbasic concept is that the relationship revealed by data on basic employment constitute a more meaningful basis for analyzing a city's economy than do those comprised by total employment.
- (2) It permits the most satisfactory classification of cities in terms of regional functions. . . . Cities are more accurately distinguished by their basic economy than by their total economy because the basics express a city's service to its region.
- (3) The basic-nonbasic concept provides a new ratio which may have significance in differentiating types of cities.
- (4) Provision of the basic-nonbasic ratio also enables a new classification for individual economic endeavors. . . . To illustrate, a business which makes all of its sales to the local market is distinctly different from one which makes all its sales to the outside market. Both businesses might be factories. The traditional method of classifying economic activities would consider them to be in the same category, namely, manufacturing, and, yet, in terms of spatial relationships with market areas are opposites; one is basic activity, the other is nonbasic. One is tied to the local region for its sales; the other is tied to the surrounding region.

Limitations.--Considerable controversy has developed over the practical usefulness of the "basic-nonbasic" analysis. Advocates of the concept have fully admitted its shortcomings. Others consider the methodology

unrealistic and incorrect but have failed to offer any practical substitute method of analyzing a community's economy.

Probably the most significant, but at the same time least conspicuous limitation is that its seeming simplicity is misleading to the novice. Great care must be taken in the selection of the "basic" and "nonbasic" activities since the differentiation of these activities must be logically reasonable as well as statistically correct. Many times the reliability of the judgment of the researcher is more important than the formula used. For example, if the technique outlined by Hoyt²⁵ is used, judgment plays a vital role. Suppose a particular product, because of its lack of local acceptance, has little sale in the community in which it is produced. Yet because the firm's share of total employment in the community is smaller than its proportional share of national employment in that industry, that firm will be classified as "nonbasic." Unless the analyst is thoroughly familiar with the market area of that firm, an error in classification will result.

If a field survey method is employed, the researcher must have the required knowledge and technical skill in order to accurately appraise the reliability of the data obtained. Whenever a sample survey is made, a knowledge of sampling techniques is necessary to insure the proper sample size and selection of the representative enterprises.

Even with an adequate sample there are certain inherent weaknesses in this method. The managers of a business may be unwilling to divulge complete information on their firm's sales or because of a lack of interest they may fail to return the questionnaire; or the managers may not know the exact extent of their firm's market inside and outside of the

area under study.²⁶ Unless questionnaires are adequately prepared and tested, they may fail to convey the correct information to all persons who are requested to submit data.

Interviewers sometimes are a weak link in the field survey method and unless they are accepted by those being interviewed they may fail to accomplish their mission. For this reason, one report stated that business executives were used as interviewers because it was felt that the managers of the firms to be interviewed would more readily accept businessmen than other persons.

A recent study revealed that in the absolute sense it is not the misclassification of "basic" and "nonbasic" activities that greatly alters the usefulness of the base-ratio method but the accuracy of the forecast of the changes in "basic" activities. This study illustrates that "for error to occur, a misclassified base or service industry must have a predicted growth rate which is different from the predicted growth rate for the total primary sector."²⁸ Thus, the skill of the analyst is a prerequisite to the reasonableness of his forecast of the components of the economy as well as the total economy.

The "basic-nonbasic" ratio is static. It holds true only for one point in time and for a specifically delineated area. Because of the dynamic nature of economic phenomena, a static ratio will serve to aid in forecasting only in the short-run.²⁹ As economic growth takes place this ratio is altered.³⁰ It then becomes necessary to compute a new ratio if the usefulness of this concept is to be extended.

The selection of basic activities by means of the "coefficient of specialization" implies that worker productivity and per capita consumption

rates are the same as the national average. However, both production and consumption rates are known to vary with different communities and regions within the United States.³¹ Differences in education, technical skill or degree of mechanization are reasons for variations in productivity. Per capita income deviates because of differences in income levels, spending habits, relative price patterns and local differences in tastes.

Another limitation of the "coefficient of specialization" as an indicator of "basic" and "nonbasic" activities is that it necessitates the assumption that transport costs determine the extent of the market area. This is a misleading assumption because it means that there will be no exports by a given industry until the community has had a share equivalent to that of the national average in that industry.³²

The "basic-nonbasic" concept fails to consider the effect of the "foreign-trade multiplier feedback."³³ In certain areas this "feed-back" can be a controlling factor in expanding the export base potential. "Feedback" results when the exporting community A, makes purchases from the importing community B. These purchases stimulate economic activity in B, which in turn increases the income in B. As B's income increases the market potential for A's product likewise increases.

The following quotation emphasizes the importance of "feedback" in relation to the size of the subject economy.

Consider the exports of New England. Like those of any other region, its exports compete with products from elsewhere, thus one expects to find that export receipts fall off as a function of distance. Few of the region's exports enjoy a world-wide market. The New York area would be expected to absorb a much higher percentage of New England's exports than would a market of equal size in the far West. Consequently, the New England area would tend to absorb a greater percentage of New York's exports than would a more remote market.

Contrast this situation with that of a mill town. Here the exports may be considered as going off into some distant place. The income of the mill town will be affected by the income of its market but the income of the market will not be affected by the income of the mill town.³⁴ In this case there is no foreign trade multiplier feedback.

Because imports represent money leaving the community, they, as well as exports, are important considerations in the appraisal of a community's economy. "Basic-nonbasic" ratios expressed in terms of employment cannot be used to indicate imports because only the gross value of exported goods can be calculated. "Value added" has been suggested as a better measure of "basic" activities since in some industries the net value of exports can be determined. This is true when the exporting firm imports its raw materials.³⁵

However, certain difficulties in classification arise when "value added" is used, particularly if the exporting industry purchases its raw materials locally. The raw-material industry will be classified as "non-basic" by definition. Yet, payment received for its raw materials in the form of the finished product is a net earning to the community. And value added in process would yield to a false estimate of the total value of the finished product to the community. The following quotation illustrates how "value added" may lead to confusion in classification.

. . . a community exports a million tons of steel. If this steel is produced in an integrated metallurgical plant, the "Value added" is the difference between the cost of ore, coal, etc., and the value of the steel; and all employment in the plant is considered "basic." But if the same steel is produced in a steel plant which buys its pig iron from an independent local blast furnace, then only the value added by the steel plant is considered "basic," and the value added by the blast furnace, by definition, is "non-basic," because it is sold to a local customer. Thus the distinction between "basic" and "nonbasic" is a function of the inner organization of the industry: The higher degree of specialization and differentiation, the breakdown of a process into parts performed by several independent establishments, the higher is the "nonbasic" share.

