AN ABSTRACT OF THE THESIS OF

M. Vivian Ledeboer for the degree of Master of Science

in Agricultural and Resource Economics presented on June 4, 1982

Title: A Structural Description of Oregon Counties, 1973-1978

Abstract approved: Redacted for privacy

Ronald A. Oliveira

Local government officials and county planners may find descriptive information concerning the economic structure of each Oregon county useful for planning for future economic development. Specifically, citizens of counties and planning districts need to know whether industries in their area are growing or declining and in which industries a comparative advantage occurs.

A regional economy is comprised of a mix of industries. Growth (decline) in various industrial sectors contributes to overall regional growth (decline). Numerous factors may account for an industry's growth: high productivity of capital and labor; new technologies which increase output per unit cost; positive labor-management relations which lead to improved performance; and unique locational advantages which may reduce input, transport, or other costs.

Prior to identifying the possible determinants of growth in a specific area, a technique which measures the differences in growth rates among regions is necessary. Shift-share analysis is a descriptive tool which permits a systematic assessment of the industrial changes occurring in a region. The shift-share technique determines how specific industries in certain regions are performing relative to the same industries in a larger reference region. The primary ob-

jective of the thesis is to apply the modified shift-share technique proposed by Kalbacher [1979] to delineate changes in income in each Oregon county for the time period 1973 to 1978. The Pacific Northwest region which includes the states of Idaho, Oregon, and Washington is the designated reference economy. Labor and proprietors' income data, available at the county level from the Bureau of Economic Analysis, are utilized to measure the change in a region's economic activity level relative to the Pacific Northwest region.

The shift-share model does not provide, by itself, a clear-cut explanation on how regions grow and to what extent interregional growth divergencies can be explained. In order to explain the varying rates of growth experienced by the individual Oregon counties, additional analysis of factors underlying the regional share component is necessary. Selected variables, which represent economic and social characteristics of each Oregon county, are utilized in the regression analysis which attempts to identify possible determinants of a county's regional share value.

A Structural Description of Oregon Counties, 1973-1978

by

M. Vivian Ledeboer

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Completed June 1982

Commencement June 1983

APPROVED:

Redacted for privacy

Associate Professor, Courtesy, of the Department of Agricultural and Resource Economics in charge of major

Redacted for privacy

Acting Head, Department of Agricultural and Resource Economics

Redacted for privacy

Dean of the Graduate School

Date Thesis is presented June 4, 1982

Typed by Dodi Reesman for M. Vivian Ledeboer

ACKNOWLEDGEMENTS

Completion of the thesis was not possible without the support and guidance of several persons. I am most indebted to Dr. Ronald A. Oliveira for his perceptive and timely suggestions as well as his continued patient support throughout the research. I am grateful for the enthusiastic support of the research by Dr. Bruce A. Weber and the helpful comments noted by Dr. Joe B. Stevens. The patient advice given by Dave Holst in the programming of the results is greatly appreciated. A thanks is also due to the Department of Agricultural and Resource Economics for a graduate research assistantship which enabled the completion of my graduate work.

My sincerest gratitude is extended to Mrs. Dodi Reesman who typed the manuscript and whose timely suggestions were important to the completion of the thesis. My parents, Edith and Bernard Ledeboer, deserve particular recognition for their optimistic and caring support throughout the last two years. Finally, a special thank-you is due to Roger Cummings for his continued and loving friendship during my graduate study.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (continued)

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (continued)

A STRUCTURAL DESCRIPTION OF OREGON COUNTIES, 1973-1978

CHAPTER I

INTRODUCTION

In 1973, the Oregon Land Use Act created the Land Conservation and Development Commission (LCDC) which is responsible for developing statewide land use goals.[1/] In order to respond to Goal 9, "To diversify and improve the economy of the State," factors affecting diversification in Oregon counties need to be identified. Knowledge about the economic structure of each county is necessary before appropriate growth-inducing sectors can be identified and their economic impacts be assessed.

The primary intent of this thesis is to examine a procedure useful for analysis of regional economic change, as measured by income. The key descriptive tool employed is shift-share analysis which enables changes in regional economic patterns in the Oregon economy to be analyzed. A major advantage of the technique is its simplicity both in terms of source data and calculations.

Local government officials and county planners may find descriptive information concerning the economic structure of each Oregon county useful for planning for future population growth and economic development. Specifically, citizens of counties and planning dis-

---

1/ Although Oregon's first land use planning legislation was passed in 1919, the Oregon Land Use Act (ORS 197) was passed in 1973 subsequent to 1969 legislation requiring comprehensive land use plans and a later statewide initiative supporting such planning.

tricts need to know whether industries in their area are growing or declining and in which industries a comparative advantage occurs.[2/] Comparative advantage sectors are "those economic activities which represent the most efficient use of resources, relative to other geographic areas" [Statewide Planning Goals and Guidelines, p. 27].

Research Problem

In recent years, regional development policy in the State of Oregon has strongly emphasized the need to develop a more favorable and diversified industrial structure in the less developed counties of the state. Oregon's natural resources are the primary basis of its economic activity. Land, forests and water provide the material for the top two industries in the state — lumber and wood products and agriculture/food processing. Indirectly, they contribute to Oregon's third largest 'industry', tourism and recreation. Of the three, lumber and wood products is dominant [Oregon 2000 Report, 1980].

In 1973, wood products employment accounted for 45 percent of total manufacturing employment in the State of Oregon. Counties which depend on the wood products sector for more than 75 percent of total manufacturing employment are designated in the map on the following page.[3/]

[2/] The term economic sector is used interchangeably with industrial sector, industry or activity throughout the thesis.

[3/] Because 1973 is the base year for the shift-share analysis in the thesis, this year was chosen to relate the importance of the wood products industry employment to individual counties. Employment estimates for the lumber and paper and total manufacturing sectors from Bonneville Power Administration are used to compute the ratio of dependence.

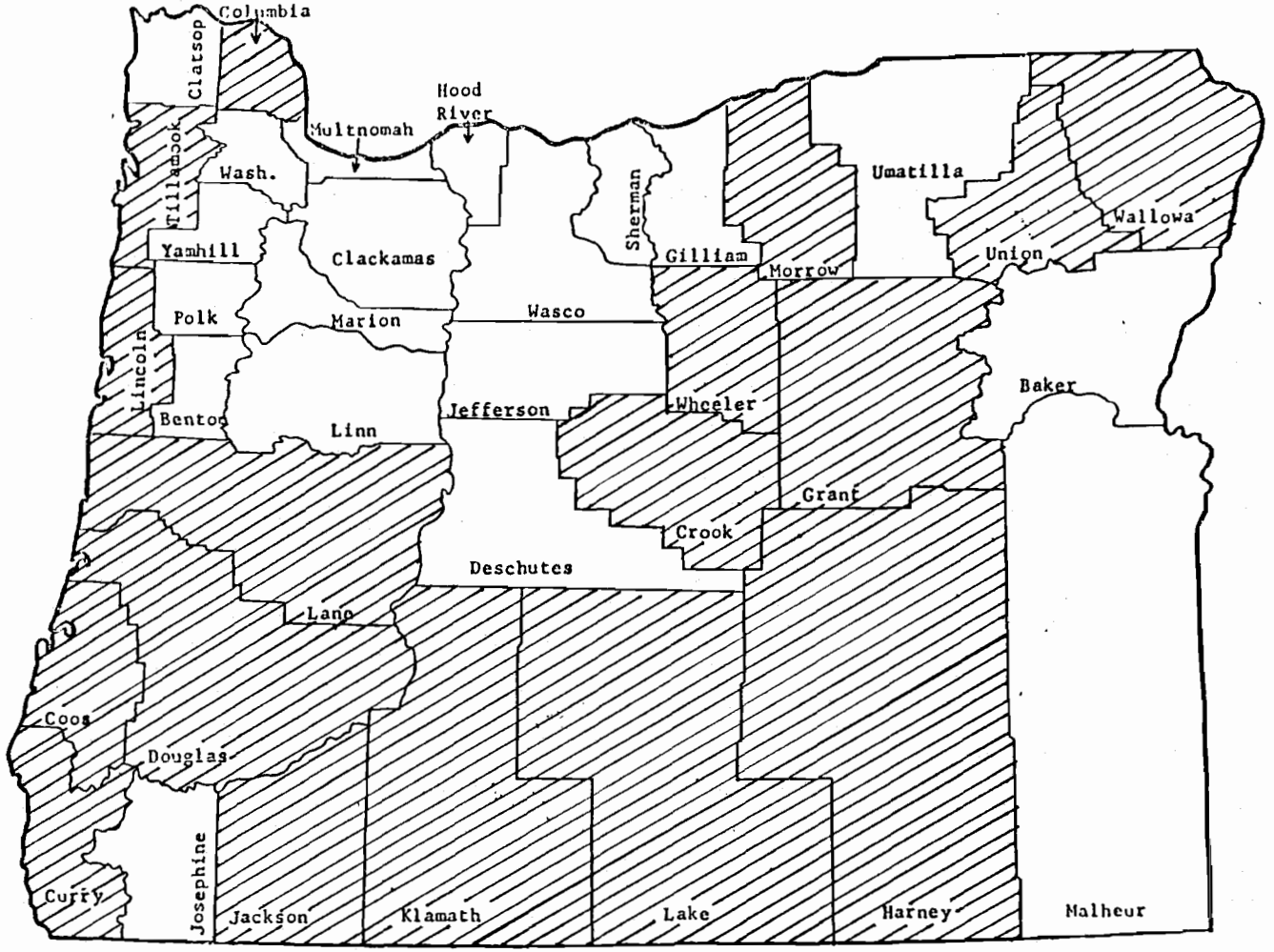

Figure 1. Oregon Counties Which Depend on Wood Products for More Than 75 Percent of Manufacturing Employment, 1973.

SOURCE: Unpublished employment data, Bonneville Power Administration, Portland, Oregon, 1981.

A study of Oregon counties classified as having a timber dependent economy (where 38 to 80 percent of total basic employment was wood products employment) found that between 1965 and 1970 county employment growth was not directly related to activity in the timber industry [Owen, 1979]. Therefore, other sectors may be providing the economic base necessary to support the county population. The economic base of an area may be defined as the aggregate of industry sectors which export goods or bring trade into an area.

A county is comprised of a mix of industries. Growth (decline) in various industrial sectors may contribute to overall regional growth (decline). Identification of those sectors playing an important role in the advantageous (adverse) status of the individual county should provide the groundwork necessary for further analysis by the regional researcher.

The causes of economic growth in a particular region and/or industry are varied and complex. Prior to identifying the possible determinants of growth in a specific area, a technique which measures the differences in growth rates among regions is necessary. Shift-share analysis is a descriptive tool which permits a systematic appraisal of the industrial changes occurring in a region between two time periods. The shift-share framework reveals how specific industries in certain regions are performing relative to the same industries in a larger reference region. The comparative spatial performances provide a basis for classification to simplify policy planning procedures at the regional level [Edwards, 1976].

It is useful to distinguish two major income growth components in regional economic growth, namely, the industry mix and regional

share. Shift-share analysis is an analytical technique used to identify these components. According to Ashby [1964, p. 14] the 'shift-share' technique

> "...is built on the assumption that it is necessary to know of a region two basic facts regarding its growth situation: First, does the region have a rapidly or slowly growing industrial mix or distribution of industries; and, second, is it increasing or decreasing its share of its industries?"

The shift-share framework, originated by Creamer [1942], has been widely used in the analysis of regional economic growth for the last 40 years. Despite its limitations, it has been useful in examining the relationship between regional economic growth and industrial composition. Thompson [1968, p. 55] states:

> "An area may grow rapidly either because it has blended a mix of fast growth industries (those of new products as Los Angeles, or those with income elastic demands as Detroit), or because it is acquiring a large share of the older, slowly growing ones (the movement of the textile industry to various North Carolina towns is such a case)."

Perloff, Dunn, Lampard and Muth [1960, p. 70] agree:

> "Emphasis on the fact that regional economic growth is not simply a matter of attracting the so-called rapid-growth industries should in no way diminish the significance for economic expansion of the presence of such industries. Clearly, a growing industry within a region is a stimulus to over-all growth. This is so evident that it does not require emphasis. The other side does require emphasis; namely, that a region can enjoy a substantial amount of over-all economic growth by absorbing

> a larger and larger share of a declining industry or by attracting the growing parts of an industry which is declining on the average."

The latter observations by Perloff et al. [1960] merit additional consideration. Success of a development policy emphasizing economic growth depends to a large extent on its feasibility rather than its desirability. Although it may be desirable for an Oregon county to attract rapid-growth industries, it is not always feasible. Indeed, for many less developed areas it is impossible. For these particular counties, a development strategy based on slowly growing or declining industries could be instrumental to a successful growth policy.

The identification of factors associated with the changes in income in each Oregon county between two time periods is useful to partially describe structural transformations in the economy and to provide possible insight into the future direction of economic development and growth. According to Brown [1971], the major use of shift-share is "to determine how each of the industries within an area contributed to the favorable or unfavorable growth, i.e., to identify the strengths and weaknesses of a region" [p. 113]. Although shift-share analysis does not indicate why the income changes have occurred, Curtis [1972] notes that the technique does provide an orderly assessment of the industrial changes occurring in an area. As Ashby [1968] observes, an in-depth explanation of these changes is beyond the scope of the shift-share technique. Kalbacher [1979] concludes that shift-share is both viable and useful when used descriptively to measure economic structure and change in a region

against some reference region.

Analysis of the changing structure of the Oregon counties will require both positive and normative research. Questions that remain unanswered include: Have the increases in population in the different counties been accompanied by growth in the county's key economic sectors? What are the sectors which contribute the most favorably (unfavorably) to individual county income? Are these classified as fast- or slow-growth sectors in relation to the State of Oregon and the Pacific Northwest region? The latter includes the States of Idaho, Oregon, and Washington, and is designated as the reference economy in this research. Have the most rapidly growing counties been supported by growth in the manufacturing sector (which includes the lumber and wood products industry)? How important is non-manufacturing (service oriented) industry to providing the economic base of a county? Can specific socio-economic characteristics, which help explain each county's current favorable (unfavorable) status, be identified?

Research Approach

The industrial composition of each Oregon county and income changes in the 12 economic sectors are described in the analytical context of the shift-share methodology. Prior to discussing the technique of analysis applied in this research, certain preliminary assumptions and classifications of data need to be identified. These include: (1) the areal unit for which growth will be described, (2) the reference region to which the study unit is compared, (3) the time span for which comparisons will be made, (4) the classification

of industries, and (5) the variable which will be used to measure the magnitude of an industry in an area. The latter two are summarized in the Data section.

Area Definition

The basic areal unit of analysis is the Oregon county. Consistent income data available at the county level makes this study region an appropriate one for analysis. The location of each county is noted on the map on the following page.

Reference Region

The majority of the previous applications of the shift-share method utilized the nation as the reference region. For the thesis research, the Pacific Northwest region was determined as the reference region. This includes the states of Idaho, Oregon, and Washington. County planners may consider information comparing each Oregon county's position relative to the Pacific Northwest, rather than the nation as a whole, more useful.

Period of Analysis

The six year period between 1973 and 1978 is chosen for analysis because it begins and ends in non-recession years. This period may not be long enough to examine long-term growth trends, but it is sufficient to eliminate short-run fluctuations in economic activity. At the time this research was undertaken, 1978 was the most recent year of complete income data from the Bureau of Economic Analysis (BEA).

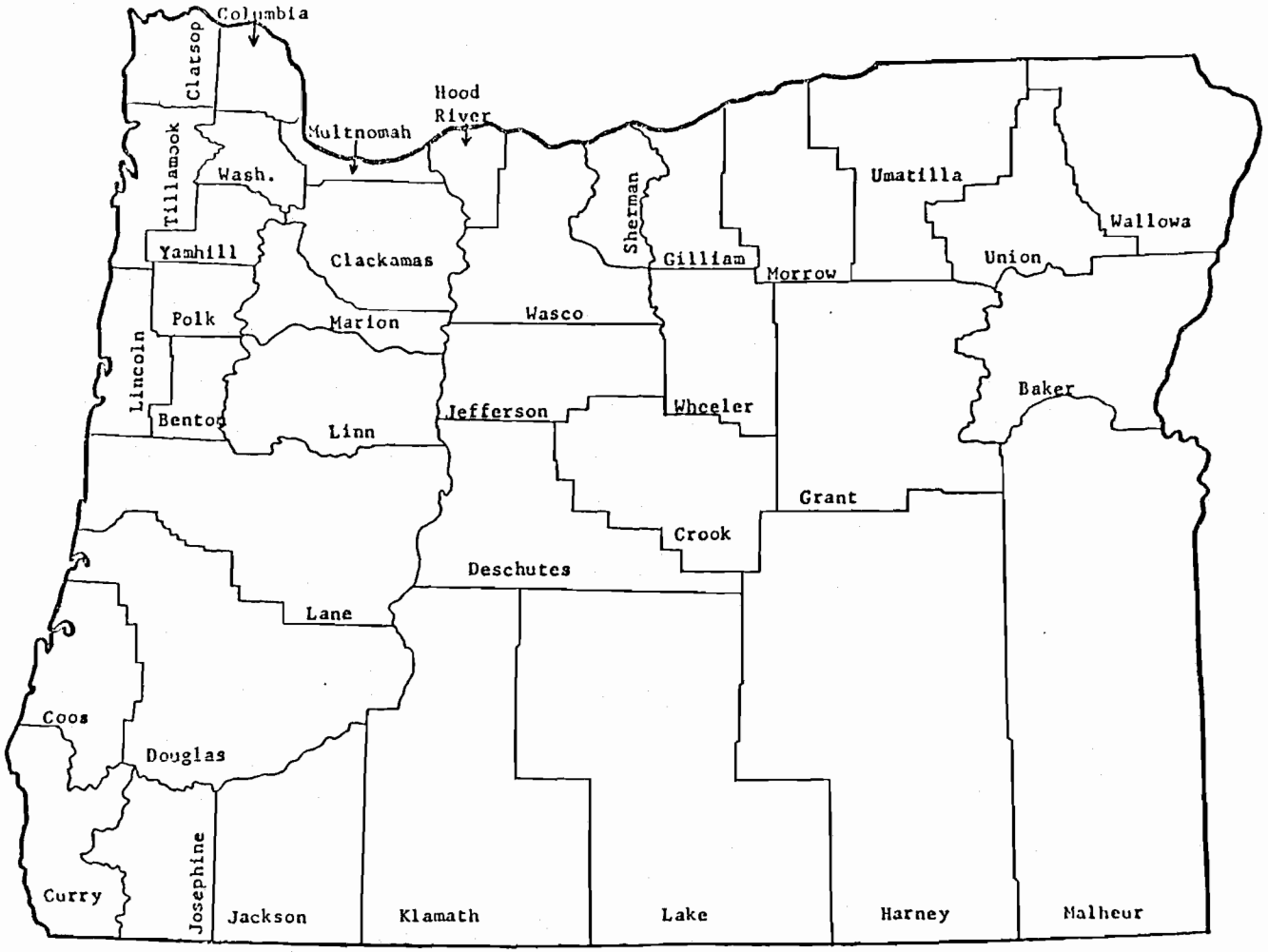

Figure 2. Location of Individual Oregon Counties.

Data

Due to the recent availability of consistent income data published annually by the Regional Economic Measurement Division of the Bureau of Economic Analysis (BEA), income data was selected to measure the economic activity in the Oregon counties. The measure labor and proprietors' income that BEA presents in industry detail for states, counties, and SMSAs reflects place of work. Included in this measure are wage and salary disbursements, other labor income and proprietors' income.

The individual industry estimates are useful for the analysis of the industrial structure of the given county. The income data is reported for 12 sectors at the one-digit Standard Industrial Classificiation (SIC) code level. Sectors included are: (1) Farm, (2) Agricultural Services, Forestry, Fisheries and Other, (3) Mining, (4) Construction, (5) Manufacturing (Durable and Non-durable Goods), (6) Transportation and Public Utilities, (7) Wholesale Trade, (8) Retail Trade, (9) Finance, Insurance, and Real Estate, (10) Services, (11) Federal Government (Civilian and Military), and (12) State and Local Government.

Method of Analysis

Since its inception, the shift-share technique has been one of the main tools for examining growth rates by region and by industry. Structural dissimilarities among the economies of different regions determine the underlying basis of the shift-share formulation. The modified version of shift-share analysis proposed by Kalbacher [1979] is utilized in the identification of the regional income disparities

among the Oregon counties. Emphasis is given to the fact that this is a study of relative change. All comparisons are with the Pacific Northwest region rate of change as a base and discussions of gains and losses are with reference to that base.

Similar to the classical shift-share equation originated by Creamer [1942], the modified shift-share variant is an identity, systematically describing differences in growth rates, by industry and by regions. Between two time points (1973 and 1978), the absolute size change in a specific sector of a given county (measured in terms of income) is partitioned into three additive components of regional growth: standard growth, industry mix, and regional share. In the classical shift-share version, the standard growth component indicates the differences between the region's actual income and that which would have occurred if total income at the regional level had grown at the same rate it did at the reference region level, during the period of analysis. Instead of the aggregate reference region growth rate, specific industry growth rates in the reference economy are used in computing the standard growth component in the modified approach.