This difficulty has given birth to the concept of "indirect primary" activities and employment. "Indirect primary" are all goods or services sold to a local establishment which in turn exports its products. But the steel mill does not only buy locally produced pig iron; it equally buys locally produced power, water, trucking services, banking services, local police and fire protection. Moreover, it buys locally produced labor power which in turn buys locally produced bread and movie shows. Once "indirect primary" activities are admitted as "basic," where can the line be drawn? The economy of an area is an integrated whole of mutually interdependent activities; the distinction between "basic" and "nonbasic" seems to dissolve into thin air.³⁶

The population "multiplier" fails to consider the family coefficient of the workers in both the "basic" and "nonbasic" activities and it omits the nonemployed population. Studies reveal that the family coefficients of workers in different types of jobs vary considerably.³⁷ If the percentage of nonemployed persons in a community (those deriving their incomes from investments, pensions, social insurance, relief payments, etc.) is large, this could result in a significant error in the population forecast.

Many writers have disagreed with the underlying philosophy of the "basic-nonbasic" concept. One critic states that "no basic industry in a modern city could function without such services as water, transportation, and communication." Therefore he contends that "the community with its services is the basis for industry as well as vice versa."³⁸

Another philosophic dissimilitude is that emphasis should be on the differences in markets (local vs. export) rather than on exports alone. Products competing in the national or international market are more vulnerable than products serving the local market since the local market is relatively free from outside competition. Thus, instead of focusing all the attention on exports, more emphasis should be placed on the industries that can serve to replace the imports supplying the home market.³⁹

This shifting of emphasis brings up another problem. As imports are replaced by local production of goods and services the more self-contained the community becomes. Should the community become completely self-contained, i.e., there are no imports or exports, then by definition there could be no economic base. On the other hand, the higher the percentage of "basic" employment the greater the dependence of the community on outside markets.

Another limitation of this concept is that it fails to take into account the monetary factor. The amount of capital available for investment (whether the source of funds is local or nonlocal) is a major determinant of the rate of growth of a community. The movement of funds needed to offset export or import disequilibria cannot be expressed in terms of the "basic-nonbasic" ratio.

A recent study revealed that a series of statistical tests failed to affirm the "basic-nonbasic" theory as a means of forecasting urban growth. Rather these empirical tests indicated a reversal of the hypothesis, i.e., "nonbasic" industries rather than "basic" industries are associated with population changes.⁴⁰

Summary.--The "basic-nonbasic" technique is but one method of economic base analysis. This analysis will do no more than pick out the export activities and indicate the ratio between the export and non-export activities as measured by employment or some other medium. Therefore, the "basic-nonbasic" method is a tool that should be used to supplement other techniques of economic analysis.

Probably the most significant contribution this technique makes to economic base analysis is the versatility of uses that are made of the "base-ratio." The "base-ratio" describes a certain relationship between

economic activities within a specifically delimited area, and it shows what activities have a direct and indirect dependence upon markets outside of this area. To a degree, the "base-ratio" provides a means for classifying types of cities and possibly a rule-of-thumb index for forecasting future employment and population.

It provides a method for developing a "coefficient of specialization" that can be used to indicate the importance of individual economic activities within the community and within the nation. The "coefficient of specialization" can be used in conjunction with other techniques as a selective device for choosing new economic activities that can add stability to the community's economic base.

This technique falls short of being an all inclusive method of economic base analysis because of certain inherent weaknesses in its conceptual framework. Because emphasis is on "exports," this technique fails to consider the effects of many factors that effect economic activity.

Generally the effects of imports cannot be determined by base-ratios nor can the effect of induced increases in imports with an increase in income be measured. This concept does not provide a measure of the increment of income set aside for savings nor does it show whether these savings are hoarded or exported to other communities. The "base-ratio" fails to consider the movement of capital funds and other kinds of import and export of capital (federal expenditures on highways, urban renewal or public housing).

The concept fails to consider the effect that changes in locational factors have on economic activity within a community and the relative

importance of these factors on "basic" employment. Changes in freight rates, in local population size, in relative population distribution between the community and the surrounding area, in the quality and size of the labor force, in taxes and inducements offered incoming enterprises and in the productive technology as it affects the useability of local resources are examples of changes in locational factors that can induce changes in the local economy. In the final analysis, these changes either increase or decrease "basic" employment.

Another major limitation is that the "base-ratio" is static. Therefore, its usefulness is limited to the short-run because this ratio is altered whenever economic growth takes place.

The usefulness of the application of this concept to urban areas diminishes as the size of the community increases. For the effect of the "foreign trade multiplier feedback" is a major economic consideration in large metropolitan areas whereas the "feedback" is nonexistent in small one-industry towns.

The "coefficient of specialization" has certain inherent weaknesses. By definition, this ratio assumes that there will be no exports until the community has had its equivalent share to that of the nation. This necessitates the assumptions that productivity and per capita consumption are the same as the nation which implies that transport costs determine the market area.

Employment, the usual criterion for quantifying the "basic" and "nonbasic" activities, limits the scope of the concept because it omits the effect that incomes of nonemployed persons have on the local economy.

Because of the many limitations of the "basic-nonbasic" method,

a more useful technique of economic base analysis is required. The following chapter suggests one technique that has certain merits over the "base-ratio" method.

CHAPTER III

AGGREGATE INCOME ANALYSIS AND PROJECTION

The purpose of this chapter is to suggest a technique of "aggregate income analysis," which is believed to be a more useful method of economic base analysis than the "basic-nonbasic" method. Glynn County, Georgia, is the subject economy used to illustrate the application of this technique. The hypothesis.--This method is based on the hypothesis that income is the major determinant of the economic base. That is, the employment and consumption in an area are directly related to the aggregate disposable personal income in an area; and the population, through its relationship to employment, is indirectly related to income.

Because these relationships can be empirically determined, changes in income may be used to estimate changes in employment and consumption and consequently changes in population. Therefore, these relationships afford a means for developing a tool for forecasting economic change in a community. It is the intent of this research to examine statistically these relationships and to present a means for estimating changes in income.

Method of analysis.--This analysis calls for four steps:

1. Determine the total aggregate income of the community and forecast the future income of the community by relating community income to U. S. disposable personal income.
2. Determine the statistical relationship between employment and income in the community and estimate future employment by applying this

relationship to future income.

3. Determine the statistical relationship between consumption and income in the community and estimate future consumption by applying this relationship to future income.

4. Determine the statistical relationship between population and employment and apply this relationship to estimated future employment.

Correlation analysis affords a means of expressing statistically the relationship between employment and income, consumption and income, and population and employment; and for forecasting future levels of the three dependent factors, employment, consumption, and population. Because correlation analysis measures only those factors that can readily be quantified, these relationships may on occasion be modified to give the effect of qualitative factors.

Since income is taken as the basis of the economy, it is first necessary to find a means of forecasting future income so that future employment, consumption, and population can be estimated. There are several possibilities for forecasting changes in income.

Locational factors (markets, raw materials, labor, transportation, financial institutions, climatic conditions, state and local laws and taxes, local attitudes, and community facilities) produce changes in economic activity. A careful analysis of these factors offers one possibility for estimating the potential income in an area. However, to forecast the exact amount and timing of the occurrence of a change in income resulting from the influence of one or more of these factors would be a difficult task. These factors may attract new investment to a community, but the entrepreneur is the one who decides when and how much the investment will be.

A more feasible approach of forecasting changes in income would be to develop a community investment multiplier. By adapting the Keynesian "multiplier"¹ concept to local conditions, a community investment multiplier, $k_c = \frac{1}{1-b}$, can be derived. This multiplier is defined as the ratio, given the local propensity to consume (b), between an increment of investment within the community and the resultant increment in total local income. In other words, the multiplier is a factor that is multiplied by a given amount of new investment to show the amount of change to expect in total income.

At present, it is impracticable to develop a community investment multiplier because there is no effective way of determining a community's propensity to consume. The propensity to consume is defined as the tendency of the local populace to spend an average of X dollars with an increase of a specified amount of Y dollars in income. For example, if the propensity to consume is 0.5, this means that on the average 50¢ will be spent for every \$1.00 increase in income. This has the multiplier effect of two. Published statistics do not as yet show a breakdown of consumption expenditures into expenditures made by the local populace and expenditures made in the community by persons living outside of the community. Some type of a survey would be necessary to provide the required breakdown. The limitations of a survey have already been discussed in connection with the "basic-nonbasic" method.

Another technique for forecasting income is to relate income changes in the subject economy to changes in the national income. In local areas where a high degree of correlation exists between local income, expenditures, and employment and national income, expenditures, and employment it may be expected that reliable forecasts for the local economy may

be based on the predicted behavior of the national economy. In general, long-run forecasts for the national economy are more reliable than long-run forecasts for the local economy where the latter is based on local economic conditions. Where practical, this is the technique recommended for forecasting income.

The remainder of this chapter is devoted to explaining the application of the aggregate income analysis to the economy of Glynn County, Georgia. The results of this analysis are not intended to be final. Therefore, it should be understood that this application is merely illustrative of the technique.

Application to Glynn County.--Simple linear correlation analysis and a modified "Doolittle Method" of multiple regression analysis are applied in this problem. Because of the expressed association of certain factors with income in the hypothesis and a need for forecasting changes in income, four separate analyses are required. They are:

1. Relation of Glynn County's net effective buying income to the United States disposable personal income.
2. Relation of total consumption expenditures to net effective buying income in Glynn County.
3. Relation of total nonagricultural employment to net effective buying income in the county.
4. Relation of total county population to total nonagricultural employment.

Number of observations in each analysis.--Table 1 shows the basic data used. The year 1946 was selected as the starting point in this problem in cases where data are available from that date forward. In choosing

Table 1. Basic Data Used in the Economic Analysis for Glynn County, Georgia, 1946 - 1957.

Year	United States		Glynn County				
	<u>1/</u>		<u>2/</u>		<u>3/</u>	<u>4/</u>	<u>5/</u>
	Disposable Personal Income (billion of dollars)		Net Effective Buying Income (million of dollars)		Consumption Expenditures (million of dollars) Deflated *	Total Non-Agricultural Employment Annual Average (thousands)	Total Population (thousands)
	Un-Adjusted	Deflated *	Un-Adjusted	Deflated *			
1946	159	192	22.3	26.8	24.7	-	-
1947	169	178	25.3	26.6	26.0	5.00	45.8
1948	188	182	50.6	49.1	46.5	5.74	38.0
1949	188	185	41.3	40.5	38.9	5.42	36.5
1950	206	200	29.2	28.4	26.7	5.62	29.4
1951	226	204	33.8	30.4	28.0	6.53	29.6
1952	237	210	35.0	30.9	28.5	6.97	29.7
1953	250	219	38.6	33.8	31.2	7.76	30.5
1954	254	221	41.3	36.0	33.4	7.59	31.8
1955	270	237	43.4	38.0	35.8	7.48	33.3
1956	287	248	47.4	40.9	38.0	8.41	33.9
1957	301	251	55.5	46.2	43.1	9.05	34.7

1/ Source: Federal Reserve Bulletins, 1947-1958.

2/ Source: Sales Management Magazine, Survey of Buying Power, 1946-1958.

3/ Values computed by assuming that the ratio of consumption to income in Glynn County was the same as the national ratio of consumption expenditures to Disposable Personal Income.

Source: Consumption ratios, Federal Reserve Bulletins, 1947-1958.

4/ Source: Georgia State Department of Labor.

5/ Source: Georgia State Department of Public Health.

* In 1947-1949 dollars.

this year of origin the distorting effects of a war-time economy were avoided. Lack of comparable data for some of the factors prior to World War II made impossible the examination of the years preceding the War.

Although Table I shows a complete tabulation of data for each factor since 1946 (excepting employment and population), some of these data for specified years are omitted in parts of the analysis because certain limitations restricted the number of observations in each individual case. The net effective buying income for the years 1948 and 1949 is believed to be unreliable; therefore, these years are omitted in the analyses where Glynn County income is used. The analysis of employment has its origin at 1947 because data prior to that date are not readily available. Population data are believed to be unreliable in this area prior to 1950; hence, the analyses using population data are limited to only eight observations. All monetary data used in this problem are deflated by the Consumer Price Index to eliminate the effect of inflation because it appeared desirable to measure only those changes in "real" income and "real" expenditures.