Because structural changes such as demand patterns and technological innovations vary, income in certain sectors grows more rapidly than it does in others [Floyd, 1973]. The classical industry mix component describes the amount of regional income growth that can be attributed to the region's initial industrial structure. The modified shift-share approach proposed by Kalbacher [1979] identifies the industry mix component as an industrial composition concept. This component measures the change in income in a region that may be

due to the fact that the region is characterized by the predominance of industries which contribute more to overall county income than do their counterparts to overall reference region income. This would be indicated by a positive industry mix value. On the other hand, a negative industry mix value reveals that the county specialized in those industries which account for a smaller proportion of county income than do their counterparts in the Pacific Northwest region. In the modified version, a declining sector at the reference level (one that experiences a negative rate of change between 1973 and 1978) may also give rise to a negative industry mix value for that sector at the county level.

The difference between the total absolute change (actual growth), and the sum of standard growth and industry mix effects defines the regional share effect. This component measures the extent to which additional income growth in a specific sector is the result of that industry growing in the county at a rate different from the reference rate of change. It may reflect the existence of regional or locational advantages (disadvantages) that allow industries in the county to grow at faster (slower) rates than they would in other regions. The regional share component indicates the region's competitiveness with other regions for a given industry and is, therefore, considered to be the dynamic element of growth in income and thus more important for regional planning and development [Andrikopoulos, 1977; Curtis, 1972; Floyd, 1973; Kalbacher, 1979; Petrulis, 1979].

The shift-share model does not provide, by itself, a clear-cut explanation on how regions grow and to what extent interregional growth differences can be explained. It simply describes the income

changes for a region not exhibiting standard performance, as experienced by the reference region, in the various industries [Andrikopoulos, 1977]. Numerous factors may account for an industry's growth: high productivity of labor and capital; new technologies which increase output per unit cost; positive labor-management relations which lead to improved performance; and unique locational factors which may reduce input, transport, or other costs [Morentz and Deaton]. In order to explain the varying rates of growth experienced by the individual Oregon counties, additional analysis of factors underlying the regional share component is necessary.

The regional share component is a useful analytical device for isolating the complex set of factors that cause industries to grow at differing rates in various regions. Selected variables, which represent economic and social characteristics of each Oregon county, are used in the regression analysis which attempts to explain each county's regional share value. Knowledge of these influences may be helpful to policy makers in charge of economic development decisions.

Thesis Objectives

Objectives defined in this research include:

(1) To classify each Oregon county based on the results of the modified shift-share analysis;

(2) To identify those sectors which contribute to each Oregon county's favorable (unfavorable) industrial structure; and

(3) To evaluate the influence of selected socio-economic characteristics on each county's regional share value.

Plan of the Thesis

The research is organized into six chapters, but can be considered in two sections. The first portion, which consists of Chapters I-III, provides the theoretical background for the thesis. Chapter I has served to introduce the reader to the concept of shift-share analysis and its suitability for describing the diverging income changes sustained by Oregon counties between 1973 and 1978.

The review of literature, Chapter II, is concerned with the historical description of the classical shift-share methodology. A brief summary of individual shift-share applications is denoted in chronological order in Table 1. Three shift-share applications are described in greater detail. The chapter concludes with a section dealing with the limitations of the classical formulation as defined by past researchers.

Chapter III sets out with a descriptive account of the income data utilized in the research. The modified shift-share approach, advocated by Kalbacher [1979] and used in the thesis, is presented in the remaining sections of the chapter. To clarify the distinction between Kalbacher's proposed modified formulation and the classical shift-share approach, a shift-share analysis of Benton County using both approaches, is performed. This serves as the introduction to the more detailed assessment of the Oregon economy which, for the time period 1973 to 1978, is disaggregated spatially (by the 36 Oregon counties). The modified shift-share results for

each county are presented in alphabetical order in Appendix A.

Included in the second segment of the thesis are Chapters IV-VI. This section is devoted to the analyses of the modified shift-share results for the Oregon counties. In Chapter IV, an overview of population and income changes between 1973 and 1978 in both Oregon and the Pacific Northwest region precedes the more detailed summary of shift-share results for the individual counties. The performance of each county, as determined by the value of the individual county's industry mix and regional share coefficients underlies the organization of this section.

Chapter V develops the regression model utilized to explain each county's regional share component. Empirical results and their validity from an econometric standpoint are discussed.

The final section, Chapter VI, summarizes the main findings of the research. Specific problems which were encountered as well as suggestions for avenues of further research are also discussed.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

The technique of shift-share analysis has long been used in regional economics to examine changes over time in a region's economic activity levels relative to those in some larger reference area, usually the nation. This regional science technique was originally developed as an aid in the organization of large quantities of data so that the regional analyst might identify more effectively the forces behind a region's growth. Shift-share components are calculated from historical data with the expectation of identifying future strengths and weaknesses in a region.

Since its origination by Daniel Creamer in 1942, shift-share analysis has experienced widespread usage as well as a good deal of criticism. The lack of a standard set of mathematical definitions and terms for the components of shift-share analysis makes the literature difficult to interpret and the contribution of various applications hard to assess. In fact, some of the debates in the literature appears to originate from a lack of agreement on terminology. It is useful, therefore, to establish the nomenclature and definitions used in this thesis prior to presenting a historical summary of previous shift-share applications.

A large volume of literature deals with limitations to the classical shift-share formulation. The limitations, as well as proposals to improve the methodology, are discussed in the concluding section of this chapter.

The Classical Shift-Share Formulation

Although attention has been given to the inclusion of shift-share in a predictive framework, it has remained almost exclusively a tool for regional description of economic growth.[1/] There are several reasons for its popularity. It is relatively inexpensive to implement compared, say, to input-output analysis. The data requirements are relatively easy to meet and the shift-share technique provides an effective way for organizing large bodies of information. Furthermore, the principal methodological procedures are straightforward [Edwards, 1976].

The relationship between regional growth and industrial structure is often described and divided into various effects, with a technique known as shift-share analysis. Basically, this methodology isolates for analysis the change in a given economic activity in a particular region between two time periods. In standard usage for regional analysis, employment data in the various industries in a region are compared to employment in the nation or some other base area. Although employment data are the most commonly used index of economic activity, any variable which can be decomposed into areas and sectors, is suitable. Depending on the circumstances of the analysis and the interests of the researcher, income, value-added, population, regional crime statistics, household electricity rates, etc., are all equally appropriate. Observation of the different

---

1/ The general view seems to be that the shift-share technique by itself does not provide an adequate framework for the analysis and forecasting of regional employment trends [Houston, 1967; Brown, 1969; Bishop and Simpson, 1972]. An informative overview of past applications using shift-share as a predictive tool is presented by Stevens and Moore [1980].

variables used in the review of shift-share applications reveals the extent of creativeness of past researchers.

The shift-share framework relates how specific industries in certain regions are performing relative to the same industries in a larger reference region. The analysis is a combination of shift analysis, which looks at the shift or change in the variable over time (for example, the change in income experienced by a study region such as an Oregon county) and share analysis, which examines the static proportion of that variable for the reference region which is accounted for by the study region [Blair and Mabry, 1980].

The difference between the base and final year of the analysis period in a study region's economic activity level, termed actual growth and measured by income in this thesis, is partitioned into three components of regional growth: standard growth, industry mix, and regional share. The standard growth component indicates the difference between the region's actual income and that which would have occurred if total income at the regional level had grown at the same rate it did in the reference region. The difference between actual and standard growth is termed net relative change. A negative shift (negative net relative change value) indicates that the region under study grew more slowly than the reference region; a positive shift (positive net relative change value) indicates that the region under study grew more rapidly than the reference region. The standard growth must be isolated in order to focus on the two remaining effects which account for differences in regional growth patterns [Petrulis, 1979; Shaffer, 1979].

Implicit in the division of the region's differential growth

into industry mix and regional share effects, is the theoretical assumption that, as an approximation, income in all industries in a region would experience the industry growth rate in the reference region unless some regional comparative advantage or disadvantage factors were operating. Since the technique does not specify what these relative advantage factors are, it does not of itself provide a theory of regional income growth [Bishop and Simpson, 1972]. Its primary purpose, however, is to focus attention on the important issue of providing insight into comparative change [Blair and Mabry, 1980].

Similar to the standard growth component, the industry mix component depends upon growth in the reference region. Specifically, it concentrates on the growth rate in each industry of the reference region as compared to the reference region's average rate of growth during the period of analysis. This component indicates the amount of regional income growth that can be attributed to the region's initial industrial structure. In other words, this is a measure of the income change determined by the types of industry located in the study region. If the local economic structure is weighted toward faster growing sectors relative to the reference region's average rate of growth, the industry mix component will be positive. The reverse is true for a negative industry mix value.

The third component of change, regional share, measures the extent to which additional income growth in a specific sector is the result of that sector in the study region growing at a rate different from the same sector at the reference region level. The ability of the local economy to capture an increasing (decreasing) share of a given industry's growth is assessed by this component.

It therefore may indicate the extent to which a region enjoys a competitive or locational advantage which allows industries in that region to grow at a faster rate than they would in other regions [Edwards, 1976].[2/] As Petrulis [1979] notes, these factors may include natural resource endowments, government subsidy and tax policies, ease of access to final and intermediate markets, economies of scale and availability and price of various factors of production.[3/]

In summary, the classical shift-share model for the i^{th} sector in the study region may be defined as:[4/]

(1) $\text{Actual growth}_i = \text{standard growth}_i + \text{industry mix}_i + \text{regional share}_i$

(2) $\text{Actual growth}_i - \text{standard growth}_i = \text{net relative change}_i$

(3) $\text{Net relative change}_i = \text{industry mix}_i + \text{regional share}_i$

[2/] Past studies have used varying terminology with respect to the regional growth components. Standard growth has been referred to as national growth, regional share, base growth effect or standard share; net relative change as total shift or net shift; industry mix as proportionality shift, compositional mix, structural growth component or component mix; and regional share as differential shift, competitive share, relative share effect or competitive position [Bishop and Simpson, 1972; Blair and Mabry, 1980; Brown, 1969; Chalmers and Beckhelm, 1976; Curtis, 1972; Esteban-Marquillas, 1972; Houston, 1967; Perloff, Dunn, Lampard and Muth, 1960; Stilwell, 1969].

[3/] Because the regional share component is considered to be the dynamic element of growth in a region's income (or any variable depicting regional economic activity), it is the more important one for regional planning and development [Andrikopoulos, 1977]. Multiple regression analysis is used in Chapter V to identify the most significant factors underlying the regional share component for each of the 36 Oregon counties.

[4/] Ashby [1964], the first researcher to make this three component model explicit, utilized shift-share analysis to examine employment trends occurring in 32 industry groups in the 50 states between 1940 and 1960.

An algebraic definition of the classical shift-share equation, utilizing the terminology adopted in the thesis, clarifies the three components of growth occurring in the i^{th} sector of the specified study region during the period of analysis:[5/]

$$S_i(s_i) = S_i(r) + S_i(r_i - r) + S_i(s_i - r_i)$$

where

S_i = base year income for sector i in study region,

s_i = growth rate during period for sector i in study region,

r = growth rate during period for all sectors in reference region, and

r_i = growth rate during period for sector i in reference region.

The study region's changing position relative to the reference region is given by the net relative change value, which is the sum of the industry mix and regional share components. As Andrikopoulos [1977] observes, the significance of the shift-share formulation centers around the fact that it summarizes the effects of three major factors on the growth of income in a particular industry or region: (i) national factors (r and r_i), (ii) local factors (s_i), and (iii) differential factor ($s_i - r_i$). This demonstrates that the growth of a region's economy can be described as a combination of exogenous (reference region) influences, the region's initial economic structure and size, and differential influences.

[5/] It may be beneficial to observe that the first term in each component is multiplied by the expression in brackets.

Historical Summary of Classical Shift-Share Applications

As a technique used in describing economic growth by region and by industry, shift-share analysis has existed for 40 years. This regional science tool was originally applied by Creamer in 1942, but gained little recognition until Perloff, Dunn, Lampard and Muth [1960] employed shift-share in a comprehensive regional growth model to describe the forces underlying the economic growth in the United States from 1870 to 1950.

The use of shift-share analysis allows one to describe a regional economy at three levels, structurally (by industrial sector), spatially (by areal unit such as county, state, etc.), or temporally (by different time periods, including annual). As evidenced in Table 1 on pages 40-49, which presents a sample of classical shift-share applications in chronological order, the reader notes that all three approaches have been attempted. A brief summary of classical shift-share applications, separated according to the dimension of the regional economy analyzed, is presented in this chapter. Studies which utilize a temporal perspective also described the regional economy at either or both a structural and spatial level. Therefore, authors which employed more than one viewpoint in their shift-share application, are summarized in the section describing studies using the temporal shift-share approach. A more detailed description of individual regional studies based on the classical formulation of shift-share analysis proposed by Creamer [1942] and made popular by Perloff et al. [1960] is given in Table 1.

Owing to the significance of the work accomplished by Perloff, Dunn, Lampard and Muth [1960], additional attention will be focused on this definitive application of shift-share analysis. This is followed by a more detailed description of two interesting approaches based on the shift-share methodology. In the analysis of the export performance of seven developing countries, Little, Scitovsky, and Scott [1970] utilize shift-share analysis to suggest that the influence of the economic policies enacted by the developing country may significantly be related to its share of world exports. Blair and Mabry [1980] examine regional crime growth among four regions in the United States, and suggest the appropriateness of this technique in the allocation of Law Enforcement Assistance Administration funds to areas experiencing particular types of crime.

A Structural Shift-Share Approach

The studies utilizing this perspective, concentrate on relating the performance of manufacturing employment among various regions to employment in the Manufacturing sector in the reference region, the United States [Borts and Stein, 1964; Creamer, 1942; Petrulis, 1979]. Shift-share applications by Fuchs [1959] and Garrett [1968] use value-added as well as employment data in their structural description of the Manufacturing sector.

A structural analysis is also emphasized in the shift-share study of changes in employment and value-added in 27 categories of forest industry in the South. Forest industries at the national level served as the standard of performance [Dutrow, 1972].

The comprehensive shift-share application by Perloff, Dunn,

Lampard and Muth [1960] broadens the structural perspective by explicitly examining the performance of ten industrial sectors across states during the period 1939 to 1958. Each sector's performance in every state was compared to that sector in the nation. The major sectors include: Agriculture; Mining; Manufacturing; Transportation and Public Utilities; Wholesale Trade; Retail Trade; Finance, Insurance, and Real Estate; Services and Miscellaneous; and Government. Two additional studies combined a structural approach with a temporal perspective and are described in the latter section [Andrikopoulos, 1977; Edwards, 1976].

A Spatial Shift-Share Approach

Several shift-share applications designated counties as the study regions and the United States as the reference economy. Curtis [1972] found that income and employment data produced similar results in his shift-share analysis of four low income, rural Alabama counties. The United States also served as the reference region in the study analyzing employment changes in four Virginia counties completed by Morentz and Deaton. Similarly, non-farm private employment trends in Wisconsin counties was examined by Shaffer, Dunford and Langrish in order to explain the state's overall negative shift-share results.

Maki and Schweitzer [1973] apply shift-share analysis on a spatial level in their study of employment trends in 14 economic areas in the douglas-fir region of western Oregon and western Washington. National industry trends served as the standard for comparison in this application. On another continent, Randall [1973]

utilized Great Britain as the reference region in his shift-share analysis of employment trends in West Central Scotland.

A spatial perspective also underlies the extensive investigation undertaken by Perloff, Dunn, Lampard and Muth [1960] in their analysis of economic growth in the United States between 1870 and 1950. Changes in income, population, and employment among the various regions during this period of analysis are examined. This study, as well as two others which also employ a spatial viewpoint, are presented in greater detail following this segment of the chapter. Little, Scitovsky, and Scott [1970] examine the value of exports among developing countries, while Blair and Mabry [1980] use shift-share analysis in the description of crime statistics among regions in the United States. Several researchers apply shift-share analysis at the temporal as well as spatial level [Ashby, 1964; Edwards, 1976; Lasuen, 1971; Bretzfelder, 1970; Paris, 1970]. These studies are summarized in the following section of the chapter.

A Temporal Shift-Share Approach

The authors who performed shift-share for more than one period of analysis first conducted the research at either a structural or spatial level. One researcher disaggregated the shift-share results at all three levels [Edwards, 1976].

Manufacturing employment in Canada is the standard of performance for two studies which apply similar structural and temporal perspectives. Andrikopoulos [1977] examines manufacturing industries in the province of Ontario, whereas Edwards [1976] studies the performance of the manufacturing sector as a whole across all Canadian

provinces. Edwards [1976] also presents a more detailed shift-share classification involving manufacturing industries in the province of British Columbia. Both authors utilize a temporal view in their investigation of the pattern of annual changes (denoted by the sign of each shift-share coefficient) in specific manufacturing industries in the respective studies. Edwards [1976] moreover, adopts a spatial perspective in his shift-share study of the ten census regions in British Columbia.

An interesting interpretation to the individual shift-share components is noted in the study by Paris [1970] which relates changes in population in nine Canadian provinces to national population growth in Canada. Using census population data, this spatial descriptive shift-share analysis is applied for six decades between 1901 and 1961.

A spatial as well as temporal perspective is adopted in the three remaining studies. Shift-share analysis is performed using employment data for two decades between 1940 and 1960 in the often quoted study by Ashby [1964]. Changes in employment in eight regions and 50 states are compared to national growth patterns for both periods of analysis. In one of the few shift-share applications using income as a measure of economic activity, Bretzfelder [1970] accomplished a similar analysis utilizing the eight regions for two different periods, 1948 to 1957 and 1959 to 1969. Only for the latter decade are income changes in all states compared to national income patterns.

The geographical patterns of economic expansion, as measured by employment data, among regions in Venezuela are examined for the

years 1941 to 1961 in the remaining shift-share application by Lasuen [1971] to be summarized. This 20 year period is further divided into two decades and shift-share analysis is performed for each period to evaluate the degree and stability of geographical concentration in the country's past economic growth.

This concludes the summary section on historical shift-share applications based on the dimension of the regional economy described. Recall that a review of each application is denoted in chronological order in Table 1. The literature review chapter now proceeds with the detailed description of three classical shift-share applications.

Perloff, Dunn, Lampard and Muth [1960]

Two distinct purposes are observed in the descriptive inter-regional perspective employed by Perloff et al. in their study of regional economic growth in the United States. One was to evaluate whether there exists an overall trend in the pattern of growth of the regions over time. The second intent was to identify the sectors responsible for the higher or lower average growth rates of the different regions and to denote the ultimate causes of those changes. Detailed knowledge of the production functions of the different industries (as provided, for example, by input-output tables) and of the factors determining the movements of the production function inputs are suggested as explaining the differential rates of growth occurring [Lasuen, 1971].

A prerequisite to understanding present differential levels of living and rates of economic expansion is a description of the regional settlement and growth patterns of the past. To meet this re-

quirement, Perloff et al. utilized the 'shift' framework to examine changes in income, population, and employment in the United States between 1870 and 1950. Although the national economy grew steadily in both population and per capita income during this period, this growth was not shared equally by the various regions in the country. Concern with the regional distribution of the volume of the economic activity prompted the researchers to examine regional shifts in employment in specific sectors between 1939 and 1958. Highlights of both studies are presented, following an explanation, by way of an example, of the 'shift' method utilized by the authors.

The 'Shift' Framework

The analytical framework suggested by Perloff et al. [1960] describes the relative extent to which individual regions have shared in the national economic growth and the shift in the relative position of the individual regions with regard to the key measures, such as population, income, and employment within major industries. This technique is based on the fact that when an industry is growing nationally because of increasing demand for its products, regions in which the nationally growing industry is located will also grow due to this advantage. Conversely, regions containing slow-growth or declining industries will suffer as a consequence. This is termed by the authors as the composition or industry mix effect.

At the same time, since competition exists between regions for industries, some regions will be getting more or less of any given industry, whether it is growing nationally or not. This is known as the local-factor effect. The authors observe that the regions

which experience net upward local-factor shifts will have gained because of their greater locational advantages for the operation of the given industries [Perloff and Dodds, 1963].[6/]

The use of the 'shift' method of presenting data allows one to observe the relative size of the gains or losses among the areas being compared. This method of regional analysis may be applied to any type of area, whether multistate, state or substate. For example, it may be used to express a change in a state's relative standing. To clarify what is being measured by this technique, an example detailing California's employment behavior is presented [Perloff and Dodds, 1963].

Between 1939 and 1958, California experienced an increase in total employment of 2,735,846 workers. If California's employment had grown at the same percentage as did the country as a whole over these years, its increase would only have been 894,064 workers. The difference between the two figures, 1,841,782 employees, is termed net employment shift. Therefore, California realized a net upward shift in employment between 1939 and 1958.