Abbreviations.--The phrases identifying the factors used in this problem are abbreviated. Henceforth, each factor will be referred to as follows: EBI, for net effective buying income in Glynn County; DPI, for United States disposable personal income (it should be noted that EBI and DPI are the same conceptually); CE, for total consumption expenditures in Glynn County; EMP for total nonagricultural employment in the county; and POP, for total county population.

The analysis.--The first step in each analysis is to apply a simple linear regression technique. This technique provides a relatively quick and easy

method for determining the significance of the relationship between two variables and for preparing a forecast of the dependent variable based on changes in the independent variable. However, the usefulness of the simple technique in any complex problem is limited because it neglects the interactions between the several variables. Differences in economic phenomena generally are due to a number of variables, all acting at the same time.

Multiple correlation analysis affords a means for explaining variations in the dependent variable when two or more independent variables are considered simultaneously. The factor time is introduced in the analysis as a second independent variable for the purpose of removing the element of trend in the data. Therefore, the second step in the analysis of each part of the problem is the application of multiple correlation.

The application of both the simple and multiple correlations to each of the parts required a total of eight regressions. The results of each analysis are presented in table form. The computed values for the dependent variables are shown in Tables 2, 4, 6, and 8. The corresponding parameters are shown in Tables 3, 5, 7, and 9. Table 10 shows the simple linear regression equations with forecasts for 1960 and 1965 and Table 11 shows the multiple regression equations with forecasts for the same years.

Definitions.--In order to facilitate the discussion of each part of this problem, a definition and explanation of the use of each of the parameters derived in the regression analyses are presented. They are as follows:

1. The letter a identifies the value of the dependent variable in the regression equation when the independent variable(s) is(are) zero. This value is usually referred to as the constant in the regression equation.

2. The letter b in the regression equation is termed the regression coefficient. It shows the average number of units increase or decrease in the dependent variable which occur with an increase of a specified unit in the independent variable. The exact size of this value depends on the relation between the variables and on the units in which each is stated. There are as many regression coefficients in the equation as there are independent variables.

3. The standard deviation is one measure of the deviation from the mean of each item in a series. This measure may be calculated by squaring the deviations of each of the items from their mean, averaging the squares and taking the square root of this average. It is stated in the same units as the original dependent variable. The advantage of this measure over the average deviation is that

. . . the process of squaring eliminates the minus signs of deviations and thus makes the standard deviation more satisfactory in complex mathematical computations. Further, the taking of the square root gives an answer which may be regarded as either plus or minus,² that is as measuring the deviations both above and below the mean.

4. Beta coefficients are the regression coefficients stated in another form, that is, each variable is stated in units of its own individual standard deviation. Since the units of the independent variables may be very different in size and variability, their regression coefficients do not indicate the comparative importance of each series; but, by stating the variables in units of their own individual standard deviation, this provides a more accurate idea of the relative importance of the independent variables in predicting the dependent variable.³

5. The standard error of estimate shows how well the estimated values agree with the values actually observed for the variable being estimated. It represents merely the standard deviation of the residuals.

This coefficient is stated in the same units as the original dependent variable, and its size can be compared directly with those values.⁴

6. Simple correlation coefficients: The primary reason for the designation "simple correlation coefficient" rather than "correlation coefficient" is to call attention to the fact that in the simple analysis the "correlation coefficient" is identical to the "simple correlation coefficient" in the multiple regression analysis for those variables that are identical in both analyses. This coefficient measures "the proportion of the variation in the dependent variable which is associated with the independent variable, and is therefore a measure of the relative importance of the concomitance of variation in the two factors."⁵

Stated in a different way, the coefficient of correlation may be said to be the ratio of the variance in the estimated values to the variance in the actual values, which provides a measure of the relative importance of the independent variable as a means of explaining the "accounted-for" variance in the dependent variable.

The squared coefficient of correlation is termed the "coefficient of determination," and is the measure of the percentage to which the variance in the dependent variable is determined by the independent variable.⁶ These coefficients are "pure numbers" whose values fall within a limited range, and for this reason they can be compared only with other like constants, derived from similar problems.

7. Multiple correlation coefficient: The meaning of this coefficient is similar to that of the coefficient of correlation in that it represents the square root of the ratio of "accounted-for" variance to total variance to be explained. The multiple coefficient measures the combined influence of the several independent variables, whereas the

correlation coefficient measures the importance of a single independent variable, as a means of explaining the differences in the dependent variable. Likewise, the square of this coefficient is called the "multiple coefficient of determination" and is the measure of the degree of variability in the dependent variable that is associated with the changes in the combined independent variables.

8. Partial correlation coefficients: This is a third type of coefficient used to explain variability in the dependent factor. In this particular case, the partial coefficient explains the amount of the "unaccounted-for" variability that is now "accounted-for" as the result of the addition of another variable to the multiple regression. More specifically, this coefficient is defined as "a measure of the extent to which that part of the variation in the dependent variable which was not explained by the other independent factors can be explained by the addition of the new factor."⁷

The partial coefficient is similar to the beta coefficient in that it is a measure of the rank of importance of each of the individual factors taken separately, while simultaneously allowing for the variation associated with the remaining independent factors. The "coefficient of partial determination" is the square of the partial coefficient and like the other coefficients of determination it is again the measure of "explained" variance.

Regression of EBI on DPI and time.--A comparison of the computed values of EBI with the actual values (Table 2) reveals that very good estimates are obtained by both methods of correlation. This is evidenced by the fact that an error of over 5 per cent is observed for only two years (5.2 per cent in 1952 and 6.5 per cent in 1957) by multiple correlation and

Table 2. Net Effective Buying Income: Actual Values Compared with Computed Values as Derived by Simple and Multiple Linear Regression Analysis of Net Effective Buying Income (EBI) on Disposable Personal Income (DPI) and Time.

(in millions of 1947-1949 dollars)

Year	Actual Values	Regression of EBI on DPI			Regression of EBI on DPI and Time		
		Computed Values	Deviation from Actual Value		Computed Values	Deviation from Actual Value	
			Amount	%		Amount	%
1946	26.8	27.6	0.8	3.0	25.5	-1.3	4.9
1947	26.6	23.9	-2.7	10.2	25.4	-1.2	4.5
1950	28.4	29.6	1.2	4.2	28.9	0.5	1.8
1951	30.4	30.7	0.3	1.0	30.6	0.2	0.7
1952	30.9	32.2	1.3	4.2	32.5	1.6	5.2
1953	33.8	34.6	0.8	2.4	34.7	0.9	2.7
1954	36.0	35.1	-0.9	2.5	36.3	0.3	0.8
1955	38.0	39.3	1.3	3.4	39.2	1.2	3.2
1956	40.9	42.1	1.2	2.9	41.6	0.7	1.7
1957	46.2	42.9	-3.3	7.1	43.2	-3.0	6.5

Table 3. Comparison of the Weights of the Parameters as Calculated in the Linear Regressions of Net Effective Buying Income (EBI) on Disposable Personal Income (DPI) and Time.

Type of Measure	Variable(s) Identifying Measure	Simple Regression Analysis	Multiple Regression Analysis
Standard Deviation	Y = EBI	61.3694	61.3694
	X = DPI	22.7596	22.7596
	T = Time		2.8723
Simple Correlation Coefficients	Y X	0.9641	0.9641
	Y T		0.9712
	X T		0.9683
Beta Coefficients	Y X	0.9641	0.3791
	Y T		0.6041
Regression Coefficients	Y X	2.5996	1.0222
	Y T		12.9093
Multiple Correlation Coefficient	Y X T		0.9759
Standard Error of Estimate	Y X	16.3156	
	Y X T		13.4048
Partial Correlation Coefficients	Y X		0.3978
	Y T		0.5685

only two years (10.2 per cent in 1947 and 7.1 per cent in 1957) by the simple regression technique.

This greater than 5 per cent deviation in 1957 can be attributed to the recession in that year. Areas in the South did not feel the effects of this recession as did the nation in general; therefore, the effects on DPI are more pronounced than on EBI. The per cent increase in DPI (deflated) from 1956 to 1957 is much smaller than the per cent increase in EBI (deflated) for that period. These per cents may be calculated readily from data shown in Table 1.

A somewhat similar condition existed in 1947. Table 1 indicates a rather sharp decline (found to be 7.3 per cent) in DPI (deflated) from 1946 to 1947 compared to the decline (less than 1 per cent) in EBI for the same period. These differences may be attributed to a general cutback in overtime in the war production industries following World War II. Also, the effects of layoffs in these industries were beginning to be felt, with aircraft and the munitions industries being the first to feel these cutbacks in employment. Since Glynn County did not have either of these industries, there was a lag in the effects of the change-over in employment from war production in the area to peacetime activities.

Although Table 2 shows very good estimates by each method of correlation, Table 3 indicates that multiple regression gave the best results. A comparison of the standard error of estimates shows that the values computed by multiple regression agree more closely with the actual values than do the values computed by simple correlation. A check of the coefficients of correlation (squared) reveals why this is true. DPI was the independent variable in the simple analysis. The amount of variability in

EBI accounted for by DPI is 92.9 per cent, whereas, in the multiple regression, with the addition of "time" as the second independent variable, the amount of "accounted-for" variability is increased to 95.3 per cent.

The rate of growth in EBI is very nearly constant, so much so that it can almost be described as a mathematical "law." The less precise relationship between EBI and DPI is improved slightly therefore, when "time" is introduced as a second independent variable. This is further verified by the values obtained for the betas and the partial correlation coefficients. Both of these coefficients indicate that "time" is the most important (time acting as a "catch all" variable rather than influencing EBI in a causal sense) of the two independent variables. The introduction of time as a variable is an artifice used to discover and measure any regularity in changes of the dependent variable not associated with changes in the other independent variables.

Regression of CE on EBI and time.--Table 4 indicates almost identical computed values for CE by each method, with the greatest margin of error (4.2 per cent) occurring in 1947 in both cases. The method used for deriving the actual consumption expenditures explains in part the close similarity of the two sets of computed values and the closeness of fit between the computed and "actual" values.

The total consumption expenditures shown in Table 1 are estimated. These estimates are based on the assumption that, in the aggregate, the ratio of CE to EBI in Glynn County is the same as the national ratio of CE to DPI. Since there is a very close correlation between consumption on the national level and DIP it would follow, therefore, that a close correlation would be obtained between CE and EBI whenever the national ratio of CE to DPI is applied to EBI for the purpose of estimating CE in Glynn County.

Table 4. Consumption Expenditures: Actual Values Compared with Computed Values as Derived by Simple and Multiple Linear Regression Analysis of Consumption Expenditures (CE) on Net Effective Buying Income (EBI) and Time.

(in millions of 1947-1949 dollars)

Year	Actual Values	Regression of CE on EBI			Regression of CE on EBI and Time		
		Computed Values	Deviation from Actual Value		Computed Values	Deviation from Actual Value	
			Amount	%		Amount	%
1946	24.7	25.1	0.4	1.6	25.2	0.5	2.0
1947	26.0	24.9	-1.1	4.2	24.9	-1.1	4.2
1950	26.7	26.6	-0.1	0.4	26.6	-0.1	0.4
1951	28.0	28.4	0.4	1.4	28.4	0.4	1.4
1952	28.5	28.9	0.4	1.4	28.8	0.3	1.1
1953	31.2	31.5	0.3	1.0	31.5	0.3	1.0
1954	33.4	33.6	0.2	0.6	33.5	0.1	0.3
1955	35.8	35.4	-0.4	1.1	35.4	-0.4	1.1
1956	38.0	38.1	0.1	0.3	38.0	0.0	0.0
1957	43.1	42.9	-0.2	0.5	43.0	-0.1	0.2

Table 5. Comparison of the Weights of the Parameters as Calculated in the Linear Regressions of Consumption Expenditures (CE) on Net Effective Buying Income (EBI) and Time.

Type of Measure	Variable(s) Identifying Measure	Simple Regression Analysis	Multiple Regression Analysis
Standard Deviation	Y = CE X = EBI T = Time	56.5477 61.3694	56.5477 61.3694 2.8723
Simple Correlation Coefficients	Y X Y T X T	0.9969	0.9969 0.9666 0.9712
Beta Coefficients	Y X Y T	0.9969	1.0222 -0.0280
Regression Coefficients	Y X Y T	0.9186	0.9436 -0.5517
Multiple Correlation Coefficient	Y X T		0.9969
Standard Error of Estimate	Y X Y X T	4.5166	4.4411
Partial Correlation Coefficients	Y X Y T		0.9519 0.0846

Since EBI is used as the base for computing CE, EBI will account for almost all of the variability in CE, as may be seen by a check of the simple and multiple regression coefficients--they are identical to four decimal places (Table 5). However, if carried to six decimal places the multiple coefficient is 0.996911, whereas the simple coefficient is 0.996889. Therefore, the addition of "time," as a second independent variable, had no appreciable effect upon the variability in CE.