This same concept may also be applied at the state industry level. During this period, every major industry sustained a greater increase in employment than it would have if each one had grown at the national rate for that industry. This is termed by Perloff et al. as the local factor net shift. The summation of each industry's

---

[6/] The relation of the terminology used by Perloff et al. and that of the thesis is as follows: total net employment shift is the net relative change component, total local-factor net shift, the regional share component and the composition effect, the industry mix component.

shift yields the state's total local-factor net shift of 1,566,021 workers. This is less than the total net shift in employment when calculated on the basis of the state's total expected rate of employment growth. The difference of 275,761 wage jobs (1,841,782 - 1,566,021) is the result of the composition effect, which exists because not only did each major industry in California grow more than the national average for the industry, but the state's industrial mix or composition was such that the number of workers employed in growth industries exceeded the national average. Therefore, both the total local-factor net shift and the composition effects contributed to California's net upward shift in total employment during this 19 year period. Accounting for 45 percent of California's favorable growth is the Manufacturing sector.

The 'shift' framework underlies both studies accomplished by Perloff, Dunn, Lampard and Muth [1960]. These are summarized in the following two sections.

Regional Economic Development, 1870 to 1957

Although all parts of the country gained from the great increases in income that have accompanied the economic development of the United States, three regions that were below the national average in per capita income in 1880 (the Southeast, Southwest, and Plains regions) were still below the national average in 1957. The relative levels of per capita income were found to be strongly associated with the level of urbanization and industrialization in the Middle Atlantic, New England, Great Lakes, and Far West regions.

Different means of attaining the increases in levels of per

capita income were evident among the various regions. The Far West and the Southwest, Florida and Virginia, and the Eastern Great Lake States all experienced above-average increases in income while also growing in population and economic activities. On the other hand, the Plains regions and some of the Southeastern states realized above-average income gains in the face of out-migration and little overall increases in population and economic activities. A few states, Oklahoma, Arkansas, and Mississippi, combined a substantial gain in per capita incomes with an actual decline in population.

Regional Distribution of Economic Activities in the United States, 1939-1958

As previously noted, not all regions shared equally in the growth experienced by the national economy. Some regions show a rate of development exceeding the average for the nation as a whole; others fell below the national standard. Perloff, Dunn, Lampard and Muth [1960] describe the differential levels of per capita income growth among regions as well as the differential levels of employment present among the major industrial sectors. Only the latter will be summarized with specific emphasis given to three activities, Mining, Agriculture, and Manufacturing, and their influence on regional structures. As the study results indicate, the 1939-1958 period is characterized by the westward movement of population and economic growth.

Mining

Mining is the smallest of the broad industrial sectors, accounting

for only 1.3 percent of total national employment in 1958. Because it provides industry with basic material inputs, it is highly localized which makes it significant in explaining the economic behavior of regions dependent on it for employment. Between 1939 and 1958, national mining employment decreased by 11 percent. In 1939, only 17 states experienced a higher mining employment as percentage of total employment, as compared to the U.S. standard of two percent. By 1957, only five of the 17 states had increased the ratio of mining employment to total employment. Expansion in the use of petroleum and natural gas accounts for the increase in Texas, Louisiana and Oklahoma, while increases in metal mining contributed to positive shifts in mining employment in New Mexico and Wyoming.

Further examination of the subsectors in the Mining industry, coal, crude petroleum and natural gas, metals and nonmetallic metals, reveals the employment behavior of two areas —— one of major growth in total employment and the other of major relative decline. The increase in minerals production (mainly oil and gas and their geological associates, sulfur and salt) has played a major role in the increase in mining employment occurring in the Southwest, particularly Texas and Louisiana. The substantial downward shifts in mining employment experienced in Pennsylvania, West Virginia, and Kentucky are due to the decline in coal mining.

Agriculture

Agriculture is described as being a major 'slow-growth' sector of the U.S. economy. The percentage of agricultural employment to total national employment fell from 27.5 percent in 1939 to 12.9

percent in 1958. In other words, agriculture's share of the labor force of the nation declined by 53.1 percent during this period.

Examining both agricultural employment data and the change in value of agricultural products sold reveals a westward movement of the sector. Areas such as the Southeast, Plains, and the Northern Mountain regions, which have depended largely on agriculture, have tended to lose out relative to regions with better access to manufacturing markets and the basic intermediate inputs. It is interesting to note that several regions, the Far West, Southern Mountain States, and Indiana, were able to experience a positive net shift in agricultural employment because they increased their share of the nation's declining agricultural employment in spite of the generally depressing effect of agricultural specialization.

Manufacturing

Twenty-eight percent of the nation's labor force was employed in the Manufacturing sector in 1958. Shifts in manufacturing employment accounted for over one-third of the total net shift in U.S. employment between 1939 and 1958. Though manufacturing utilizes the largest share of inputs coming from the resource sectors, the dominant locational factor tended to be closeness to markets rather than closeness to input sources, for all stages of manufacturing activity during this period. One exception is the important contribution of oil and gas to the growth of manufacturing in the Southwest.

The overall effect of the changes in manufacturing employment has been to produce a moderate relative shift out of the Manufacturing

Belt into the Southeast, Southwest, and Far West. California and Texas account for over half of the net upward shift experienced by manufacturing employment in the United States.

Perloff and Dodds [1963] denote five factors which may explain the differential rates of manufacturing growth experienced by the various regions. One factor is income elasticity; slow-growth sectors such as food-processing and basic resource using sectors produce goods for which demand varies little with rising consumer income. On the other hand, the only rapid-growth sectors that can be classified as resource-using (rubber, paper, and chemicals) are those whose products are most likely to enjoy increasing demand because they supply intermediate necessities for the rapid-growth industries in the nation. Sector substitution, the second factor contributing to varying rates of growth among manufacturing sectors, accounts for the slow-growth of the forest products industries. Substitutions of metals and plastics for wood products is the cause of transfers of employment from the latter sector to the former ones. The increase in exports of more highly finished manufacturing products over such goods as food, textiles, and apparel, is the third factor. Another is the fact that not all manufacturing sectors have shared equally in the gains in labor productivity. Most of the rapid-growth industries realized the greatest gains in labor productivity. The final factor contributing to the differential rates of growth experienced by manufacturing sectors among regions was the change in the composition of the consuming sectors of the economy. During the 1939-1958 period, a larger share of output, particularly in the area of military defense, was absorbed by the U.S. government.

The comprehensive regional growth project undertaken by Perloff, Dunn, Lampard and Muth [1960] established shift-share analysis as a useful tool in the description of regional growth patterns. As observed in this chapter, researchers in various countries, including Canada, Scotland and Venezuela, as well as in the United States utilized the shift-share framework. The following two studies exemplify the scope of more recent shift-share applications.

Little, Scitovsky, and Scott [1970]

An interesting shift-share application was developed by these researchers to measure the export performance of seven developing countries (Argentina, Brazil, India, Mexico, Pakistan, Philippines and Taiwan) in relation to exports of all developing countries and world exports. If one accepts the premise that there is a large market for many of the commodities which developing countries export, one can surmise that by increasing their share of exports, they can increase their value of exports substantially. The authors also examine whether a country's past increases or reductions in its share of world exports can be explained by the economic policies the developing country has pursued, rather than by factors outside of its control.

The change in value in each developing country's exports between 1953 and 1965 is partitioned into increases (decreases) due to (1) average change, (2) commodity composition, and (3) the change in shares. The average change is defined as the change in value which would have occurred if the country's exports had risen in the

same proportion as world exports. To obtain the value of the commodity composition component, the difference in the composition of the developing country's exports and the world's exports is determined by examining the change in each commodity group. The third component, the change in shares, is a residual. This is defined as the difference between the level of exports, which would have been attained had the developing country's share in each commodity group remained constant, and the actual level of exports. This is due to the changes in the developing country's share of world exports.

If one assumes that each developing country supplies only a small proportion of world exports of each commodity, then the first two components of change are largely outside the control of the exporting country.[7/] The residual, a change in value of exports due to the change in the country's shares of world exports, is perceived to be under the country's control. Therefore, if changes in shares are an important part of changes in total exports and if they appear to be related to economic policies which encourage or discourage exports, Little, Scitovsky, and Scott [1970] postulate that developing countries do have some control over the level of their export earnings.

In the analysis of the export performance of the seven developing countries, the authors found that four countries (Argentina, Pakistan, Philippines and Taiwan) were able to increase their exports through increasing their shares in world exports of particular com-

---

7/ Note that in the long run, a country can alter the commodity composition of its exports. This was successfully accomplished by Taiwan [Little, Scitovsky, and Scott, 1970].

modity groups. The improved performance of these countries, as compared to the other ones, may be partly due to the various measures undertaken to increase exports in the late 1950s and early 1960s. For example, economic policies which offset the bias resulting from protection against exporting manufactures, were followed by both Pakistan and Taiwan. Actual bonuses were given in Pakistan to induce increases in manufacturing exports. On the other hand, three countries (Brazil, India, and Mexico) lost exports during this period of analysis by failing to maintain their shares of world exports. This may be related to the protective economic policies pursued by these countries. For example, Brazil's poor performance is partly explicable in terms of currency over-valuation and the desire to restrict coffee exports in order to keep up coffee prices. Mexico's currency devaluation in 1954 most likely explains its weak showing. The loss in export share experienced by India may be due to the protective policies, such as export taxes and export controls and quotas, initiated by the government. These were not lifted until 1961. As indicated by the authors, this evidence refutes the pessimistic view that developing countries are powerless to increase their exports.

Blair and Mabry [1980]

A novel shift-share application based on the classical formulation was proposed by Blair and Mabry [1980] to aid in the analysis of regional crime growth. This attempt to expand the usefulness of the shift-share methodology was undertaken to demonstrate to criminal justice practitioners how their jurisdictions are faring relative to others within the region or the nation as a whole.

The shift-share technique is applied to changes in the total number of crimes by major crime type within four regions in the United States (South, North Central, West, and Northeast) for the time period 1970 to 1975. The seven major crime types are separated between violent and property crimes. The violent crime category is comprised of murder, rape, robbery, and assault. Burglary, larceny and auto theft are included in the property crime category.

Because the actual number of each type of crime increased during this period, the standard growth effect was uniformly positive. The product of the average percentage increase in all crimes in the reference region (the United States) and the number of crimes in the specific region in 1970 yields the standard growth component. The net relative change in regional crime indicates whether a region gained or lost relative to an expectation derived from the standard growth component. This is the difference between the actual increase in number of crimes in the region during the period and the standard growth component. The summation of the number of crimes due to industry mix and regional share effects also yields the net relative change in regional crime value.

Evaluation of the industry mix component for each crime type reveals a consistent shift in the composition of crimes across all regions: away from all four types of violent crime and toward crimes involving property, mainly larceny. Both burglary and auto theft actually showed a decline in importance in the crime mix of all four regions.

Examination of the regional share effects for the individual crime types is interesting because these indicate how each region

shared in the total crime increase in the nation during the period — whether a region was an 'exporter' or 'importer' of crime. Regional share results reveal that the South, North Central, and Northeast shares of violent crime decreased at the expense of the West, whose relative share of the increase in violent crime rose significantly. The classification of a region into an 'exporter' or 'importer' of crime does not imply that people committing a given type of crime are necessarily moving from one region to another. Rather, it is suggested by the authors that examination of changing enforcement patterns, penality structures and so on in a given region, relative to other regions, be investigated by policy makers to explain the varying regional share effects. The possible influence of the larger increase in population in the West during this period is not considered by the authors.

In conclusion, the use of shift-share analysis in examining regional crime growth does not explain the causes for the differential rates of growth experienced by the four regions, although it does classify and describe the changes and highlight areas of additional investigation. For example, Blair and Mabry [1980] note that this shift-share approach may be useful in the allocation of Law Enforcement Assistance Administration funds across regions and in the targeting of funds to aid in the reduction of particular types of crime. Furthermore, the technique may be applied at any level, i.e., to cities, counties, or regional planning agencies, to help develop their policies toward crime.

Table 1. Review of Shift-Share Applications in Chronological Order.

Year	Author(s)	Title	Type of Data Used	Period of Analysis
1942	Creamer	Shifts of Manufacturing Industries	Employment	Not Available

Summary: As the originator of the concept of shift-share analysis, Creamer utilized the technique to depict the locational shift of each manufacturing industry among regions in the United States. Manufacturing employment in the U.S. serves as the standard for comparison.

****

1959	Fuchs	Changes in the Location of U.S. Manufacturing Since 1929	Value added, Employment	1929-1954 1947-1954

Summary: Utilizing the United States as the reference region and the individual states as study regions, changes in the location of the manufacturing industry for two overlapping time periods are investigated. The outcome of the study reveals that in 1929, the Southern and Western states together accounted for slightly less than one out of every four manufacturing jobs. By 1954, their share had increased to one out of three manufacturing jobs.

****

Table 1. Review of Shift-Share Applications in Chronological Order (continued).

Year	Author(s)	Title	Type of Data Used	Period of Analysis
1960	Perloff, Dunn Lampard & Muth	Regions, Resources, and Economic Growth	Income, Population, Employment	1870-1957
			Employment	1939-1958

Summary: This comprehensive regional growth study applied the 'shift' framework in the description of income, population, and employment changes among regions in the United States between 1870 and 1950. The United States served as the reference economy. Employment in specific sectors was examined in further detail during the period 1939 to 1958. A detailed description of this important shift-share application is presented in this chapter.

****

1964	Ashby	The Geographical Redistribution of Employment: An Examination of the Elements of Change	Employment	1940-1950 1950-1960

Summary: Between 1940 and 1960, U.S. employment increased by 21 million persons or 46 percent. In this frequently quoted study, shift-share analysis is utilized to relate change in employment in the eight U.S. regions and the 50 states to national growth patterns in both decades. Detailed shift-share values are presented for 32 industry groups for the State of Washington.

****

Table 1. Review of Shift-Share Applications in Chronological Order (continued).

Year	Author(s)	Title	Type of Data Used	Period of Analysis
1964	Borts, Stein	Economic Growth in a Free Market	Employment	1919-1929 1929-1947 1948-1953 1948-1957

Summary: Borts and Stein utilized shift-share analysis to test the hypothesis that patterns of economic growth among U.S. regions are explainable in terms of their industrial composition. The differences in rates of growth in manufacturing employment among 48 states was compared to the standard growth exhibited by the change in national manufacturing employment for the four time periods. A significant association between the two growth patterns was only found in the latter period.

****

Year	Author(s)	Title	Type of Data Used	Period of Analysis
1968	Garrett	Growth in Manufacturing in the South, 1947-1958: A Study in Regional Industrial Development	Value added Employment	1947-1958

Summary: Regional patterns in manufacturing growth in the South relative to the United States are examined for this expansive post-World War II period. To denote differences in growth in employment and value added, manufacturing industries are aggregated into three categories: resource-oriented, market-oriented, and labor-oriented. Results suggest that three factors account for the rapid increase in manufacturing experienced by the South: (1) growth in national demand, (2) the South's continuing competitive labor advantage, and (3) the declining importance of the availability of natural resources.

****

Table 1. Review of Shift-Share Applications in Chronological Order (continued)

Year	Author(s)	Title	Type of Data Used	Period of Analysis
1970	Bretzfelder	Geographic Trends in Personal Income in the 1960's	Income	1948-1957 1959-1969

Summary: Using the United States as the reference region, shift-share analysis is applied to eight regions for both periods and to all states for the latter period, 1959-1969. During every decade between 1929 and 1969, income growth was faster in the western and southern portions of the country than in the northern and eastern regions. In the regional shift-share analysis covering the latter two decades, the regional share (RS) effect was the most important element in explaining differential regional growth. A high correlation was found between the RS effect and relative growth in total income. A positive RS value was found in every region that experienced above-average growth in total income and vice versa. Little correlation was found between the industry mix effect and relative change in total income.

****

Year	Author(s)	Title	Type of Data Used	Period of Analysis
1970	Little, Scitovsky, Scott	Industry and Trade in Some Developing Countries	Value of Exports	1953-1965

Summary: These authors employed shift-share analysis to measure the export performance of seven developing countries in relation to exports of all developing countries and to 'world' exports. A positive correlation was found between a country's economic policies and the change in each country's share of world exports, the residual component. Countries practicing favorable trade policies were able to increase their exports through increasing their shares in world exports of particular commodity groups.

****

Table 1. Review of Shift-Share Applications in Chronological Order (continued).

Year	Author(s)	Title	Type of Data Used	Period of Analysis
1970	Paris	Regional/Structural Analysis of Population Changes	Population	1901-1961

Summary: Using population figures from seven decennial censuses from 1901 to 1961, shift-share analysis is conducted for nine Canadian provinces. In population analyses, the age group represents the sector. The shift-share components are interpreted as follows: the standard growth rate for the reference economy, Canada, takes into account the impact of total migration; the industry mix component corresponds to the advantage (or disadvantage) a region receives from its age structure in the base year of the analysis; and the regional share component indicates the purely regional factors in explaining differences in population growth. This value reveals the impact of variations in net births (differences in fertility and overall death rates among children during period in each province) and the combined death-migration rates (death rates and in-migration rates above or below national rates). Results reveal the small role of the industry mix component as compared to the regional share component in explaining regional population variations in all six periods of analysis.

****

1971	Lasuen	Venezuela: An Industrial Shift-Share Analysis, 1941-1961	Employment	1941-1961 1941-1951 1951-1961

Summary: The geographical patterns of economic expansion between 1941 and 1961 in the developing country of Venezuela are examined to evaluate the degree and stability of geographical concentration in the country's past economic growth. Due to the oil boom, total employment almost doubled during this period but not all regions, subregions and states shared equally in this growth. Results indicate that Venezuela's development is highly concentrated in a few core periods. Even in two decade long subperiods, stability in the relative structure of the states and regions at all levels is found. The industry mix component was the dominant factor in Venezuela's spatial growth.

****

Table 1. Review of Shift-Share Applications in Chronological Order (continued).

Year	Author(s)	Title	Type of Data Used	Period of Analysis
1972	Curtis	Shift-Share Analysis as a Technique in Rural Development Research	Income Employment	1960-1969

Summary: Primary intent of the study was to identify the structural transformation occurring in four low income, rural Alabama counties in relation to the U.S. Firms are aggregated into ten sectors. Of the increase in total personal income experienced in the counties, 94 percent is accounted for by national growth, -3 percent by industry mix and 9 percent by the regional share (RS) component. Manufacturing was the biggest contributor to the positive RS value. Shift-share analysis of the employment data yields similar results.

****

Year	Author(s)	Title	Type of Data Used	Period of Analysis
1972	Dutrow	Shift-Share Analysis of Southern Forest Industry 1958-1967	Employment Value added	1958-1963 1963-1967

Summary: Using both employment and value added data, shift-share analysis is used to describe changes in 27 categories of forest industry in the South. Nationally, forest industries qualify as a slow growing sector in terms of employment, value added and new capital expenditures. During this period, however, forest industries in the South are rapid growers in both value added and capital expenditures. The loss in employment (mainly in sawmills and planing mills) may be explained by the fact that the forest industry in the South is becoming less labor intensive.

****

Table 1. Review of Shift-Share Applications in Chronological Order (continued).

Year	Author(s)	Title	Type of Data Used	Period of Analysis
1973	Maki, Schweitzer	Importance of Timber-Based Employment to the Douglas-Fir Region, 1959-1971	Employment	1959-1971

Summary: This study examines employment trends in fourteen economic areas in the douglas-fir region of Western Oregon and Western Washington, and uses shift-share analysis to trace out the changes in employment due to national industry trends and to local conditions. Although employment increased by 25 percent in this douglas-fir region, timber dependent industries did not share in this substantial increase. In terms of the region's economic base, the study also found a decline in the importance of timber industries to this region.

****

1973	Randall	Shift-Share Analysis as a Guide to the Employment Performance of West Central Scotland	Employment	1959-1968

Summary: While the reference region, Great Britain, experienced an overall employment growth rate of 5.1 percent, the study region of West Central Scotland suffered a decline of 10,000 jobs. Results at the broad industry level reveal that 91 percent of the negative net relative change value is due to the unfavorable regional share component rather than an unfavorable industry mix component as suggested by previous studies. Results from this study are used to examine more closely the limitations of shift-share, such as data disaggregation by industrial grouping, spatial boundaries, male versus female employment, time periods and linkages between different industrial sectors.

****

Table 1. Review of Shift-Share Applications in Chronological Order (continued).

Year	Author(s)	Title	Type of Data Used	Period of Analysis
NA*	Shaffer, Dunford, Langrish	Changes in Wisconsin's Non-Farm Private Employment 1962-1972: A Shift and Share Analysis	Employment	1962-1973

Summary: Although employment grew by 30 percent in Wisconsin during the decade, the state experienced both negative industry mix and regional share values when compared to the United States. Shift-share analysis is used to describe employment trends in all the Wisconsin counties in order to measure their contribution to the state's overall negative outlook. Comparisons of SMSA to non-SMSA counties as well as five regional groups of counties are presented.

****

1976	Edwards	Industrial Structure and Regional Change: A Shift-Share Analysis of the British Columbia Economy 1961-1970	Employment	1961-1970

Summary: Using manufacturing employment in Canada as the reference industry, this study examines changes in manufacturing employment in each province. British Columbia is described in more detail; the shift-share analysis is disaggregated temporally (by annual time periods), structurally (by 20 industry goups under manufacturing) and spatially (by the 10 census regions). It is suggested that the shift-share results be used to identify those regions which may require economic assistance.