Regression of EMP on EBI and time.--In this analysis, a comparison of the computed values with the actual values (Table 6) readily indicates that EBI alone, (time is implicit, however) gives a far less reliable forecast of employment than does EBI and time acting jointly. The computed values derived by multiple regression show three years where the margin of error exceeds 5 per cent (7.1 per cent in 1950; 7.3 per cent in 1953; and 7.0 per cent in 1955). There are four years where the deviations exceed 5 per cent by the simple regression technique, the largest of which is 12.8 per cent in 1947. Probably the reason for this amount of error is that a sizable percentage (almost 11 per cent)⁸ of the workers in Glynn County commute daily to their jobs from areas outside of the county. This has the effect of saying that the income of 1,000 workers out of the 9,000 (1957 annual average) employed in Glynn County is not included in the income statistics for Glynn County. This inconsistency arises because employment data is tabulated by place of employment and income data is tabulated by place of residence.

Even with this sizable commuting factor, EBI alone accounts for 87.6 per cent of the variability in employment. However, the multiple correlation coefficient (squared) shows that 93.5 per cent of the variability is accounted for when both EBI and time (now acting as a "catch all"

Table 6. Employment: Actual Number Compared with Computed Number as Derived by Simple and Multiple Linear Regression Analysis of Employment (EMP) on Net Effective Buying Income (EBI) and Time.

(thousands)

Year	Actual Number	Regression of EMP on EBI			Regression of EMP on EBI and Time		
		Computed Number	Deviation from Actual Number		Computed Number	Deviation from Actual Number	
			Amount	%		Amount	%
1947	5.00	5.64	0.64	12.8	5.01	0.01	0.2
1950	5.62	5.98	0.36	6.4	6.02	0.40	7.1
1951	6.53	6.36	-0.17	2.6	6.42	-0.11	1.7
1952	6.97	6.46	-0.51	7.3	6.75	-0.22	3.2
1953	7.76	7.01	-0.75	9.7	7.19	-0.57	7.3
1954	7.59	7.43	-0.16	2.1	7.60	0.01	0.1
1955	7.48	7.81	0.33	4.4	8.00	0.52	7.0
1956	8.41	8.36	-0.05	0.6	8.43	0.02	0.2
1957	9.05	9.36	0.31	3.4	8.98	-0.07	0.8

Table 7. Comparison of the Weights of the Parameters as Calculated in the Linear Regressions of Employment (EMP) on Net Effective Buying Income (EBI) and Time.

Type of Measure	Variable(s) Identifying Measure	Simple Regression Analysis	Multiple Regression Analysis
Standard Deviation	Y = EMP X = EBI T = Time	121.3443 59.8308	121.3246 59.8308 2.9682
Simple Correlation Coefficients	Y X Y T X T	0.9364	0.9364 0.9645 0.9478
Beta Coefficients	Y X Y T	0.9364	0.2188 0.7571
Regression Coefficients	Y X Y T	1.8990	0.4438 30.9463
Multiple Correlation Coefficient	Y X T		0.9670
Standard Error of Estimate	Y X Y X T	42.7890	30.9080
Partial Correlation Coefficients	Y X Y T		0.2561 0.6879

variable) are considered.

Regression of POP on EMP and time.--The best set of estimates of the series was obtained in this analysis. The greatest observed margin of error in the simple analysis was 2.4 per cent in 1950 and 1952, and the largest error by multiple regression was 1.7 per cent in 1952 (Table 8).

"Time" is used as the independent factor in the simple analysis and is found to be associated with 94.5 per cent of the variability in population. In this instance time indicates that most of the variability in the dependent factor is attributable to trend. In the multiple analysis, when employment is added as the second factor, the combined influence of time and employment is associated with 97.9 per cent of the variability in population.

It should be noted that the beta and regression coefficients (Table 9) for employment in the multiple regression analysis carry a negative sign. These negative signs are attributable to the fact that a sizable number of the workers in Glynn County commute daily. This means that as employment opportunities increase in Glynn County there is a tendency on the part of labor to commute from their present place of abode rather than to move into the area where they obtain jobs.

Forecasts.--The purpose of this problem is to evaluate a technique for predicting future economic activity in Glynn County. The methodology already described is effective for estimating past activity, since the computed values in each part of the problem compare favorably with the observed values. However, one final prediction is required, if this methodology is to be applied as a means for forecasting the individual factors in the coming years. That is, it is first necessary to predict the expected DPI for whatever years a forecast is desired, since, in this

Table 8. Population: Actual Number Compared with Computed Number as Derived by Simple and Multiple Linear Regression Analysis of Population (POP) on Employment (EMP) and Time.

(thousands)

Year	Actual Number	Regression of POP on Time			Regression of POP on EMP and Time		
		Computed Number	Deviation from Actual Number		Computed Number	Deviation from Actual Number	
			Amount	%		Amount	%
1950	29.4	28.7	-0.7	2.4	29.1	-0.3	1.0
1951	29.6	29.5	-0.1	0.3	29.3	-0.3	1.0
1952	29.7	30.4	0.7	2.4	30.2	0.5	1.7
1953	30.5	31.2	0.7	2.3	30.6	0.1	0.3
1954	31.8	32.0	0.2	0.6	32.1	0.3	0.9
1955	33.3	32.9	-0.4	1.2	33.5	0.2	0.6
1956	33.9	33.7	-0.2	0.6	33.8	-0.1	0.3
1957	34.7	34.6	-0.1	0.3	34.4	-0.3	0.9

Table 9. Comparison of the Weights of the Parameters as Calculated in the Linear Regressions of Population (POP) on Employment (EMP) and Time.

Type of Measure	Variable(s) Identifying Measure	Simple Regression Analysis	Multiple Regression Analysis
Standard Deviation	Y = POP X = EMP T = Time	19.8396	19.8396 100.1211 2.2913
Simple Correlation Coefficients	Y X Y T X T	0.9720	0.8613 0.9720 0.9473
Beta Coefficients	Y X Y T		-0.5799 1.5214
Regression Coefficients	Y X Y T	8.4166	-0.1149 13.1733
Multiple Correlation Coefficient	Y X T		0.9896
Standard Error of Estimate	Y X T Y T	4.6612	2.8544
Partial Correlation Coefficients	Y X Y T		0.7906 0.9591

methodology, EBI is related to DPI and all other subsequent factors are either directly or indirectly related to EBI.

The technique used for predicting DPI is as follows:

1. DPI (deflated) is plotted on a semi-log scale for the years recorded in Table 1. Examination of this plotting reveals that a trend line having points of contact at 1947 and 1957 gives the most representative rate of growth for the eleven year period (Figure 1).

2. The rate of growth from 1947 to 1957 is then computed mathematically. DPI is found to have an annual rate of growth of 3.5 per cent.

3. The next step is to compute the estimates for 1960 and 1965. This is done by extending the 1957 value forward three and eight years respectively at the 3.5 per cent annual rate. The computed values are found to be 278 billion dollars for 1960 and 330 billion dollars for 1965.

Although this method is a relatively simple and easily applied technique, it is very reliable for forecasting long-run changes in the national economy. The 1960 estimate of 278 by this method may be verified by a forecast of DPI made in a study a few years ago covering all aspects of the national economy for 1960.⁹ All dollar values in this study are given in 1951 dollars. Therefore, the DPI value for 1960 is recorded as 307.6 billion dollars, when adjusted to 1947-1949 dollars this figure becomes 277 billion dollars.

A second test, using the values in the above mentioned study, verifies the 1965 DPI forecast of 330 billion dollars. The annual rate of growth of DPI for the nine-year period, 1951 to 1960, is 3.5 per cent. This rate is identical to the rate computed for the ten-year period, 1947 to 1957. Using this rate (3.5 per cent) to project the 1951 value fourteen years, the 1965 value stated in 1947-1949 dollars is 329 billion dollars.

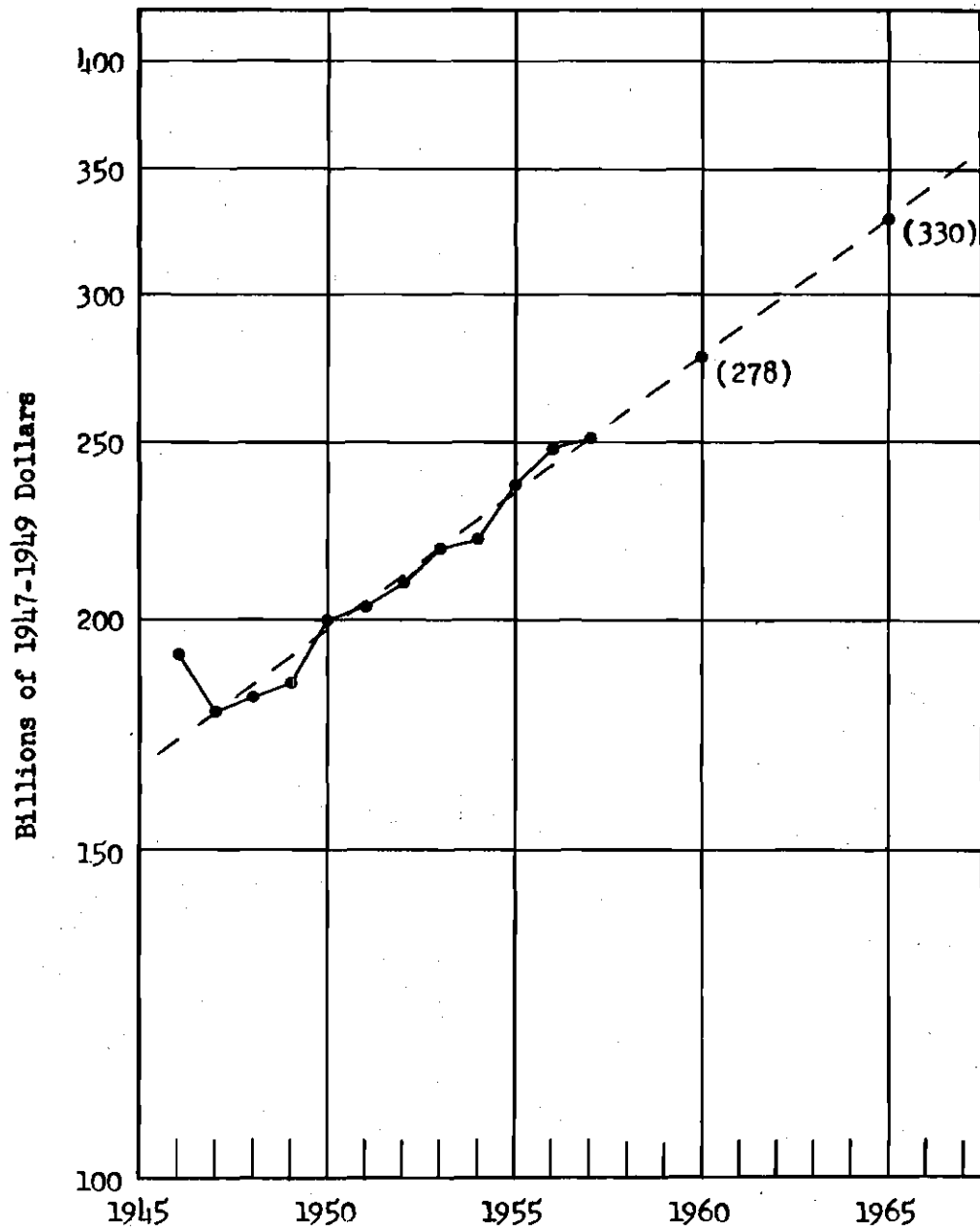


Figure 1

U. S. Disposable Personal Income
1946 to 1957
with Projections to 1960 and 1965

These estimates of DPI are the basis for the 1960 and 1965 forecasts for Glynn County. Table 10 shows the expected values for each factor computed by the formulas derived by simple correlation. Table 11 shows the values for each factor derived by the multiple regression technique.