****

* Date not available.

Table 1. Review of Shift-Share Applications in Chronological Order (continued).

Year	Author(s)	Title	Type of Data Used	Period of Analysis
1977	Andrikopoulos	Regional Growth Differential in Manufacturing Employment: The Case of the Province of Ontario, Canada	Employment	1961-1973

Summary: Employment in manufacturing industries in the province of Ontario is analyzed in relation to the reference region, Canada. Ontario is the only province which experienced a positive industry mix component due to its high concentration of export-oriented industries (defined as those with location quotients greater than one). Ontario's unfavorable regional share component may indicate that other provinces (British Columbia and Alberta) are able to compete successfully with Ontario for manufacturing industries. The pattern of annual changes (denoted by the sign of each shift-share component) is presented on an industry-by-industry basis.

****

1979	Petrulis	Regional Manufacturing Employment Growth Patterns	Employment	1967-1973

Summary: The study describes employment growth patterns experienced in 21 manufacturing industries among different metro and nonmetro areas and the nine census regions in the U.S. Two patterns appeared: U.S. industrial growth seems to be moving from metro to nonmetro areas and jobs shifted to the South and West at the expense of the nation's Northwest and Midwest regions.

****

Table 1. Review of Shift-Share Applications in Chronological Order (continued).

Year	Author(s)	Title	Type of Data Used	Period of Analysis
1980	Blair, Mabry	Regional Crime Growth-An Application of the Shift-Share Technique	Crime Statistics	1970-1975

Summary: Using data depicting actual number of crimes by seven different crime types, shift-share analysis is employed in the analysis of regional crime growth among four regions in the U.S. (South, North Central, West, and Northeast) in relation to the nation as a whole. Examination of the industry mix component for each crime type reveals a shift away from violent crimes towards ones involving property. Analysis of the regional share component for each crime type indicates that the South, North Central and Northeast shares of violent crime decreased at the expense of the West, whose relative share of the increase in violent crime rose significantly.

****

NA*	Morentz, Deaton	An Analysis of the Local Economies of Montgomery, King and Queen, Goochland, and Prince Edward Counties Based on Shift-Share Analysis	Employment	1974-1978

Summary: Each of these counties in Virginia served as the study region while the nation was the reference region in this classical shift-share application.

* Date not available.

Conclusion

Since its introduction by Creamer [1942], the classical shift-share formulation has enjoyed extensive application in the analysis of regional growth patterns in many countries. In the past 20 years, concern with the theoretical short-comings of the technique motivated several regional analysts to investigate more thoroughly the implications of shift-share methodology. Identification of limitations of the classical shift-share formulation was accompanied by suggestions for improvements. The remaining section of the chapter is devoted to summarizing the body of literature which dealt with these issues.

Introduction to Limitations of the Classical Shift-Share Formulation

The classical shift-share equation is designed to decompose the growth of a regional variable such as income, employment, output, etc., into three effects which measure differential growth among study regions and a reference region.[8/] Given information on employment by industrial sectors for each study region at two points in time, shift-share analysis divides the change in a region's employment during the period of analysis (actual growth) into three components: standard growth, industry mix, and regional share. An algebraic description of the growth components is denoted in Figure 3.

8/ A literature review of the shift-share technique revealed only limitations dealing with the classical formulation and not the modified approach proposed by Kalbacher [1979], which is used in the thesis. Therefore, in this section, employment is used as the regional variable and the nation as the reference region. Both were used extensively in early shift-share descriptions and applications.

Actual growth minus standard growth equals net relative change

$S_i(s_i) - S_i(r)$ = net relative change which is divided into:

(a) Industry mix = $S_i(r_i - r)$ and

(b) Regional share = $S_i(s_i - r_i)$

Definition of notation:

S_i = base year employment for sector i, in study region

s_i = growth rate during period for sector i, in study region

r_i = growth rate during period for sector i, in reference region

r = growth rate during period for all sectors in reference region

Figure 3. The Classical Shift-Share Formulation.[a/]

[a/] Employment is used as the measure of economic activity.

Observation of the shift-share components reveals that actual growth is the sum of standard growth plus industry mix plus regional share, or algebraicly,

$$S_i(s_i) = S_i(r) + S_i(r_i - r) + S_i(s_i - r_i)^{9/}$$

This equation separates the increase (decrease) in a study region's employment in a specified period into (i) the change resulting from economic growth in the reference region, (ii) the change due to the type of economic activity in the study region relative to the reference regions, and (iii) the change resulting from growth characteristics of the study region's industries [Shaffer, Dunford, and Langrish].

Attention should be given to the fact that shift-share analysis is no more than a standardization procedure for decomposing the change of a regional variable. The technique is non-statistical as it is not possible to determine whether the calculated industry mix and regional share values are significantly different from zero. Thus, the shift-share equation is an identity rather than a behavioral model of regional growth. Herzog and Olsen [1977] emphasize that shift-share analysis is not intended to explain why the industry mix or regional share effect is positive in some regions and negative in others.

Criticisms to the classical shift-share formulation as revealed by past researchers, may be summarized in five categories. Each limitation is considered in the remaining sections of the literature review chapter.

9/ The reader is referred to Figure 3 for the definition of variables.

Interdependence Between the Industry Mix and Regional Share Components

The regional share component has been described as the dynamic element of change within a region by Ashby [1970]. However, examination of the regional share equation, $S_i(s_i - r_i)$, reveals that this value depends not only on the dynamic nature of the sector, $(s_i - r_i)$, but also on the concentration of the base year employment in that sector in the study region, S_i.[10/] Therefore, Herzog and Olsen [1977] argue that the industry mix and the regional share effects are interwoven: regional structure determines the magnitude of both values with the result that the regional share component is an impure measure of regional competitive advantage or disadvantage.

To solve the problem of interwoven effects, Esteban-Marquillas [1972] redefined the regional share component and created a fourth component, the allocation effect. The revised equation is based on a new element, b', which Esteban-Marquillas terms the homothetic employment. This element is defined as "the employment that sector i of region j would have if the structure of the employment in such a region were equal to the national structure" [Esteban-Marquillas, 1972, p. 251]. Another way of stating this is that b' is the employment that region j would have in the i^{th} sector if the location

---

10/ The notation is as previously defined: S_i, base year employment for i^{th} sector in the study region; s_i, growth rate during period for the i^{th} sector in the study region; and r_i, growth rate for i^{th} sector in the reference region.

quotient for this sector in the region were equal to one [Herzog and Olsen, 1977].[11/]

Using the previously defined symbols, where b' is homothetic employment in sector i of region j, an algebraic description of the revised regional share equation is given:[12/]

$$b' = S(R_i/R) = R_i(S/R)$$

$$\text{Regional share} = b'(s_i - r_i)$$

Expressing the regional share component in this manner leaves a portion of regional growth unexplained. This becomes the fourth component, the allocation effect, and is computed by:

$$\text{Allocation effect} = (S_i - b')(s_i - r_i).$$

11/ Briefly, the location quotient is a tool for comparing a region's percentage share of a particular activity with its percentage share of some basic aggregate. Using employment in sector i in the nation is a base, the location quotient for industry i in a given region is:

$$\frac{S_i/R_i}{S/R} \quad \text{or} \quad \frac{S_i/S}{R_i/R}$$

where S_i = employment in i^{th} sector in a given region; S = employment in all sectors in the same region, R_i = employment in i^{th} sector in the nation; and R = employment in all sectors in the nation. Regional literature suggests that those industries with a location quotient greater than unity represent the areas of strength within a region. Use of the location quotient to identify the export and import industries of a region requires serious qualifications. The reader is referred to Isard [1960, pp. 123-126] for a detailed study of the limitations.

12/ The definition of two elements (R_i, R) not previously noted in this section are: R_i, base year employment for i^{th} sector in the reference region and R, base year employment for all sectors in the reference region.

Therefore the shift-share equation becomes: actual growth equals the sum of standard growth plus industry mix plus regional share plus the allocation effect, or algebraicly,

$$S_i(s_i) = S_i(r) + S_i(r_i - r) + b'(s_i - r_i) + (S_i - b')(s_i - r_i).$$

According to Esteban-Marquillas [1972], the use of homothetic employment instead of effective employment results in purging the industry mix component of the influence of the regional share effect. The allocation effect then accounts for the residual unexplained regional growth. The sign of the total allocation value (computed by summing up the allocation effects of the individual sectors) reveals whether or not the specific study region specialized in those sectors in which it enjoys better competitive advantages. On the other hand, if the region is not specialized in a given sector ($S_i - b' = 0$), or if it does not enjoy any competitive advantage ($s_i - r_i = 0$), the allocation effect is zero; this sector does not contribute to the region's growth through this component.

An empirical application utilizing the definition of homothetic employment proposed by Esteban-Marquillas [1972] to calculate the regional share and the added allocation effects was accomplished by Herzog and Olsen [1977]. The shift-share approach was used to describe employment change between 1960 and 1970 for the eight economic regions in the United States as defined by the Regional Economic Analysis Division, U.S. Department of Commerce. The Great Lakes region was the only one found to have a positive allocation value. Since a positive allocation component implies correct regional struc-

ture, it was questioned why so few regions had an employment distribution consistent with regional competitive advantage. Further investigation revealed that the inconsistencies were due to a weighting problem —— no account was made of structural change occurring during the period of analysis. Recall that S_i refers to base year employment for the i^{th} sector in the study region; no reference is made to terminal year employment in the i^{th} sector.

Herzog and Olsen [1977] conclude that although the new formulation does expand the analytic properties of shift-share, interpretations based on empirical implementation are sensitive to the temporal representation of regional structure. Following another economist's view on the limitation of interwoven effects, is the section which presents a detailed analysis of the problem encountered in the empirical work undertaken by Herzog and Olsen [1977].

Stilwell [1970] observes that the industry mix effect will normally be understated because of the influence of interindustry linkages and multiplier effects. A region which has below-average representation in the reference region's industries would be expected to perform relatively poorly in industries supplying intermediate products used in those sectors. By having a depressing effect on the growth of regional employment, this slow growth will result in downward multiplier effects via its impact on aggregate demand.

The economic interpretation of the regional share component is noted as a "unique estimate of the impact on regional growth of industry mix" [Stilwell, 1969, p. 166]. By regarding the regional share value as a minimum estimate of the effect on growth in employment by industry mix, the problem of interdependence among the two

components is avoided [Mackay, 1968; Stilwell, 1969]. This may not be particularly helpful in some circumstances; however, where the regional share effect is small relative to the industry mix value, it may be reasonable to conclude that industry mix was the main cause of regional growth differentials.

To determine the magnitude of the regional share value, Stilwell [1969] suggests that regression analysis is necessary. The size of the regional share component, as revealed in the analysis of historical data, may be explained by independent variables likely to be causally related with that value, i.e., distance from market centers, quality of infrastructure, financial inducements offered by local or national government to locate in the different regions and so on. Stilwell notes that it is possible to include the value of the industry mix component as an independent variable. This would deal with the criticism that the size of the regional share value depends in part upon the industry mix component because of the existence of multiplier effects. There is a built-in check of the validity of this procedure in that the size of the regression coefficient associated with the industry mix value should approximate the value of the regional multiplier minus unity [Stilwell, 1970].

Changes in the Industrial Structure in the Study Region During the Period of Analysis

Shift-share analysis describes change in an economic variable, such as employment, over a specified period of time. This leads to the second area of criticism relating to this technique: no account is made for changes in the overall industrial structure in the study

region during the period of analysis. Specifically, the calculation of the industry mix component does not consider the growth occurring in the individual sector in the study region. When shift-share component totals are determined for a particular region, the weights used to represent the industrial structure of a period are the values of base year employment in the individual sectors. If structural changes occur between the base and terminal year of the analysis, changes in employment may result from factors that are not captured and described by the shift-share method [Herzog and Olsen, 1977; Houston, 1967; Morentz and Deaton; Stilwell, 1970].

The industry mix component reflects the extent to which the study region, in the base year, specialized in those industries which during the period grew at or above-average rates in the reference region. A situation where this assumption is unrealistic may occur in a region which specialized in nationally declining industries at the start of the period of analysis, and then modifies its structure during the period such that it can no longer be unfavorable in light of national trends [Stilwell, 1969]. A method of dealing with the problem of differential change affecting a region's industrial structure within the time period of analysis is suggested by Stilwell [1969]. Prior to describing the Stilwell modification to shift-share analysis, a review of past proposals suggested for identification of a region's structural change during the analysis period is summarized.

Stilwell [1969] notes that several previous authors have proposed remedies for this technique's defect. Fuchs suggested that one use a measure based on the average of results obtained using the structure in the base and the terminal years. In doing this, Fuchs

observes that one no longer can sum the industry mix and regional share components to reflect comparative gain or loss for the region. Dunn likens this problem to that of index numbers: the longer the period from the base year, the larger the bias resulting from changes in the weighting. Thirwall examined the change in the industry mix component by dividing the time interval into two subperiods and applying shift-share analysis to each one. Noting the resulting industry mix values, Thirlwall would assume that the region was favorably modifying its industrial structure if the value was positive in both periods. The drawback to this proposal is more empirical than conceptual. Data is needed for at least three separate years. Stilwell [1969] advocates the use of four subperiods and the examination of the industry mix component resulting from the four separate shift-share calculations. This requires information for five separate years and the volume of calculations is considerable.

Stilwell [1969] proposed an improvement in the shift-share methodology in order to take account of the fact that industrial structure in some regions improves while that in others deteriorates over the period between the base and terminal years of analysis. This refinement recognizes the influences of regional specialization and changes in industry mix during this period. Using the nomenclature already presented in this paper, Stilwell proposed the following:

(1) Compute the reverse industry mix value (RIM). This is the same as the ordinary industry mix (IM) component in the classical shift-share equation except that:

(a) the terminal rather than the base year employment is utilized, and

(b) the growth rate applied to this terminal year employment is the national all industry rate (r) less the growth rate for the specific sector in the nation (r_i). Using the previously defined symbols, one notes: Traditional industry mix = $S_i(r_i - r)$; S_i is the base year employment for sector i in the study region.

Proposed reverse industry mix = $S_i'(r - r_i)$; S_i' is the terminal year employment for sector i in the study region. The reverse industry mix represents the net shift in employment one would have expected in light of the study region's final industrial secture. The industry mix effect traditionally computed shows the expected shift resulting from the study region's initial structure.

(2) The industry mix value obtained from traditional shift-share is subtracted from the reverse industry mix value. The difference so computed is called the industry mix modification (IMM). In symbols, RIM - IM = IMM.

(3) The industry mix modification is subtracted from the regional share value to obtain the residual regional share (RRS), and added to the industry mix value to obtain the reverse industry mix (RIM).

An algebraic summary should clarify Stilwell's refinement to the traditional shift-share equation:

$$SG + IM + RS = AG$$

$$SG + (IM + IMM) + (RS - IMM) = AG$$

$$SG + (IM + \underbrace{(RIM - IM)}_{IMM}) + (RS - \underbrace{(RIM - IM)}_{IMM}) = AG$$

$$SG + RIM + RSS = AG$$

where

SG = standard growth,

IM = industry mix,

RS = regional share,

AG = actual growth or total change in the regional variable,

IMM = industry mix modification,

RIM = reverse industry mix, and

RRS = residual regional share.

The existence of the industry mix modification indicates the net shift resulting from there being a difference between the initial and final industrial structure of employment in the region. Note that the industry mix modification indicates only whether or not the region has improved its mix relative to the reference region; it does not reveal whether or not a region has improved its industrial mix in absolute terms. Therefore, the sign and magnitude of this component in any region shows the effect of change in the industry mix of the region relative to the modification of the industry mix in the nation as a whole. A positive value indicates that the study

region modified its industrial structure during the period of analysis so as to specialize more in the industries in which employment is growing rapidly in the reference region. The study region's industrial composition has allowed it to take advantage of national trends which could be a result of the region having a comparative advantage in the reference region's growth industries and a comparative disadvantage in the reference region's declining industries. The focus is really on what is happening to the regional composition of each industry rather than on the industrial composition of each region [Chalmers, 1971]. A negative industry mix modification value indicates the opposite occurring: the study region is specializing in declining reference region industries and reducing its specialization in the national growth industries. Before one can conclude that the study region is facing a bleak future, further analysis is necessary. A region may be better off specializing in nationally static industries for which it has comparative advantage than by encouraging growing industries at the reference region level but for which the study region is less suited. Therefore, the industry mix modification helps to identify areas not yet suffering from declining employment shares, but perhaps likely to do so in the future [Stilwell, 1969].

Both Stilwell [1969] and Randall [1973] observe that care should be exercised in reaching conclusions when different measures of economic activities are used. For example, when using employment rather than output in analyzing regional growth, industries enjoying increases in productivity which result in labor-saving will appear to be 'faring poorly' in terms of employment growth. Nevertheless,

Stilwell [1969] argues that the industry mix modification component is a valid guide to further analysis; it does indicate whether the region's industry mix is becoming more or less favorable to regional growth.

Ashby [1970] agrees that Stilwell's proposed modification helps detect regional changes in industrial structure but he argues that this can be achieved in a more logical manner. Consider the expression (SG + RIM + RRS = AG).[13/] The following is observed by Ashby:

(a) the term SG remains a function of the initial base year exclusively,

(b) the term RIM becomes a function of the terminal year exclusively, and

(c) the term RRS is based on the difference between an initially based component, RS, and the dually based (RIM - IM). Therefore this value is a function of both initial and terminal years.

It is Ashby's contention that if a change in base year is to occur, then it is more logical that the base for all components be shifted simultaneously and to the same degree. Albeit Ashby does not claim to define an optimal base (whatever base is used can be optimal only in respect to a particular analytical perspective), he urges that a completely consistent base be established with respect to whatever temporal viewpoint is taken.

13/ The reader may recall that SG refers to standard growth; RIM, reverse industry mix; RRS, residual regional share; AG, actual growth; IM, industry mix; and RS, regional share.

An empirical shift-share application using the modification proposed by Stilwell [1969] and improved by Ashby [1970], revealed inconsistent results in a shift-share study of Northeast Thailand [Chalmers, 1971]. Northeast Thailand production is heavily concentrated in rice, a slow growing sector at the national level. The Northeast region was able to expand its production of rice more rapidly than the rest of Thailand, i.e., this region is increasing its concentration in a slow growing sector relative to the rest of the country. Stilwell [1969] states that a region tending to increase its specialization in nationally slow growing industries is indicative of a negative industry mix modification value. In actuality, this calculated value for Northeast Thailand was positive [Chalmers, 1971]. In a later article written by Edwards, Harniman and Morgan [1978], the authors agree with Chalmers that an error had occurred in Stilwell's proposed modification. The problem arises because the reverse industry mix component "is expressed in terms of initial year employment and not of terminal year employment and therefore the reverse industry mix value reflects the employment in the initial year in terms of the industry mix in the terminal year" [Edwards, Harniman, Morgan, 1978, p. 99].

Chalmers [1971] suggests an alternative measure which correctly identifes whether a region is making relative improvements in its ability to take advantage of national growth trends. Recall that the regional share component reveals if the region is acquiring an increasing share of the industry. Furthermore, note that the difference between the rate of growth of the industry at the national level and the rate of growth of all industries (r_i - r) as revealed

in the calculation of the industry mix value, tells whether the industry in question is a fast or slow grower. Chalmers [1971] proposes to weight each regional share component by this difference, to obtain a measure of relative mix modification (MM) for each region. Thus, $RS_i(r_i - r) = MM$. The sum of the relative mix modification components across regions for a given industry is zero, and therefore the sum of these components across regions for all industries will also equal zero. This measure allows the industry mix and regional share values to be weighted in such a way that it can be determined whether the net effect of these shifts is to generate an improvement in the industrial structure of a region relative to that occurring in other regions. Chalmers [1971] did not attempt an empirical application of his improvement.

Further review of the literature did not reveal any empirical applications based on the modification proposed by Chalmers [1971]. Past shift-share applications have employed time periods of analysis from between five and ten years in length.[14/] In all of these studies it was assumed that the length of the study period chosen was not long enough to allow for major structural changes in the region's industrial sectors. As one author observes, "...it is necessary to choose a time period sufficiently long for basic trends to become apparent, although not so long that significant breaks in trend are concealed within it" [Randall, 1973, p. 3].

14/ The length of analysis period assumed in individual shift-share studies is noted in Table 1 in the first segment of this chapter. Table 1 presents a summary of classical shift-share applications in chronological order.

Sensitivity of Results to the Level of Data Disaggregation Used

The third area of concern encountered in shift-share analysis relates to the fact that the relative size of the industry mix and the regional share values are not invariant with disaggregation.[15/] The sum of either component for the disaggregated data is unlikely to equal that same component measured from aggregated data. For a given region, as the number of industrial sectors is increased, the regional share value will tend to vanish. Assuming the nation as the reference region, Houston [1967] observes that in general, since the national growth component is invariant with disaggregation, as one disaggregates, competitive position, as related by the regional share coefficient and the most important in explaining long-run growth, will tend to decline in importance, and the industry mix value to gain in importance. Houston [1967] does acknowledge Ashby's claim that shift-share analysis is invariant with regional disaggregation; given a specific number of industrial sectors, the shift-share components computed for a state will exactly equal the sum of the shift-share components for all counties in the state [Ashby, 1968].