Both methods of analysis give very similar forecasts for each factor in 1960, but the multiple regression technique gives a somewhat lower estimate of EBI, CE, and EMP and a slightly higher estimate of POP in 1965 than the simple technique.

By comparison, the simple technique shows projected income at 49.9 million dollars in 1960 and 63.9 million dollars in 1965. The multiple regression technique shows the 1960 income as 49.8 million dollars and the 1965 income as 61.8 million dollars. A difference of 2.1 million dollars is observed in the estimates for 1965.

Consumption expenditures for 1960 by the simple technique are 46.3 million dollars. This estimate is one-tenth of a million dollars higher than the estimate derived by multiple regression for 1960. The difference in the 1965 forecasts of CE is 1.9 million dollars. The multiple regression technique shows a 57.3 million dollar expenditure for 1965 whereas the simple technique gives a forecast of expenditures of 59.2 million dollars.

The dollar values for income and consumption expenditures are quoted in 1947-1949 dollars. Hence these values represent a forecast of "real" income and "real" expenditures.

Employment forecasts by the simple technique show 10,100 workers in 1960 and 12,700 workers in 1965. The multiple regression technique shows 10,000 workers in 1960 and 11,500 workers in 1965. Although the

Table 10. Simple Linear Regression Equations Used in the Glynn County, Georgia, Economic Analysis with Forecasts for 1960 and 1965

Equation	Forecast for Y		No.
	1960	1965	
<u>Regression of EBI on DPI</u>			
$Y = - 223.51 + 2.5996X$			(1)
Where Y = EBI (forecast in millions of 1947-1949 dollars) and X = DPI	49.9	63.9	
<u>Regression of CE on EBI</u>			
$Y = 4.93 + 0.9186X$			(2)
Where Y = CE (forecast in millions of 1947-1949 dollars) and X = EBI	46.3	59.2	
<u>Regression of Employment on EBI</u>			
$Y = 58.9 + 1.899X$			(3)
Where Y = Employment (forecast in thousands) and X = EBI	10.1	12.7	
<u>Regression of Population on Time</u>			
$Y = 286.67 + 8.4166T$			(4)
Where Y = Population (forecast in thousands) and T = Time	37.1	41.3	

Table 11. Multiple Linear Regression Equations Used in the Glynn County, Georgia, Economic Analysis with Forecasts for 1960 and 1965

Equation	Forecast for Y		No.
	1960	1965	
<u>Regression of EBI on DPI and Time</u>			
$Y = 59.1 + 1.0222X + 12.909T$			(5)
Where Y = EBI (forecast in millions of 1947-1949 dollars), X = DPI and T = Time	49.8	61.8	
<u>Regression of CE on EBI and Time</u>			
$Y = - 1.07 + 0.9436X - 0.5517T$			(6)
Where Y = CE (forecast in millions of 1947-1949 dollars), X = EBI and T = Time	46.2	57.3	
<u>Regression of Employment on EBI and Time</u>			
$Y = 383.35 + 0.4438X + 30.4963T$			(7)
Where Y = Employment (forecast in thousands), X = EBI and T = Time	10.0	11.5	
<u>Regression of Population on Employment and Time</u>			
$Y = 355.35 - 0.1149X + 13.1733T$			(8)
Where Y = Population (forecast in thousands), X = Employment and T = Time	37.3	42.0	

estimates by the two methods differ by only 100 workers in 1960, these estimates differ by 1,200 workers by 1965.

The population forecasts show that the multiple regression technique gives the highest estimates for 1960 and 1965. By the multiple regression technique the forecast for 1960 is 37,300 and for 1965 the estimate is 42,000. By the simple technique the forecasts are 37,100 and 41,300 respectively.

Conclusion.--This problem is presented for the purpose of suggesting an alternative approach to economic base analysis. The intent of this problem is not to supply a comprehensive analysis of the economy of Glynn County, but to illustrate the application of correlation analysis to a problem of this type.

The analysis, as it now stands, is incomplete. Correlation analysis provides a reliable measure of the relationship between variables whenever those variables can be quantified. It does not, however, measure those qualitative factors that also influence variations in the dependent factors. Therefore, for the analysis to be comprehensive, the quantitative analysis must be supplemented by a qualitative analysis.

The nature of income, source of investment capital, progressiveness of the community, and modes and customs of the people are a few of the factors that must be included in the qualitative analysis. Areas where the predominant industries are service type generally have a larger income than areas that are primarily dependent upon manufacturing. Likewise, manufacturing areas have greater incomes than agricultural areas. Another factor influencing income is the seasonal, cyclical, or secular nature of the industries in an area. New investment in an area is limited by the amount of capital available for that purpose. Generally,

the economic benefits are greater and competition minimized whenever internal capital as opposed to external capital is adequate to supply the demands for new investment.

The progressive attitude of a community exerts a very real influence on the economic growth in an area. Some communities do not grow because the people are content with what they have or because they are too selective in their acceptance of various types of economic activity. The effect of modes and customs in an area will be seen in the size and quality of the labor force, and in the spending and saving habits of the people.

Locational factors (markets, materials, labor, climate, transportation, state and local laws and taxes and community facilities) have important qualitative characteristics. No economic base analysis is complete until the influence of these factors is carefully weighed.

In addition to the need for a qualitative analysis to supplement the correlation analyses, it may justifiably be argued that there are other limitations in the methodology as presented. For example, the number of observations in each part of the analysis may be considered to be too few in number to be of value for long-term forecast purposes. An explanation has already been given as to why the number of observations are small and why they vary.

In addition to the above explanation, there are two other reasons for using the available data. First, instead of selecting one point in time as a basis for a forecast, each analysis is based on a trend spanning several years. Second, the purpose of this problem is to show that this technique, based on the findings in each analysis, has merit as a possible alternative method of economic base analysis and should be examined further in the light of such possibilities.

Additional studies could include a change in the boundaries of the area from one county to several; or increase the number of quantifiable variables in each analysis. For example, the boundaries could be defined by the market area of the City of Brunswick; or could be redefined to include the labor market area so that those workers who are now classified as commuters would be included. Other quantifiable variables that could be justifiably included in an economic base analysis are, for example: an index of the cost of living in the area, a ratio of personal taxes to income, a ratio of the prices of consumer durable goods to general consumer goods, an index of local construction, the median age and educational level of the labor force, the number employed in manufacturing, the trades, and the services and professions, and the "family coefficients" of workers by type of job.

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