Related to this concern is the level of aggregation appropriate for the shift-share application. Buck [1970] asserts that the finer the level of industrial classification, the more accurate the results of the shift-share analysis. For example, the use of data reported

15/ Note that this concern is not unique to shift-share analysis. Location quotients, used as an indirect measure of a region's exports, will reveal greater and greater exports from a region the finer the level of disaggregation.

at the two or three digit Standard Industrial Classification (SIC) code level would highlight structural differences within a region which would not be revealed if analysis were done using the broad industrial classification present at the one-digit SIC code level. Stilwell [1970] strongly refutes Buck's predisposition for finer levels of industrial groups. Such detailed disaggregation tending toward the equation of firms with industries, would reduce the regional share component to zero. Stilwell [1970] submits that the secondary use of the shift-share analysis determine the appropriate level of disaggregation to use. Broader groupings may be more useful as a general guide to the sectoral distribution of the regional share component, especially because problems of classifying individual firms into industries increase as the sectoral groupings become finer.[16/]

Use of the Nation as a Reference Region

The procedure used in shift-share analysis divides the change in a variable depicting regional economic activity in a particular sector into three exhaustive components related to standard growth, industry mix and regional share. The fourth criticism directed at shift-share methodology concerns the standard growth component, i.e., the use of the United States average as the basic standard for comparison [Brown, 1969; Craig, 1959; Houston, 1967].

16/ In most any type of regional analysis, the availability of data will dictate the degree of disaggregation used. Because of non-disclosure rules, data for sectors beyond the one-digit SIC code level is not available in many counties. The modified shift-share analysis of the Oregon counties, presented in this research, is based on data reported at the one-digit SIC code level. Thus, no account is made of regional specialization within an industry grouping.

To be theoretically correct, when using the nation as a reference region, one should only apply shift-share analysis to industries serving a national market. This requires identifying just which of the region's industries are national which can be difficult [Houston, 1967]. Brown [1969] identifies the correct base of a regional industry as the area that surrounds the industries that supply the same market. Using this base, the residual regional share component left after subtracting the total industry growth can be given a more clear interpretation: a value that shows how a region's industry has grown compared to its competitors.

Ashby [1968, p. 424] justifies using the nation as the reference region with the following argument:

> "comparisons of growth performances in particular industries in particular regions are helpful both with national aggregates and the national industry performance levels. Much of the utility of such comparisons arises from having a common standard of reference even though there is no absolute normative action about such a standard."

Houston [1967] continues to argue that there is excessive dependence on what happed in the nation as opposed to the region. An examination of the shift-share equation reveals that only the size of the regional share value, which is a residual, does not depend on the reference region.

Policy Implications Drawn from Shift-Share Results

The remaining limitation to shift-share analysis concerns the policy conclusions drawn from the results. The separation and analysis of historical data into industry mix and regional share

share values has been regarded as valuable to policy makers because the policies appropriate to a region growing slowly as the result of an unfavorable industrial structure are said to be different from those appropriate to regions suffering because of negative competitive advantage (a negative regional share value). It has been argued that the cure for a negative industrial mix component is a direct injection of growth industries and the cure for a negative regional share value are improvements in the region's infrastructure [Shaffer, Dunford, Langrish; Stilwell, 1970]. This over-simplification should be avoided: a region whose growth is lagging because of a negative competitive advantage could improve its relative position as a result of an injection of growth industries. Similarly, improvements in a region's infrastructure could improve a region lagging behind because of a negative industrial mix value [Buck, 1970; Stilwell, 1969, 1970].

Conclusion

Shift-share analysis has very little contribution to make to the theory of regional growth. Care should be exercised in interpreting the results — the primary role of this technique is as a framework for further analysis. As Randall [1973] observes, the main value of shift-share analysis is its ability to draw attention to features of regional performance which merit further investigation.

Taking into consideration the limitations to the classical shift-share formulation discussed in this section, Chapter III introduces a modified approach proposed by Kalbacher [1979]. The de-

scription of the Oregon economy is based on this new version. To clarify the distinction between the classical and modified shift-share formulations, a shift-share analysis of Benton County utilizing both approaches is presented in the next chapter.

CHAPTER III

A MODIFIED VERSION OF THE CLASSICAL SHIFT-SHARE FORMULATION

Introduction

In the past, several variants of shift-share analysis have been proposed to increase its descriptive and explanatory value. As illustrated in the previous chapter, the majority of the suggested modifications to the classical shift-share identity either produced additional theoretical inconsistencies or yielded contradictory results in empirical settings [Chalmers, 1971; Edwards, Harniman and Morgan, 1978; Esteban-Marquillas, 1972; Herzog and Olsen, 1977; Stilwell, 1969, 1970].

Also indicated in the previous chapter is that criticisms concerning the shift-share approach to regional analysis are usually based on a misunderstanding of its purpose. It is misleading to suggest that this standardization technique provides the analyst with a comprehensive theory of regional growth [Bishop and Simpson, 1972]. Shift-share analysis does, however, focus attention on the important issue of describing differential changes, either spatially, structurally or temporally. As one researcher observes, "...when used descriptively to measure economic structure and change in a region against some norm, shift-share is both useful and viable" [Kalbacher, 1979, p. 12].

Taking into account the limitations to the classical shift-share formulation, as reviewed in the latter segment of Chapter II,

the modified approach suggested by Kalbacher [1979] is selected to provide an ex-post description of the Oregon economy for the time period, 1973 to 1978.[1/] This proposed variant provides a comparative measure of industrial composition not present in the classical formulation.[2/] Similar to prior shift-share applications, the research assumes that major structural changes in the region's industries have not occurred during the six year period chosen for analysis. The Pacific Northwest egion, which includes the tates of Idaho, Washington, and Oregon, is determined as the reference economy. County planning agents may find information concerning each Oregon county's (or industry's) position relative to the Pacific Northwest, rather than the nation as a whole, more appropriate.

A spatial perspective underlies the modified shift-share description of the 12 major industrial sectors in each of the 36 Oregon counties presented in this research. The main data source is income data available at the county level from the Bureau of Economic Analysis (BEA).

A brief history of the income data utilized to measure the economic activity of an Oregon county is described in the first segment of this chapter. The second section presents a comparison

---

1/ This modified formulation of the shift-share methodology was empirically tested by Kalbacher [1979]. Utilizing employment data for nine industrial sectors, she applies this version in her comparison of nonmetropolitan counties with predominantly black populations (50 percent or more) in nine southern states to the designated reference economy consisting of all the nonmetropolitan counties in the nine southern states.

2/ Paris [1970] introduces but does not empiricize the notion of sectoral weights, i.e., the relative weight of a sector's income (employment) to total income (employment) in both the study and the reference regions. The according revisions made in the calculation of the standard growth, industry mix and regional share components coincide with those suggested by Kalbacher [1979].

between the classical shift-share fomulation and the modified shift-share model proposed by Kalbacher [1979]. Actual income data for the 12 sectors in Benton County is used to clarify the calculations involved in both approaches. The intent of the example is to accentuate the conceptual differences between both formulations. The modified shift-share results for the 12 industrial sectors in each of the 36 Oregon counties are presented in Appendix A.

A Measure of Economic Activity

This thesis describes patterns in income changes in 36 counties and 12 industrial sectors in Oregon during the years 1973 to 1978. This period was selected because it begins and ends in non-recession years. Although the length of time may not be long enough to examine long-term growth trends, it is sufficient to eliminate short-run fluctuations in economic activity.

Economic activity of an area can be measured many ways, i.e., employment, value-added, income wages and salaries, and population. Each reflects a different dimension of the economy. The majority of past applications of shift-share analysis utilized employment data, although Bretzfelder [1970] and Curtis [1972] are among the few who used income data. Due to the recent availability of consistent income data published annually by the Regional Economic Measurement Division of the Bureau of Economic Analysis (BEA), this study utilized income data (specifically, labor and proprietors' income) in the descriptive analysis of the Oregon economy.

For regional economic measurement, income is recorded either

by place of work (where earned) or place of residence (where received). By definition, the category termed personal income, is a measure of income received.

There are six major categories of personal income payments: wages and salary disbursements, other labor income, proprietors' income, rental income of persons, dividends and personal interest income, transfer payments and personal contributions for social insurance. The sum of three of these categories of income payments (wage and salary disbursements, other labor income, and proprietors' income) is termed labor and proprietors' income and is presented for 12 major industry groups [Local Area Personal Income: 1973-1978, A Summary, 1980].

The measure labor and proprietors' income that the BEA presents for industry in states, counties and SMSAs reflects place of work. The bulk of the income data necessary to preparing the estimates of labor and proprietors' income is reported by the industry in the county in which the business establishment is located. Therefore, these estimates are useful for the analysis of the industrial structure of a given area.

To protect against the inadvertant disclosure of confidential information, the BEA releases estimates at the one-digit Standard Industrial Classification (SIC) code level. Sectors included are: (1) Farm, (2) Agricultural Services, Forestry, Fisheries, and Other, (3) Mining, (4) Construction, (5) Manufacturing (Durable and Nondurable Goods), (6) Transportation and Public Utilities, (7) Wholesale Trade, (8) Retail Trade, (9) Finance, Insurance, and Real Estate, (10) Services, (11) Federal Government (Civilian and Military), and

(12) State and Local Government.

Components of Regional Economic Growth

As in the classical shift-share approach, the modified version uses characteristics of a selected reference economy as a norm for comparisons and accounts for differences in actual and standard growth in terms of industry mix and regional share. Both the classical and the modified versions of shift-share analysis explicitly divide regional economic growth into three components: standard growth, industry mix, and regional share. Although similar interpretations apply to the terms common to both versions, the standard growth and the industry mix components are defined differently in the modified version. Traditionally, results are presented as absolute numbers, either as number of jobs when employment data was used or in dollar amounts when income data was used in the analysis. As Kalbacher [1979] points out, this makes direct comparisons between regions and time periods difficult. In the modified approach proposed by Kalbacher [1979], the results are expressed as percentages to make interregional and intertemporal comparisons easier. The modified version also includes a comparative measure of industrial composition not present in traditional shift-share.

Both variants require the same data. An algebraic description comparing the two versions and an explanation of the individual elements in the equations are given in Figure 4. As previously stated, actual income data for Benton County will be used to clarify the calculations in both approaches. Attention is focused on the Agricultural Services, Forestry, Fisheries and Other (ASFF) sector.

Classical Approach

Actual growth minus standard growth equals net relative change

$S_i(s_i) - S_i(r)$ = net relative change which is divided into:

(a) Industry mix: $S_i(r_i - r)$

(b) Regional share: $S_i(s_i - r_i)$

Modified Approach

Actual growth minus standard growth equals net relative change

$\frac{S_i}{S}(s_i) - \frac{R_i}{R}(r_i)$ = net relative change which is divided into:

(a) Industry mix: $r_i\left(\frac{S_i}{S} - \frac{R_i}{R}\right)$

(b) Regional share: $\frac{S_i}{S}(s_i - r_i)$

Note that S refers to the region under study and R to the reference economy:

S_i = Base year income for sector i, in study region

S = Base year income for all sectors in study region

s_i = Growth rate during period for sector i, in study region

s = Growth rate during period for all sectors in study region

R_i = Base year income for sector i, in reference region

R = Base year income for all sectors in reference region

r_i = Growth rate during period for sector i, in reference region

r = Growth rate during period for all sectors in reference region

Figure 4. Algebraic Comparison Between the Classical and Modified Versions of Shift-Share Analysis.

The necessary data for Benton County, the region under study, and the Pacific Northwest, the reference region, is presented in Table 2.

Net Relative Change

The first step in a shift-share application is to determine the differential regional growth or net relative change, the difference between a region's actual and standard growth. This is the amount by which a county's growth in income between 1973 and 1978 is above or below the norm established by the reference economy, the Pacific Northwest.

In the classical shift-share formulation, standard growth in the i^{th} sector in the study region reveals what the growth in income would have been if change had occurred at the average rate of expansion in the reference region. The following equation yields the classical net relative change component for the i^{th} sector, where aggregate growth is standard.[3/]

$$\text{Net relative change}_i = S_i(s_i) - S_i(r)$$

Using actual income data, that part of Benton County's net relative change attributable to the Agricultural Services, Forestry, Fisheries, and Other (ASFF) sector is computed as:[4/]

[3/] Refer to Figure 4 for definitions of the notation used.

[4/] In all examples, income data is presented in thousands of dollars. In the classical formulations, income values are rounded to the nearest whole dollar while percentages are rounded to the second decimal place in the modified shift-share calculations.

Table 2. Data for Classical and Modified Versions of Shift-Share Analysis: Benton County.

Sector	Income in the Reference Region Pacific Northwest			Income in the Study Region Benton County		
	1973	1978	Growth Rate 1973-1978	1973	1978	Growth Rate 1973-1978
	Thousands		Percent	Thousands		Percent
1) Farm	1,712,529	1,947,383	13.71	5,819	7,251	24.61
2) Agricultural Services, Forestry, Fisheries, and Other	159,630	410,614	157.23	1,193	2,621	119.70
3) Mining	81,912	178,474	117.89	181	405	123.76
4) Construction	1,587,287	3,511,604	121.23	7,853	15,660	99.41
5) Manufacturing	5,601,627	10,272,061	83.38	29,735	71,662	141.00
6) Transportation and Public Utilities	1,876,786	3,307,777	76.25	7,939	13,402	68.81
7) Wholesale Trade	1,569,262	3,114,974	98.50	2,956	7,237	144.82
8) Retail Trade	2,822,257	4,932,823	74.78	17,399	32,776	88.38
9) Finance, Insurance, and Real Estate	1,146,801	2,475,854	115.89	4,841	12,785	164.10
10) Services	3,450,866	6,972,116	102.04	24,146	52,344	116.78
11) Civilian and Military Federal Government	1,669,145	2,607,261	56.20	11,552	17,962	55.49
12) State and Local Government	3,170,658	5,257,787	65.83	47,595	80,077	68.25
TOTAL INCOME:	24,848,760	44,988,728	81.05	161,209	314,182	94.89

SOURCE: Local Area Personal Income: 1973-1978, A Summary, Bureau of Economic Analysis, U.S. Department of Commerce (1), July 1980.

$$\text{Net relative change}_{ASFF} = 1193(1.197) - 1193(.8105)$$

$$= 1428 - 967 = 461 \text{ (or \$461,000)}$$

In the modified approach, the standard growth component is computed somewhat differently. Specific industry growth rates in the reference economy are used instead of the aggregate growth rate. Therefore, the modified shift-share equation for the i^{th} sector in a study region, where industry growth is the standard, is:

$$\text{Modified net relative change}_i = \frac{S_i}{S}(s_i) - \frac{R_i}{R}(r_i)$$

For each sector in the county, the actual change in income between 1973 and 1978 (s_i) is weighted by the contribution that sector makes to total county income in the base year, 1973 ($\frac{S_i}{S}$). Likewise, the standard growth refers to the change in income experienced by each sector in the reference region (r_i) during the same time period, weighted by the contribution that sector makes to total reference economy income in the base year ($\frac{R_i}{R}$). The sign of the net relative change value depends on whether the specified sector in the study region grew faster (positive) or slower (negative) than in the reference economy during the same period. The sectoral weights determine the magnitude of the net relative change component as well as its sign. For example, the net relative change value for the ASFF sector in Benton County is computed as follows:

$$\text{Modified net relative change}_{ASFF} = \frac{1193}{161,209}(1.197) - \frac{159,630}{24,848,760}(1.5723)$$

$$= .0074\ (1.197) - .0064\ (1.5723)$$

$$= .0089 - .0101 = -.0012 \text{ (or } -.12\%)$$

Based on the classical version, if the ASFF sector had changed at the rate that the Pacific Northwest economy experienced (81.05 percent), income in this sector would have increased by $967,000. However, the Benton County ASFF sector sustained a 119.7 percent increase in income between 1973 and 1978 (actual growth was $1,428,000). The net of these two figures ($461,000) measures that part of overall net relative change attributable to the ASFF sector in Benton County. This component is similarly calculated for the remaining sectors; results are presented in Table 3.

Because the ASFF sector's growth in Benton County (119.7 percent) failed to keep pace with that attained by the ASFF sector in the Pacific Northwest (157.23 percent), the net relative change component related by the modified approach, is negative. The negative differential growth is only slightly offset by the fact that the ASFF sector accounts for slightly more of Benton County's income (.74 percent) than it does in the Pacific Northwest region (.64 percent).

In the modified version, each component of the equation is in percentage form to facilitate direct comparisons between regions and time periods. Therefore, that part of Benton County's net relative change traceable to the ASFF sector (-.12 percent) is computed as the difference between the sector's contribution to overall county growth (actual growth is .89 percent) and to that of the Pacific Northwest (standard growth is 1.01 percent). As previously indicated, this negative net relative change value reveals that the ASFF sector in Benton County fell short of the norm established by that sector in the Pacific Northwest. This negative

Table 3. Classical Shift-Share Components for Benton County, 1973-1978.

Sector	Pacific Northwest[a]			Benton[a]			Shift-Share Components[a/b]				
	Standard Income 1973	Standard Income 1978	Percentage Change 1973-1978	County Income 1973	County Income 1978	Percentage Change 1973-1978	Actual Growth	Standard Growth	Net Relative Growth	Industry Mix	Regional Share
1) Farm	1,712,529	1,947,383	13.71	5,819	7,251	24.61	1,432	4,716	- 3,284	-3,918	634
2) Agricultural Services, Forestry, Fisheries and Other	159,630	410,614	157.23	1,193	2,621	119.70	1,428	967	461	909	- 448
3) Mining	81,912	178,474	117.89	181	405	123.76	224	147	77	67	10
4) Construction	1,587,287	3,511,604	121.23	7,853	15,660	99.41	7,807	6,365	1,442	3,155	- 1,713
5) Manufacturing	5,601,627	10,272,061	83.38	29,735	71,662	141.00	41,926	24,100	17,826	693	17,133
6) Transportation and Public Utilities	1,876,786	3,307,777	76.25	7,939	13,402	58.81	5,463	6,435	- 972	- 381	- 591
7) Wholesale Trade	1,569,262	3,114,974	98.50	2,956	7,237	144.82	4,281	2,396	1,885	516	1,369
8) Retail Trade	2,822,257	4,932,823	74.78	17,399	32,776	88.38	15,377	14,102	1,275	-1,091	2,366
9) Finance, Insurance, and Real Estate	1,146,801	2,475,854	115.89	4,841	12,785	164.10	7,944	3,924	4,020	1,686	2,334
10) Services	3,450,866	6,972,116	102.04	24,146	52,344	116.78	28,197	19,570	8,627	5,068	3,559
11) Civilian and Military Federal Government	1,669,145	2,607,261	56.20	11,552	17,962	55.49	6,410	9,363	- 2,953	-2,871	- 82
12) State and Local Government	3,170,658	5,257,787	65.83	47,595	80,077	68.25	32,484	38,576	- 6,092	-7,244	1,152
TOTAL	24,848,760	44,988,728	81.05	161,209	314,182	94.89	152,973	130,661	22,312	-3,411	25,723

[a] Income figures and shift-share components are expressed in thousands of dollars. Growth rates are rounded to the second decimal place.

[b] Due to rounding, some of the expressed equalities did not exactly balance. In such cases, results were adjusted to compensate for rounding error.

differential growth may be due to an unfavorable industry mix component or to adverse growth characteristics of the ASFF sector as exhibited by a negative regional share component, or due to a combination of both effects.

Differential growth values for the additional sectors are similarly derived and are presented in Table 4. Analogous to the classical approach, the net relative change component for Benton County may be obtained either by summing individual values for the sectors or by applying aggregate county data to the equations. Examination of Table 4 reveals that Benton County's growth rate exceeded that of the Pacific Northwest by 13.83 percent during this period of analysis. This occurred in spite of the preponderance of sectors which experienced a negative net relative change value. The important contribution of both Manufacturing and State and Local Government [Oregon State University] sectors to Benton County's economy should be emphasized.

Both approaches indicate that Benton County enjoyed a positive net relative change component for this period, although examination of both Tables 3 and 4 reveals that different sectors contributed to the favorable net differential change for each version. The contribution of the industry mix and regional share components to Benton County's favorable position is the topic of the next two sections.

Industry Mix

The industrial sectors in the study region and the growth status of the corresponding sectors in the reference economy underlies the industry mix component in both versions. While the industry mix

Table 4. Modified Shift-Share Components for Benton County, 1973-1978.

Sector	Pacific Northwest[a]			Benton[a]			Shift-Share Components[b]				
	Standard Income 1973	Standard Income 1978	Percentage Change 1973-1978	County Income 1973	County Income 1978	Percentage Change 1973-1978	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	1,712,529	1,947,383	13.71	5,819	7,251	24.61	.89	.94	- .05	- .45	.40
2) Agricultural Services, Forestry, Fisheries and Other	159,630	410,614	157.23	1,193	2,621	119.70	.89	1.01	- .12	.16	- .28
3) Mining	81,912	178,474	117.89	181	405	123.76	.14	.39	- .25	- .26	.01
4) Construction	1,587,287	3,511,604	121.23	7,853	15,660	99.41	4.84	7.75	- 2.91	- 1.84	- 1.07
5) Manufacturing	5,601,627	10,272,061	83.38	29,735	71,662	141.00	26.00	18.79	7.21	- 3.42	10.63
6) Transportation and Public Utilities	1,876,786	3,307,777	76.25	7,939	13,402	68.81	3.39	5.76	- 2.37	- 2.00	- .37
7) Wholesale Trade	1,569,262	3,114,974	98.50	2,956	7,237	144.82	2.66	6.23	- 3.57	- 4.42	.85
8) Retail Trade	2,822,257	4,932,823	74.78	17,399	32,776	88.38	9.54	8.50	1.04	- .43	1.47
9) Finance, Insurance, and Real Estate	1,146,801	2,475,854	115.89	4,841	12,785	164.10	4.92	5.34	- .42	- 1.87	1.45
10) Services	3,450,866	6,972,116	102.04	24,146	52,344	116.78	17.49	14.17	3.32	1.11	2.21
11) Civilian and Military Federal Government	1,669,145	2,607,261	56.20	11,552	17,962	55.49	3.98	3.78	.20	.25	- .05
12) State and Local Government	3,170,658	5,257,787	65.83	47,595	80,077	68.25	20.15	8.4	11.75	11.04	.71
TOTAL	24,848,760	44,988,728	81.05	161,209	314,182	94.89	94.89	81.06	13.83	- 2.13	15.96

[a] Income figures are expressed in thousands of dollars. Growth rates are rounded to the second decimal place.

[b] Shift-share components are expressed in percentage form rounded to the second decimal place. Due to rounding, some of the expressed equalities did not exactly balance. In such cases, results were adjusted to compensate for rounding error.

values in both shift-share approaches describe a given region's industrial composition, the way in which growth attributed to this component is distributed among sectors differs between versions.

In the classical shift-share formulation, a region's growth due to the industry mix component occurs because a region has a favorable distribution of fast-growing industries, i.e., those whose growth at the reference level exceed the aggregate reference region growth rate. This component reflects a region's mix of rapid- or slow-growth industries and is the summation of the industry mix value derived for each sector in the study region.

Traditionally, the industry mix component for the i^{th} sector is calculated by multiplying the base year sector income by the difference in the growth rate of that sector at the reference level and the aggregate growth rate experienced by the reference region:

$$\text{Industry Mix}_i = S_i(r_i - r)$$

For the Agricultural Services, Forestry, Fisheries and Other (ASFF) sector in Benton County, this value equals:

$$\text{Industry mix}_{ASFF} = 1193\ (1.5723 - .8105)$$
$$= 909\ (\text{or } \$909{,}000)$$

The ASFF sector in the Pacific Northwest sustained a bigger percentage increase in income during this period than did the Pacific Northwest economy as a whole, which accounts for the positive industry mix value for the ASFF sector in Benton County. Values for the remaining sectors are similarly calculated and presented in Table 3. The summation of the values for the individual sectors yields the total industry

mix component for Benton County; this cannot be computed from aggregate county data. Although the majority of the county's industries grew at a faster rate than the aggregate at the Pacific Northwest level, the unfavorable impact of the State and Local Government sector played a major role in the county's negative industry mix value, as computed by the classical approach.

As the traditional industry mix formulation does not consider the industrial composition in both the study and reference regions, Kalbacher [1979] includes a comparative measure of industrial composition in the modified version. For the i^{th} sector in the study region, this value is computed as:

$$\text{Modified industry mix}_i = r_i\left(\frac{S_i}{S} - \frac{R_i}{R}\right)$$

The difference in income proportions in each sector explicitly reveals those industries in the county with greater or less than the standard volume of activity. Kalbacher [1979] indicates that these sectors are the ones which most influence the study region's growth vis-a-vis other regions. This influence will be positive when base year sector income is proportionately greater in the study region and negative when less, than the proportion of that same sector in the reference economy in the base year. This difference is weighted by the growth rate of the specific sector in the reference region. This weight, combined with the difference in proportions, determines the magnitude of the mix value. Thus, the sign of the industry mix component depends on whether the industry is relatively more or less concentrated in the county as compared to the Pacific Northwest and whether reference industry growth was positive or negative during

the period. Following the modified approach, the industry mix value for the ASFF sector in Benton County is computed as:

$$\text{Modified industry mix}_{ASFF} = 1.5723 \left(\frac{1193}{161,209} - \frac{159,630}{24,848,760}\right)$$

$$= 1.5723 \ (.0074 - .0064)$$

$$= .0016 \ (\text{or } .16\%)$$

Because of its greater contribution to total Benton County income (as compared to its performance in the Pacific Northwest), the ASFF sector accounted for a positive .16 percent of the overall Benton County growth experienced between 1973 and 1978 (94.89 percent).

In summary, the industry mix component for a study region, as computed by the classical formulation, measures the difference in income due to differences in growth rates among sectors at the reference region level. A county's performance, as measured by this component, indicates how much of the local growth is due to having more (or less) rapidly growing industries than the reference region.

In contrast, the use of sectoral weights in the modified shift-share approach leads to a divergent interpretation of the industry mix component. Rather than comparing industry growth rates at the reference region level, proportions of that sector to total county and Pacific Northwest income, respectively, are considered. Attention should be focused on the fact that a fast-growing industry (in the reference region) can only contribute to a county's favorable industry mix component if that sector accounts for a larger proportion of county income than it does in the reference region. Consider a sector whose share of county income is less than its share of Pacific Northwest income. The modified industry mix

value will be negative and the extent to which that sector detracts from the county's rate of change depends on that sector's rate of growth at the reference level. Therefore, a fast-growing sector, under-represented in the study region will have a negative impact on the county's overall industry mix value.

The modified industry mix value for a county equals the sum of the products for each sector, of the sectoral growth rate in the reference region multiplied by the difference in the relative weights of the sector in the study region and the reference region [Paris, 1970]. Thus the total industry mix component for Benton County is attained by the summation of each sector's value. Similar to the classical industry mix component, it cannot be computed from the aggregate data. As revealed in Table 4, the ASFF sector was only one of four sectors (the others being Services, Federal Government, and State and Local Government) which experienced a positive industry mix value to help offset Benton County's overall negative industrial composition for this period. Only these sectors contributed more, proportionately, to total Benton County income growth than their counterparts in the Pacific Northwest. One may conclude that Benton County's negative industry mix component decreased the county's growth rate by 2.13 percent to 94.89 percent for this five year period. Because this is still greater than the 81.05 percent standard growth component, an examination of the regional share component is necessary in order to account for the differential growth or net relative change value of 13.83 percent sustained by Benton County during the period of analysis.

Regional Share

The third factor which accounts for differential rates of growth is the regional share component, which relates the change in income due to differences between study and reference region growth rates in each sector. The only variation between the two versions is that this difference is weighted by the specific sector's base year income in the classical approach, while the modified formulation utilizes that sector's proportion of total base year income in the study region as the weight. Either approach yields the same conclusion: an industry that is growing faster in a region than its counterpart in the reference region will add to the study region's overall growth [Dutrow, 1972].

The regional share value for the i^{th} sector in a study region is computed by the classical version as:[5/]

$$\text{Regional share}_i = S_i(s_i - r_i)$$

For the Agricultural Services, Forestry, Fisheries and Other (ASFF) sector, the amount of income accounted by this component is:

$$\text{Regional share}_{ASFF} = 1193\ (1.197 - 1.5723)$$
$$= -488\ (\text{or } -\$448{,}000)$$

5/ Another way of looking at the regional share component is that it is the residual value after standard growth and industry mix have been subtracted from the actual growth sustained by the specified sector in the study region during the period of analysis. This holds true for both the classical and modified versions.

The regional share equation for the i^{th} sector in the study region following the modified approach is:

$$\text{Modified regional share}_i = \frac{S_i}{S}(s_i - r_i)$$

The sector's growth rate in the study region is compared with its rate in the reference economy and weighted by the income ratio in the base year. The regional share effect is thus stronger for sectors with either a large proportion of county income or a large favorable difference between the sectoral growth rate in the county over that experienced in the Pacific Northwest. Continuing with the ASFF sector, this component examines the difference in the growth rate in this sector experienced in Benton County and the Pacific Northwest and weighs this difference by the contribution of the ASFF sector to total Benton County income in 1973:

$$\text{Modified regional share}_{ASFF} = \frac{1193}{161,209}\ (1.197 - 1.5723)$$

$$= .0074\ (-.38)$$

$$= -.0028\ (\text{or } -.28\%)$$

Both approaches indicate that the ASFF sector in Benton County failed to keep pace with the standard established by that sector in the Pacific Northwest. This poor growth performance relates a loss in income of $448,000 by the classical formulation, and a lowering of the regional growth rate by .28 percent by the modified version.

For both shift-share formulations, Benton County's overall regional share component is calculated by adding up the individual sector values. Similar to the total county industry mix value, the

regional share component cannot be calculated from aggregate data except by using footnote 5/ in this chapter. Results are presented in Table 3 for the classical approach and in Table 4 for the modified formulation suggested by Kalbacher [1979]. The regional share component for the county indicates the region's competitiveness with other counties for a given industry. This overall total reveals whether more of the county's activity is concentrated in sectors growing faster (positive value) or slower (negative value) than their counterparts in the Pacific Northwest. Locational advantages (vis-a-vis other counties) indicate the existence of some regional comparative advantage available to Benton County industries. This may result from a variety of factors, some peculiar to only one or a few industries. As Petrulis [1979] notes, these factors may include natural resource endowments, government subsidy and tax policies, ease of access to final and intermediate markets, economies of scale, and availability and prices of various factors of production.

Examination of the regional share values derived by either version reveals the importance of the Manufacturing sector to Benton County's overall positive regional share component. Between 1973 and 1978, income in the Manufacturing industry increased by 141.0 percent which greatly exceeds the 83.38 percent growth standard established by this sector in the Pacific Northwest. Both approaches show four sectors in Benton County not surpassing the growth rates set by their counterparts in the Pacific Northwest: Agricultural Services, Forestry, Fisheries and Other, Construction, Transportation and Public Utilities, and the Federal Government sectors. The re-

maining industries all contributed to Benton County's favorable regional share component.

Results

Between 1973 and 1978, personal income in the ASFF sector in the Pacific Northwest grew by $250,984,000. This 157.23 percent increase made this sector the fastest growing industry in the Pacific Northwest region, the reference economy in this shift-share application. Income growth in the ASFF sector in Benton County did not keep up with the large gain sustained by its counterpart in the Pacific Northwest. During the same five year period, income in this sector for Benton County increased by 119.7 percent or $1,428,000.

In calculating the net relative change component, the classical version compares the growth rate in the ASFF sector in Benton County (119.7 percent) to the rate of expansion experienced by the Pacific Northwest region as a whole during the period (81.05 percent). By traditional shift-share, therefore, the ASFF sector gained $461,000 which was due to a favorable industry mix value ($909,000) and offset by an adverse regional share value (-$448,000). On the other hand, the modified approach reveals an outward shift of income and measures this loss in terms of the effect on the growth rate rather than by an actual loss in income. Benton County's overall growth rate was .12 percent less because of the concentration and growth in the ASFF sector which lagged behind its counterpart in the Pacific Northwest. This loss traces to a favorable industry mix value of .16 percent which is offset by an adverse regional share value of -.28 percent.

As a final point, the results of the modified approach may be converted to actual dollar amounts, by multiplying base year total income in the study region by the appropriate percentage. For instance, applying the net relative change effect for the ASFF sector in Benton County (-.12 percent or -.0012) to overall county income in 1973 ($161,209,000) yields actual income loss of $193,000, compared with a gain of $461,000 computed by the classical formulation. Actual income figures may be computed for each component at the sector and aggregate levels by the same procedure. As Kalbacher [1979] notes, all income figures at the aggregate level obtained by converting relative results equal those derived from the traditional analysis, but at the sector level, only those for actual growth and regional share are equivalent.[6/] Table 5 presents actual income figures for the 12 sectors in Benton County based on the modified version.

Conclusion

Taking into account the limitations of the classical shift-share formulation discussed in the latter section of Chapter II, a modified approach to shift-share analysis suggested by Kalbacher [1979] is introduced in this chapter. To underscore conceptual dif-

---

6/ As indicated in the description of the calculations involved in the modified approach, all the percentages are rounded to the second decimal place. When multiplied with Benton County's base year income ($161,209,000), the resulting income figure was rounded to the nearest whole dollar. This accounts for the discrepancies between individual sector actual growth and regional share values as well as the aggregate level components computed by both approaches.

Table 5. Converted Results of the Modified Shift-Share Analysis for Benton County.

Sector	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	1,435	1,515	- 80	- 725	645
2) Agricultural Services Forestry, Fisheries, and Other	1,435	1,628	- 193	258	- 451
3) Mining	226	629	- 403	- 419	16
4) Construction	7,803	12,494	- 4,691	- 2,966	- 1,725
5) Manufacturing	41,914	30,291	11,623	- 5,513	17,136
6) Transportation and Public Utilities	5,465	9,286	- 3,821	- 3,224	- 597
7) Wholesale Trade	4,288	10,043	- 5,755	- 7,125	1,370
8) Retail Trade	15,379	13,703	1,676	- 693	2,369
9) Finance, Insurance, and Real Estate	7,931	8,608	- 677	- 3,015	2,338
10) Services	28,195	22,843	5,352	1,789	3,563
11) Civilian and Military Federal Government	6,416	6,094	322	403	- 81
12) State and Local Government	32,484	13,542	18,942	17,797	1,145
TOTAL	152,971[a/]	130,676[a/]	22,295[a/]	- 3,433[b/]	25,728[c/]

a/ Figure may be obtained by applying aggregate data to the appropriate equation or summing values for the individual sectors.

b/ Figure may only be obtained by summing values for the individual sectors.

c/ Figure may either be obtained by summing values for the individual sectors or by subtracting both the standard growth and industry mix components from the actual growth component.

NOTE: Due to rounding, column sums may not exactly equal independently computed totals. Some of the expressed equalities did not exactly balance; in such cases, the results were adjusted to compensate for rounding error. Income figures are expressed in thousands of dollars.

ferences, a shift-share analysis of Benton County for the period 1973 to 1978 is conducted utilizing both methodologies.

This chapter concludes the first segment of the research which served to familiarize the reader with the technique of general shift-share analysis. The remainder of the thesis is concerned with the analyses of the modified shift-share results for the Oregon economy between 1973 and 1978.

CHAPTER IV

MODIFIED SHIFT-SHARE RESULTS FOR THE OREGON ECONOMY

Introduction

For the period of analysis, 1973 to 1978, a spatial perspective underlies the descriptive analysis of each of the 36 Oregon counties. Income changes during the six year study period in the 12 industrial sectors are described within the context of the modified shift-share approach advocated by Kalbacher [1979]. The Hewlett-Packard 41C calculator was utilized in the derivation of the modified shift-share results for the individual Oregon counties presented in Appendix A. Currently, a program written by the author for the APPLE II_+ micro-computer is available. The latter program is listed in Appendix B.

In the present chapter, the results of the modified shift-share analysis of the Oregon economy are summarized. For the spatial shift-share analysis, a classification scheme based on the values (positive or negative) of the shift-share components is utilized to clarify each county's status. It is significant to emphasize that modified shift-share analysis is a study of relative change. All comparisons are with the rate of change established by the Pacific Northwest region during the six year period of analysis and discussions of a county's performance are with reference to that base. Recall that the reference region includes the states of Idaho, Oregon, and Washington.

As noted, the categorization of each county based on the values of the two components relating differential change, i.e., the industry

mix and regional share components, is detailed in this chapter. Sectors contributing favorably (adversely) to the individual county's present position are identified. It is anticipated that the strengths and weaknesses of each county, as revealed in the individual county profiles, may allow the regional investigator to identify more effectively the forces behind regional economic growth. Although these summary statistics only apply to the period of analysis, 1973 to 1978, description of a county's past performance in terms of income changes in the 12 sectors may contribute to a more realistic appraisal of its future growth prospects. Since the performance of the individual county is relative to the Pacific Northwest region as a whole, a description of population and income change in the reference region is presented prior to the individual county profiles.

Economic Change in the Pacific Northwest Region, 1973-1978

In the past decade, social scientists have been concerned with the population turnaround or flow of people from large, industrial and urban cities to small cities and rural areas. In a study of population migration, Fuguitt and Voss [1979] described an accelerated regional shift of people from the industrial Northeast and the agricultural heartland of the United States to the South and to the West. In this research, interest centers on the Pacific Northwest region which includes the states of Idaho, Oregon, and Washington. Specific emphasis is given to the change in population and income in the state of Oregon as compared to the Pacific Northwest region.

Between 1973 and 1978, population increased by 10.4 percent in

the Pacific Northwest region. This represents two and one-half times the national rate of population growth. Table 6 reveals the breakdown among the three states.

Similar to the Pacific Northwest region, Oregon's population grew at a rate two and one-half times the national average during this period. In these six years, the number of people in the state increased by 224,000. Net migration accounted for two-thirds of the gain. The remaining one-third of Oregon's population growth is attributed to natural increase —— births minus deaths [Oregon 2000 Report, 1980].[1/]

As shown in Figure 5, population growth varies widely among Oregon counties. In general, population growth rates were highest in the Willamette Valley; Deschutes and Jefferson Counties in central Oregon; Josephine and Jackson Counties in southern Oregon; and the Northeastern counties bordering the Columbia River. Of the latter, Morrow County sustained the largest population increase (54.4 percent). In contrast, both Multnomah and Sherman Counties actually experienced a decline in population between 1973 and 1978.

There appears to be general agreement in the economic literature that regional growth usually implies increased income, an increase in jobs (to the extent that growth is not due to labor substituting technological development), increased demand for local

---

1/ The demographic equation for estimating the change in population is: Births - Deaths + Net Migration. Births - Deaths is fairly constant over time. Net migration refers to inmigrants-outmigrants.

Table 6. Population and Income Data for States in the Pacific Northwest Region, 1973 and 1978.

Area	Total Population[a]			Total Income		
	Thousands		Percent Change	Millions of Dollars		Percent Change
	1973	1978	1973-1978	1973	1978	1973-1978
United States	209,846	218,051	3.91	1,045,303	1,709,616	63.55
Pacific Northwest Region	6,430	7,096	10.36	24,849	44,988	81.05
Idaho	773	878	13.55	2,775	4,807	73.23
Oregon	2,220	2,444	10.08	8,540	15,415	80.5
Washington	3,437	3,774	9.79	13,534	24,766	82.99

[a] The Bureau of Economic Analysis uses Bureau of Census county population totals as of July 1, which are available for each year beginning with 1971.

SOURCE: Local Area Personal Income: 1973-1978, A Summary, Bureau of Economic Analysis, U.S. Department of Commerce (1), July 1980.

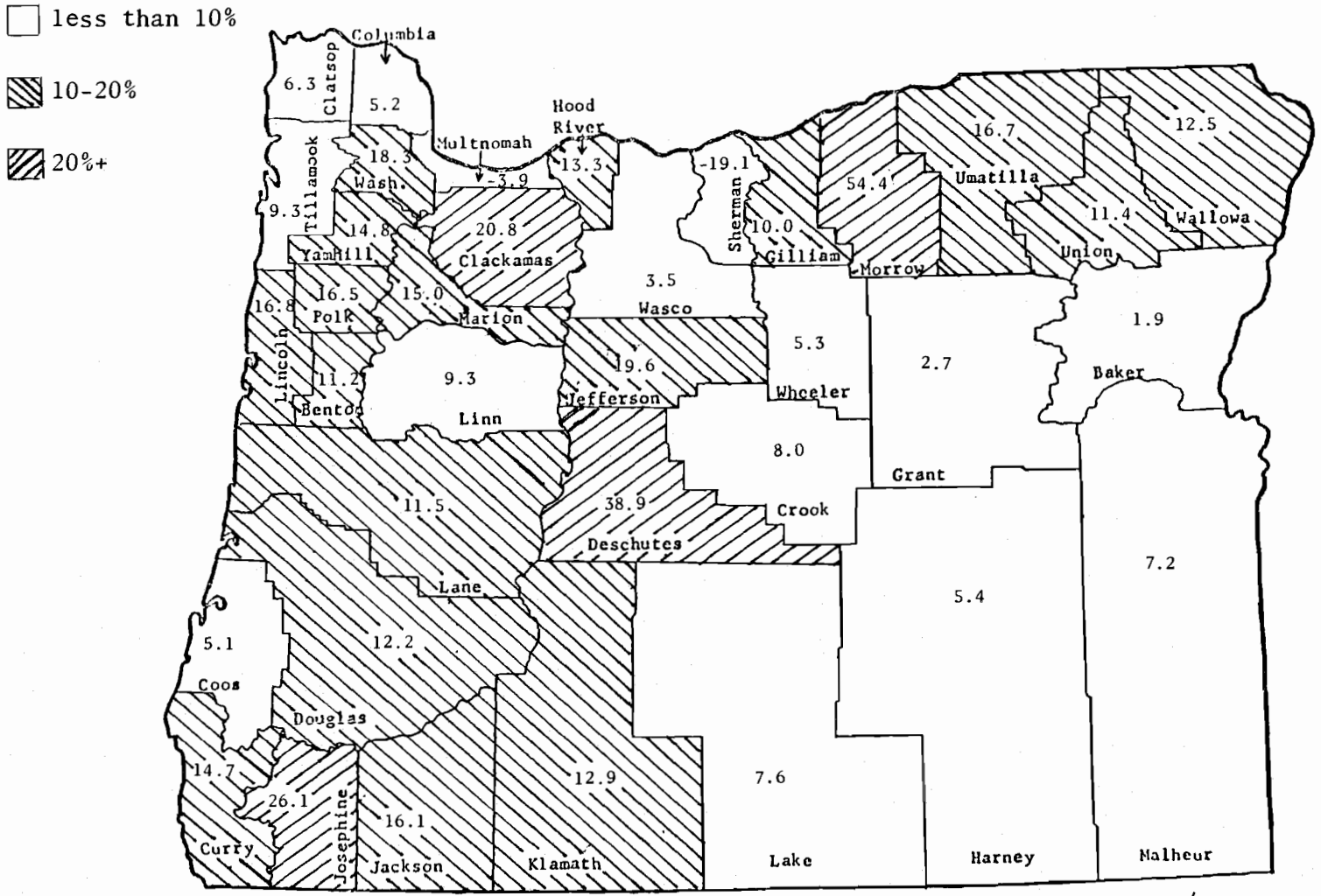

Figure 5. Percent Change in Population in Individual Oregon Counties, 1973-1978.[a/]

[a/] During this period, Oregon sustained a 10.1 percent increase, while population in the Pacific Northwest region increased by 10.4 percent.

business services and an expanded tax base.[2/] For the purpose of this research, specific attention is given to the change in income experienced by the Pacific Northwest region and the state of Oregon between 1973 and 1978.[3/] Table 6 reveals the increase in income experienced by the states of Idaho, Oregon, and Washington, which comprise the Pacific Northwest region. All three states exhibit a rate of income growth exceeding the United States average of 63.6 percent. Income in Oregon increased by 80.5 percent which is very close to the rate sustained by the Pacific Northwest region as a whole. A study of the map in Figure 6 reveals regional differences in the amount of income growth experienced by individual Oregon counties. When compared to the income increases in both Oregon and the Pacific Northwest region, almost half the Oregon counties (16 out of 36) sustained above-average increases in income. Two particular counties, Morrow and Washington, experienced an over 120 percent increase during the six year period, whereas Wheeler is the sole county to undergo a decrease in income by 14.3 percent.

Has the increase in population growth in individual Oregon counties been accompanied by increases in income? A comparison of Figures 5 and 6, depicting county location and the change in both population and income between 1973 and 1978, reveals that for the

---

[2/] Confidence in the population stabilizing influence of industrial growth has long been a cornerstone of rural development strategies. New industry presumably provides employment opportunities for attacting new residents and displaced agricultural workers; it also provides diversity in the economic base of communities [Fuguitt and Voss, 1979, pp. 16, 38-39].

[3/] The measure labor and proprietors' income, that the Bureau of Economic Analysis presents in industry detail for states, counties and SMSAs, consists of wage and salary disbursements, other labor income and proprietors' income.

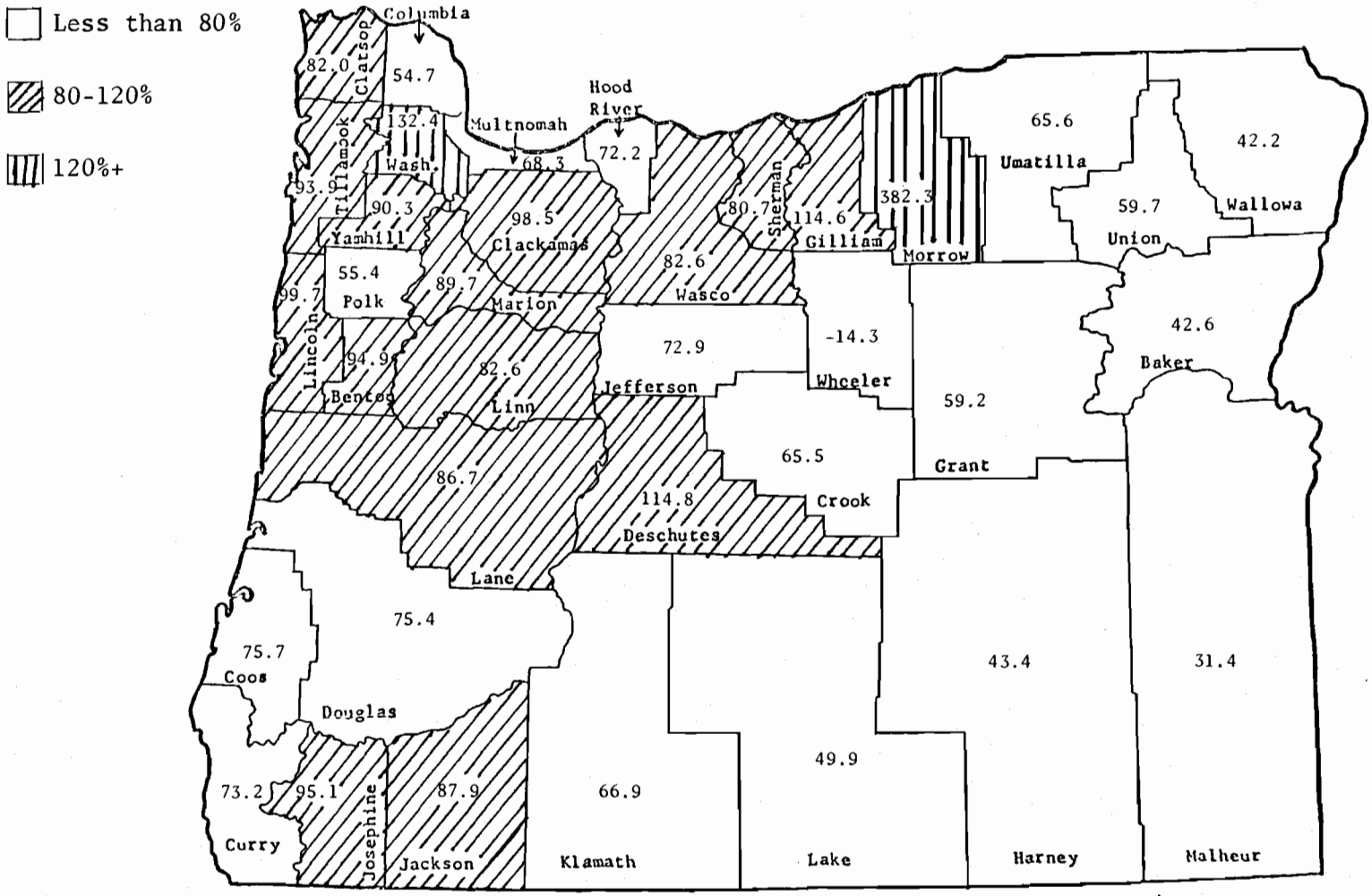

Figure 6. Percent Change in Income in Individual Oregon Counties, 1973-1978.[a/]

a/ During this period, income in Oregon increased by 80.5 percent, while the Pacific Northwest region experienced an 81.1 percent gain in income.

most part the answer is affirmative. Counties that tended to attract people are those which exhibit above-average increases in income, as one might expect. Of course, there are counties whose population and income performance do not fit this generalization.

Exceptions include Sherman County which maintained an above-average increase in income despite a 19.1 percent decrease in population. Gilliam County exhibits the fourth largest income gain, although its population only increased at an average rate. Clatsop, Linn, and Tillamook Counties all experienced above-average increases in income despite below-average increases in population.

On the other hand, several counties sustained above-average increases in population along with below-average increases in income. These counties include Curry, Douglas, Hood River, Jefferson, Klamath, Polk, Umatilla, Union, and Wallowa. Table 7 presents a summary of the Oregon counties in order of their rank in terms of both population and income change between 1973 and 1978.

As indicated earlier, income increased by 81.1 percent in the Pacific Northwest region during the six year period of analysis. Table 8 reveals the varying growth rates sustained by the 12 sectors. Also noted is the percent contribution the individual sector makes to total reference region income in both base and terminal years of the analysis period. Recall that the base value plays a significant role in the modified shift-share analysis. The Pacific Northwest region is utilized as the norm for comparison when determining each Oregon county's favorable (adverse) growth performance between 1973 and 1978. A tabulation of industry performances among the three states which are included in the Pacific Northwest region is presented

Table 7. A Ranking of Oregon Counties Based on Population and Income Percentage Changes Between 1973 and 1978.

Rank	Population	Growth Rate 1973-1978 (percent)	Income	Growth Rate 1973-1978 (percent)
1	Morrow	54.35	Morrow	382.32
2	Deschutes	38.93	Washington	132.39
3	Josephine	26.06	Deschutes	114.79
4	Clackamas	20.80	Gilliam	114.56
5	Jefferson	19.57	Lincoln	99.70
6	Washington	18.28	Clackamas	98.48
7	Lincoln	16.79	Josephine	95.11
8	Umatilla	16.67	Benton	94.89
9	Polk	16.53	Tillamook	93.88
10	Jackson	16.13	Yamhill	90.28
11	Marion	14.95	Marion	89.70
12	Yamhill	14.78	Jackson	87.89
13	Curry	14.71	Lane	86.73
14	Hood River	13.33	Linn	82.60
15	Klamath	12.93	Wasco	82.55
16	Wallowa	12.50	Clatsop	82.01
17	Douglas	12.22	Sherman	80.66
18	Lane	11.51	Coos	75.74
19	Union	11.43	Douglas	75.41
20	Benton	11.15	Curry	73.19
21	Gilliam	10.00	Jefferson	72.85
22	Tillamook	9.34	Hood River	72.22
23	Linn	9.31	Multnomah	68.31
24	Crook	7.97	Klamath	66.85
25	Lake	7.58	Umatilla	65.56
26	Malheur	7.17	Crook	65.50
27	Clatsop	6.27	Union	59.69
28	Harney	5.41	Grant	59.19
29	Wheeler	5.26	Polk	55.42
30	Columbia	5.16	Columbia	54.67
31	Coos	5.05	Lake	49.93
32	Wasco	3.45	Harney	43.44
33	Grant	2.67	Baker	42.62
34	Baker	1.92	Wallowa	42.18
35	Multnomah	- 3.87	Malheur	31.38
36	Sherman	-19.05	Wheeler	- 14.25
	OREGON	10.08	OREGON	80.50
	PACIFIC NORTHWEST REGION	10.36	PACIFIC NORTHWEST REGION	81.05

Table 8. Income Data for the Pacific Northwest Reference Region, 1973 and 1978.[a/]

Sector	Pacific Northwest Region				
	Income 1973	Percent of Total Income	Income 1978	Percent of Total Income	Growth Rate 1973-1978
1) Farm	1,712,529	6.89	947,383	4.33	13.71
2) Agricultural Services, Forestry, Fisheries, and Other	159,630	.64	410,614	.91	157.23
3) Mining	81,912	.33	178,474	.40	117.89
4) Construction	1,587,287	6.39	3,511,604	7.81	121.23
5) Manufacturing	5,601,627	22.54	10,272,061	22.83	83.38
6) Transportation and Public Utilities	1,876,786	7.55	3,307,777	7.35	76.25
7) Wholesale Trade	1,569,262	6.32	3,114,974	6.92	98.50
8) Retail Trade	2,822,257	11.36	4,932,823	10.96	74.78
9) Finance, Insurance, and Real Estate	1,146,801	4.61	2,475,854	5.50	115.89
10) Services	3,450,866	13.89	6,972,116	15.50	102.04
11) Civilian and Military Federal Government	1,669,145	6.72	2,607,261	5.80	56.20
12) State and Local Government	3,170,658	12.76	5,257,787	11.69	65.83
TOTAL	24,848,760	------	44,988,728	------	81.05

[a/] Income data refers to labor and proprietors' income presented for each sector at the state and county level by the Bureau of Economic Analysis. Income figures are expressed in thousands of dollars.

SOURCE: Local Area Personal Income: 1973-1978, A Summary, Bureau of Economic Analysis, U.S. Department of Commerce (1), July 1980.

in Table 9.

Patterns of County Income Change

The three components of change described by shift-share analysis provide different information useful in determining future economic direction for the individual Oregon county. The first component, the standard growth component, is the least useful to the county planning agent because it is based on the growth experienced by the particular sector in the Pacific Northwest region, which is beyond the influence of local citizens.[4/]

The remaining two components of change, industry mix and regional share, reflect local factors that cause a divergency between county and Pacific Northwest regional change. The industry mix component indicates the change in income due to the proportion of economic activity in the county relative to the Pacific Northwest region. Because every sector in the Pacific Northwest region changed at a positive rate, the sign of the county industry mix component depends solely on whether the region has an excess of industries accounting for more of county base year income than their counterparts of Pacific Northwest regional income in 1973. Therefore, a county weighted by sectors whose share of county income is less than its share of Pacific Northwest income, will exhibit a negative industry mix component. The reverse holds true for a positive industry mix component.

4/ Since every sector in the Pacific Northwest reference region sustained an increase in income between 1973 and 1978, the standard growth component is positive in all the shift-share results presented for the Oregon economy.

Table 9. Income Data for the States Comprising the Pacific Northwest Region, 1973 and 1978.[a/]

Sector	Oregon					Washington					Idaho				
	Income 1973	Percent of Total Income	Income 1978	Percent of Total Income	Growth Rate 1973-1978	Income 1973	Percent of Total Income	Income 1978	Percent of Total Income	Growth Rate 1973-1978	Income 1973	Percent of Total Income	Income 1978	Percent of Total Income	Growth Rate 1973-1978
1) Farm	408,557	4.78	487,677	3.16	19.37	786,692	5.81	1,002,850	4.05	27.48	517,280	18.64	456,856	9.50	- 11.68
2) Agricultural Services, Forestry, Fisheries, and Other	47,443	.55	120,494	.78	153.98	95,118	.70	255,691	1.03	168.82	17,069	.61	34,429	.72	101.71
3) Mining	21,230	.25	43,903	.28	106.80	25,030	.18	59,243	.24	136.69	35,652	1.29	75,328	1.57	111.29
4) Construction	555,594	6.51	1,087,822	7.06	95.79	830,368	6.13	2,007,250	8.10	141.73	201,325	7.26	416,532	8.66	106.90
5) Manufacturing	2,163,760	25.34	3,948,170	25.61	82.47	2,989,762	22.09	5,448,534	22.00	82.24	448,105	16.15	875,357	18.21	95.35
6) Transportation and Public Utilities	697,625	8.17	1,185,349	7.69	69.91	991,352	7.33	1,765,642	7.13	78.10	187,809	6.77	356,786	7.42	89.97
7) Wholesale Trade	599,287	7.02	1,132,659	7.35	89.00	837,536	6.19	1,684,741	6.80	101.15	132,439	4.77	297,574	6.19	124.69
8) Retail Trade	1,012,268	11.85	1,776,888	11.53	75.54	1,487,497	10.99	2,630,701	10.62	76.85	322,492	11.62	525,234	10.93	62.87
9) Finance, Insurance, and Real Estate	398,611	4.67	864,125	5.60	116.78	648,111	4.79	1,373,222	5.55	111.88	100,079	3.61	238,507	4.96	138.32
10) Services	1,188,614	13.92	2,359,525	15.31	98.51	1,909,341	14.11	3,891,821	15.71	103.83	352,911	12.72	720,770	14.99	104.24
11) Civilian and Military Federal Government	364,868	4.27	574,620	3.73	57.49	1,125,338	8.32	1,747,513	7.06	55.29	178,939	6.45	285,128	5.93	59.34
12) State and Local Government	1,082,100	12.67	1,833,960	11.90	69.48	1,808,147	13.36	2,898,835	11.71	60.32	280,411	10.11	524,992	10.92	87.22
TOTAL	8,539,957	------	15,415,192	------	80.51	13,534,292	------	24,766,043	------	82.99	2,774,511	------	4,807,493	------	73.27

[a/] Income data refers to labor and proprietors' income presented for each sector at the state and county level by the Bureau of Economic Analysis. Income figures are expressed in thousands of dollars.

SOURCE: Local Area Personal Income: 1973-1978, A Summary, Bureau of Economic Analysis, U.S. Department of Commerce (1), July 1980.

A county's regional share component relates whether the aggregate of industries in the county are growing faster or slower than their counterparts in the Pacific Northwest. A positive value implies the county has a comparative advantage and is capturing an increasing proportion of the reference region's income change in the industrial sectors located within the county. In other words, the positive regional share implies that a county is quite competitive in attracting industry within a particular sector to the area. The opposite occurs for a negative regional share value.

Table 10 presents the shift-share components, as calculated by the modified formulation suggested by Kalbacher [1979], for the individual Oregon counties. Note that each component is in percentage form and that the percent change in income experienced by each county between 1973 and 1978 is denoted by the actual growth component. Because relative measures tend to overstate the growth of areas with a small income base and understate the growth of areas with a large income base, it is useful to examine the shift-share components in terms of absolute income gained or lost rather than as an increase or decrease in the growth rate. Note that the same caveat applies to absolute measures which tend to overstate the growth of big areas and understate the growth of little areas. By multiplying base year income in each county by the appropriate percentage, the modified shift-share results may be converted to actual dollar amounts. These are presented in Table 11. Overstatement of the relative measure is especially evident in Morrow County. Although the county did experience a large increase in actual dollar income, it is by no means as large as the 382 percent change value would

Table 10. Modified Shift-Share Components for Oregon Counties, 1973-1978.[a]

	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
Baker	42.64	81.06	-38.42	-11.36	-27.06
Benton	94.89	81.06	13.83	- 2.13	15.96
Clackamas	98.49	81.06	17.43	3.29	14.14
Clatsop	82.03	81.06	.97	2.52	- 1.55
Columbia	54.69	81.06	-26.37	5.93	-32.30
Coos	75.74	81.06	- 5.32	1.34	- 6.66
Crook	65.32	81.06	-15.74	- 4.37	-11.37
Curry	73.19	81.06	- 7.87	.44	- 8.31
Deschutes	114.82	81.06	33.76	3.79	29.97
Douglas	75.43	81.06	- 5.63	1.78	- 7.41
Gilliam	114.56	81.06	33.50	-15.60	49.10
Grant	59.18	81.06	-21.88	-13.69	- 8.19
Harney	43.62	81.06	-37.44	-19.52	-17.92
Hood River	72.24	81.06	- 8.82	-10.88	2.06
Jackson	87.88	81.06	6.82	3.17	3.65
Jefferson	72.85	81.06	- 8.21	-16.42	8.21
Josephine	95.13	81.06	14.07	3.33	10.74
Klamath	66.85	81.06	-14.21	- 2.63	-11.58
Lake	49.93	81.06	-31.13	-18.65	-12.48
Lane	86.75	81.06	5.69	3.54	2.15
Lincoln	99.70	81.06	18.64	4.44	14.20
Linn	82.60	81.06	1.54	- 1.49	3.03
Malheur	31.39	81.06	-49.67	-19.69	-29.98
Marion	89.69	81.06	8.63	- 2.13	10.76
Morrow	382.33	81.06	301.27	-12.54	313.81
Multnomah	68.29	81.06	-12.77	7.04	-19.81
Polk	55.42	81.06	-25.64	-10.42	-15.22
Sherman	80.29	81.06	- .77	-18.77	18.00
Tillamook	93.85	81.06	12.79	- 4.86	17.65
Umatilla	65.60	81.06	-15.46	-14.66	- .80
Union	59.71	81.06	-21.35	- 6.86	-14.49
Wallowa	42.19	81.06	-38.87	-25.67	-13.20
Wasco	82.50	81.06	1.44	- 4.84	6.28
Washington	132.39	81.06	51.33	3.98	47.35
Wheeler	- 14.23	81.06	-95.29	-15.70	-79.59
Yamhill	90.28	81.06	9.22	- 7.49	16.71

[a] Shift-share components are expressed in percentage form rounded to the second decimal place. Due to rounding, some of the expressed equalities did not exactly balance. In such cases, results were adjusted to compensate for rounding error.

Table 11. Converted Shift-Share Components for Oregon Counties, 1973-1978.

County	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Baker	21,074	40,062	- 18,988	- 5,614	- 13,374
2) Benton	152,971	130,676	22,295	- 3,433	25,729
3) Clackamas	453,567	373,298	80,269	15,151	65,118
4) Clatsop	82,105	81,134	971	2,522	- 1,551
5) Columbia	48,550	71,959	- 23,409	5,264	- 28,673
6) Coos	150,770	161,360	- 10,590	2,667	- 13,257
7) Crook	27,490	34,114	- 6,624	- 1,839	- 4,785
8) Curry	31,652	35,056	- 3,404	190	- 3,594
9) Deschutes	147,051	103,814	43,237	4,854	38,383
10) Douglas	211,749	227,554	- 15,805	4,997	- 20,802
11) Gilliam	6,435	4,553	1,882	- 876	2,758
12) Grant	15,743	21,564	- 5,821	- 3,642	- 2,179
13) Harney	14,552	27,042	- 12,490	- 6,512	- 5,978
14) Hood River	39,027	43,792	- 4,765	- 5,878	1,113
15) Jackson	280,981	259,175	21,806	10,136	11,670
16) Jefferson	24,259	26,993	- 2,734	- 5,468	2,734
17) Josephine	102,905	87,685	15,220	3,602	11,618
18) Klamath	125,858	152,611	- 26,753	- 4,951	- 21,802
19) Lake	12,189	19,789	- 7,600	- 4,553	- 3,047
20) Lane	681,208	636,527	44,681	27,798	16,883
21) Lincoln	73,171	59,491	13,680	3,259	10,421
22) Linn	225,515	221,311	4,204	- 4,068	8,272
23) Malheur	31,702	81,867	- 50,165	- 19,886	- 30,279
24) Marion	514,713	465,187	49,526	- 12,224	61,750
25) Morrow	58,237	12,347	45,890	- 1,910	47,800
26) Multnomah	2,193,905	2,604,158	-410,253	226,169	-636,422
27) Polk	53,009	77,533	- 24,524	- 9,967	- 14,557
28) Sherman	6,076	6,135	- 59	- 1,421	1,362
29) Tillamook	50,285	43,432	6,853	- 2,604	9,457
30) Umatilla	115,619	142,867	- 27,248	- 25,838	- 1,410
31) Union	43,391	58,906	- 15,515	- 4,985	- 10,530
32) Wallowa	9,397	18,055	- 8,658	- 5,718	- 2,940
33) Wasco	55,925	54,949	976	- 3,281	4,257
34) Washington	701,139	429,295	271,844	21,078	250,766
35) Wheeler	- 1,047	5,967	- 7,014	- 1,155	- 5,859
36) Yamhill	113,858	102,230	11,628	- 9,446	21,074
OREGON	6,875,031[a]	6,922,488[a]	- 47,457[a]	182,417[b]	-229,874[c]

[a] Figure may be obtained by applying aggregate data to the appropriate equation or summing values for the individual sectors.

[b] Figure may only be obtained by summing values for the individual sectors.

[c] Figure may either be obtained by summing values for the individual sectors or by subtracting both the standard growth and industry mix components from the actual growth component.

NOTE: Due to rounding, column sums may not exactly equal independent computed totals. Some of the expressed equalities did not exactly balance; in such cases, the results were adjusted to compensate for rounding error. Income figures are expressed in thousands of dollars.

suggest. Figure 7 describes the location and performance of each county based on the sign of the two components reflecting differential change, industry mix and regional share, respectively.

The two major components representing differential income change may be classified into four categories according to the possible combinations of the signs of the industry mix and regional share values.[5/] Oregon counties are separated according to the classification of regional types noted in Figure 8, which also presents a review of the modified shift-share equation.

This section continues with the four-fold classification which summarizes the income growth patterns among the various counties in Oregon. Within each regional category is a table relating individual county profiles. Counties are listed in terms of their growth rate between 1973 and 1978 —— the fastest growing county in the particular regional category is noted first. Sectors are ranked in terms of their importance to each shift-share component. The first industry in each category represents the one contributing most favorably (adversely) to the particular component. Identification of each county's strengths and weaknesses during the six year analysis period provides the county planner with descriptive information necessary to preparing for future economic development (or decline).

5/ More elaborate classification schemes have been suggested in the past. For example, Ashby [1968] proposed seven categories and Stilwell [1969] utilized 14 classes. But, as Paraskevopoulos [1974] observes, such detailed classifications do not contribute significantly to the explanation of regional growth.

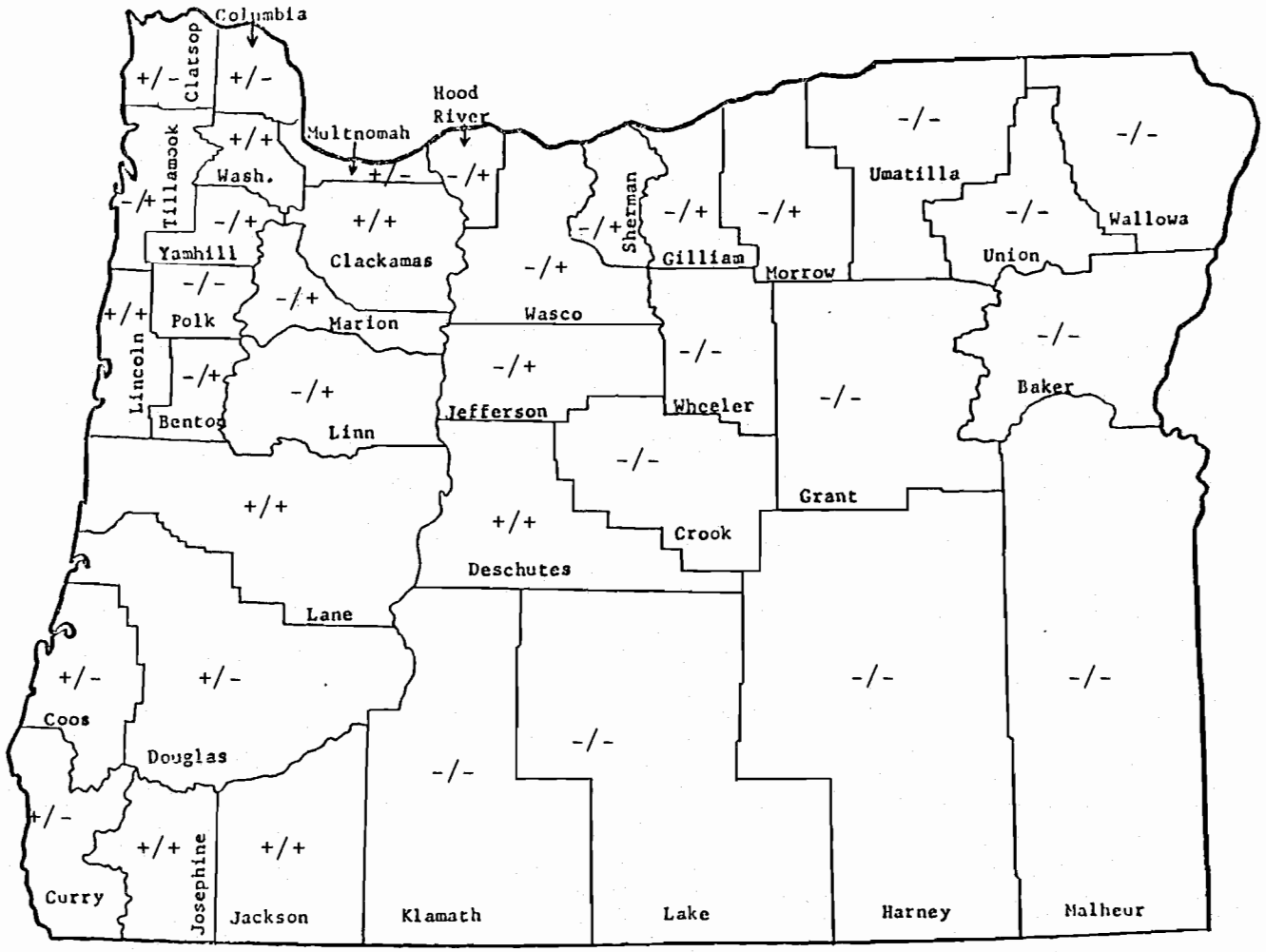

Figure 7. Sign of the County Shift-Share Components Reflecting Differential Change (Industry Mix/ Regional Share).

Regional Categories	Industry Mix	Regional Share
(I)	+	+
(II)	-	-
(III)	+	-
(IV)	-	+

Modified Shift-Share Equation

$$\text{Actual Growth}_i = \text{Standard Growth}_i + \text{Industry Mix}_i + \text{Regional Share}_i$$

$$\frac{S_i}{S}(s_i) = \frac{R_i}{R}(r_i) + r_i\left(\frac{S_i}{S} - \frac{R_i}{R}\right) + \frac{S_i}{S}(s_i - r_i)$$

S_i = base year income for sector i, in study region

S = base year income for all sectors in study region

s_i = growth rate during period for sector i, in study region

R_i = base year income for sector i, in reference region

R = base year income for all sectors in reference region

r_i = growth rate during period for sector i, in reference region

Figure 8. Classification of Regional Types.

Regional Category I

(positive industry mix; positive regional share)

Counties exhibiting high growth potential fall into this category. These areas are gaining in income in terms of both industry mix and regional share effects. Table 12 presents the salient characteristics of each of these counties while Figure 7 reveals their respective locations. As previously stated in this chapter, counties which experienced advantageous growth in income also were those exhibiting above-average increases in population (refer to Figures 5 and 6).

Each county's advantageous industrial composition is reflected by the favorable industry mix component. A relatively large positive industry mix value in a region reveals a preponderance of fast-growth industries which most influence the county's growth vis-a-vis other counties. Kalbacher [1979] notes that such regions tend to have a higher propensity for long-term growth than do regions with slower growing industries. In general, the Construction, Manufacturing and Retail Trade sectors were important in determining each county's favorable industry mix value.

This favorable industrial composition is accompanied by some local economic force that is reflected in the positive income gain measured by the regional share component. Recall that the regional share effect arises because some counties are expanding in certain sectors more rapidly than others due to locational advantages such as better access to markets or basic inputs. As noted in Table 12,

Table 12. Counties in Regional Category I (+ IM; + RS).

County[a/]	Total Population			Total Income			Standard Growth	Net Relative Change	Industry Mix	Regional Share	Sectors Contributing to the Net Relative Change Component[b/]		Sectors Contributing to the Industry Mix Component[b/]		Sectors Contributing to the Regional Share Component[b/]	
	Thousands		Percent Change	Thousands of Dollars		Percent Change	Percent				Favorably	Adversely	Favorably	Adversely	Favorably	Adversely
	1975	1978	1975-1978	1975	1978	1975-1978										
Washington	192.7	216.1	18.5	529,601	1,230,722	132.4	81.1	51.3	4.0	47.3	MFG; RT; C; SRVS	FED GOV; T&PU; ST& LOC GOV; ASFF	MFG; C; RT; MNG	FED GOV; T&PU; ST& LOC GOV; SRVS	MFG; RT; SRVS; WT	ASFF
Deschutes	37.5	52.1	38.9	126,071	275,085	114.8	81.1	33.8	3.8	30.0	RT; C; MFG; SRVS	FARM; ASFF	C; RT; FI&RE; MFG; T&PU	WT; SRVS; FED GOV; FARM	SRVS; MFG; RT; T&PU	FARM; ASFF
Lincoln	26.8	31.5	16.8	73,391	146,562	99.7	81.1	18.6	4.4	14.2	MFG; RT; ASFF; ST& LOC GOV	WT; T&PU; FED GOV; FI&RE	RT; ASFF; C; ST& LOC GOV	WT; FI&RE; FED GOV; SRVS	MFG; RT; ASFF; SRVS	C; T&PU; FED GOV; MNG
Clackamas	249.1	278.8	20.6	460,521	916,027	98.8	81.1	17.4	3.3	14.1	MFG; RT; SRVS; WT	T&PU; FED GOV; ASFF; MNG	C; MFG; RT; WT	T&PU; FED GOV; FI&RE; FARM	MFG; SRVS; RT; FI&RE	C; ASFF
Josephine	42.6	53.7	26.1	108,173	211,052	95.1	81.1	14.1	3.3	10.7	MFG; RT; SRVS; FARM	WT; FED GOV; C; T&PU	MFG; RT; ST&LOC GOV; C	WT; SRVS; FI&RE; FED GOV	MFG; SRVS; FARM; FI&RE	C; MNG; RT; FED GOV
Jackson	306.0	323.1	16.1	319,733	600,745	87.8	81.1	6.6	3.2	3.6	RT; SRVS; ST&LOC GOV; T&PU	FI&RE; C; FARM; MFG	MFG; RT; C; SRVS	FI&RE; WT; FED GOV; FARM	RT; WT; FED GOV; ST&LOC GOV	MFG; C; ASFF; SRVS
Lane	281.1	297.7	11.5	785,256	1,466,322	86.7	81.1	5.7	3.3	2.2	RT; ST&LOC GOV; SRVS; MFG	FED GOV; FI&RE; T&PU; FARM	MFG; RT; ST& LOC GOV; C	FED GOV; FI&RE; WT; FARM	SRVS; RT; ST&LOC GOV; WT	MFG; T&PU; MNG; C

a/ Counties are ranked based on the actual growth component starting with the one experiencing the largest percentage change in income.

b/ Sectors are ranked in order of importance to each shift-share component. The first sector in each category of four represents the one contributing most favorably (adversely) to each component. The remaining four sectors fall between both extremes.

The following sector abbreviations are used: (ASFF) Agricultural Services, Forestry, Fisheries and Other; (MNG) Mining; (C) Construction; (MFG) Manufacturing; (T&PU) Transportation and Public Utilities; (WT) Wholesale Trade; (RT) Retail Trade; (FI&RE) Finance, Insurance and Real Estate; (SRVS) Services, (FED GOV) Civilian and Military Federal Government; (ST&LOC GOV) State and Local Government.

both Manufacturing and Services sectors favorably influenced each county's regional share value.

Both the industry mix and regional share effects contributed to a very fast rate of economic expansion between 1973 and 1978 in the seven counties. Because this position indicates high growth potential in the county economy, it is preferred by county officials [Morentz and Deaton; Paraskevopoulos, 1974; Petrulis, 1979; Stilwell, 1970].

Regional Category II

(negative industry mix; negative regional share)

In contrast to the previous regional category, counties in this grouping exhibit stagnation or decline in income due to both adverse industry mix and regional share effects.[6/] As revealed in Table 13, exactly one-third of the Oregon counties fall into this unfavorable regional classification. The majority of counties are located in Eastern Oregon (see Figure 7) and with the exception of Klamath, Polk, Umatilla, Union and Wallowa Counties, they sustained below-average gains in population during the six year analysis period (refer to Figure 5).

Usually termed depressed counties, these areas have suffered income losses not only because of an adverse industrial composition, but also from competitive disadvantages, which have led to declines

---

6/ Recall that shift-share analysis is a study of relative change. Counties in this grouping all experienced a negative net relative change value because income growth was less than the standard rate established by the Pacific Northwest reference region during the analysis period. Wheeler County is the only one to suffer an actual decrease in income between 1973 and 1978.

Table 13. Counties in Regional Category II (- IM; - RS).

County[a/]	Total Population			Total Income			Standard Growth	Net Relative Change	Industry Mix	Regional Share	Sectors Contributing to the Net Relative Change Component[b/]		Sectors Contributing to the Industry Mix Component[b/]		Sectors Contributing to the Regional Share Component[b/]	
	Thousands		Percent Change	Thousands of Dollars		Percent Change	Percent				Favorably	Adversely	Favorably	Adversely	Favorably	Adversely
	1973	1978	1973-1978	1973	1978	1973-1978										
Klamath	52.6	59.4	12.9	188,269	314,119	66.8	81.1	-14.2	- 2.6	-11.6	MFG	SRVS; C; WT; FARM	MFG; T&PU; RT; FED GOV	SRVS; WT; FI&RE; C	MFG; FI&RE; ST&LOC GOV	T&PU; FARM; RT; C
Umatilla	46.2	53.9	16.7	176,248	291,796	65.6	81.1	-15.5	-16.7	- .8	T&PU; ST&LOC GOV; ASFF	FARM; C; SRVS; FI&RE	FARM; ST&LOC GOV; T&PU; RT	MFG; SRVS; FI&RE; WT	MFG; SRVS; T&PU; WT	FARM; C; FED GOV; RT
Crook	11.5	12.2	6.0	42,085	69,651	65.5	81.1	-15.7	- 4.4	-11.4	MFG	SRVS; T&PU; C; FI&RE	MFG; FARM; ASFF	SRVS; FI&RE; RT; ST&LOC GOV	RT; WT	T&PU; FARM; C; SRVS
Union	21.0	23.4	11.4	72,670	116,050	59.7	81.1	-21.4	- 6.9	-14.5	T&PU; ST&LOC GOV; MFG	C; FARM; FI&RE; WT	T&PU; MFG; ST& LOC GOV; FARM	SRVS; WT; FI&RE; FED GOV	SRVS; T&PU; FED GOV; WT	FARM; C; RT; ASFF
Grant	7.5	7.7	2.7	26,603	42,349	59.2	81.1	-21.9	-13.7	- 8.2	MFG; FED GOV; ST&LOC GOV; MNG	SRVS; C; WT; FI&RE	MFG; FED GOV; FARM; ST&LOC GOV	SRVS; WT; FI&RE; T&PU	MFG; ST&LOC GOV; MNG	C; FARM; WT; ASFF
Polk	37.5	33.7	16.5	95,649	148,659	55.4	81.1	-25.6	-10.4	-15.2	MFG; ASFF	SRVS; FARM; T&PU; WT	MFG; FARM; ST& LOC GOV; ASFF	SRVS; WT; T&PU; FED GOV	FI&RE; WT; SRVS; ASFF	MFG; FARM; ST&LOC GOV; T&PU
Lake[c/]	6.6	7.1	7.6	24,413	36,602	49.9	81.1	-31.1	-18.6	-12.5	FED GOV; ST&LOC GOV; FARM	SRVS; MFG; RT; FI&RE	FED GOV; FARM; ST&LOC GOV	SRVS; C; ASFF, MNG, WT; T&PU	C; ST&LOC GOV; FED GOV	MFG; RT; SRVS; FI&RE
Harney	7.4	7.8	5.4	35,360	47,852	43.4	81.1	-37.4	-19.5	-17.9	FED GOV	SRVS; C; FI&RE; RT	MFG; FARM; FED GOV	SRVS; C; WT; FI&RE	WT; ASFF	MFG; FARM; RT; T&PU
Baker[c/]	15.6	15.9	1.9	49,423	70,485	42.6	81.1	-39.4	-11.4	-27.1	ASFF, MNG, C; FED GOV	FARM; MFG; SRVS; ST&LOC GOV	ASFF, MNG, C; FARM; RT; FED GOV	SRVS; MFG; WT; FI&RE	SRVS; WT; FED GOV	FARM; MFG; RT; ASFF, MNG, C
Sullivan	6.6	7.2	12.5	22,274	31,669	43.2	81.1	-38.9	-25.7	-13.2	----------	SRVS; C; FARM; T&PU	FARM; AFSS; ST& LOC GOV; MNG	MFG; SRVS; WT; T&PU	MFG; WT; T&PU; FI&RE	FARM; C; ASFF; RT
Malheur	23.7	25.4	7.2	100,996	132,690	31.4	81.1	-49.7	-19.7	-30.0	ASFF	FARM; MFG; SRVS; C	FARM; ASFF; RT	MFG; C; SRVS; FI&RE	WT; T&PU; MFG	FARM; SRVS; RT; ST& LOC GOV
Wheeler[c/]	1.9	2.0	5.5	7,361	6,312	-16.2	81.1	-95.3	-15.7	-79.6	ST&LOC GOV	ASFF, MFG; FARM; SRVS; RT	ASFF, MFG; FARM; ST&LOC GOV	SRVS; C; WT; RT	ST&LOC GOV; C	ASFF, MFG; FARM; FI&RE; RT

a/ Counties are ranked based on the actual growth component starting with the one experiencing the largest percentage change in income.

b/ Sectors are ranked in order of importance to each shift-share component. The first sector in each category of four represents the one contributing the most favorably (adversely) to each component. The remaining four sectors fall between both extremes.

The following sector abbreviations are used: (ASFF) Agricultural Services, Forestry, Fisheries, and Other; (MNG) Mining; (C) Construction; (MFG) Manufacturing; (T&PU) Transportation and Public Utilities; (WT) Wholesale Trade; (RT) Retail Trade; (FI&RE) Finance, Insurance and Real Estate; (SRVS) Services; (FED GOV) Civilian and Military Federal Government; (ST&LOC GOV) State and Local Government).

c/ Due to missing data, sectors are combined in the following counties: Lake (ASFF, MNG, WT); Baker (ASFF, MNG, C); Wheeler (ASFF, MFG).

in their share of these same industries [Kalbacher, 1979; Petrulis, 1979]. For example, the Farm sector accounts for a large proportion of county income (positive industry mix value). Because this sector's growth lagged behind the Farm sector in the Pacific Northwest region, the Farm activity in the individual county has a negative regional share value. The proportion of income which is accounted for by the Farm sector in each county determines the magnitude of the income loss due to the adverse regional share effect. In addition, examination of Table 13 reveals the negative impact of each county's underrepresentation in the Services sector to the overall industry mix component.

Because these regions do not have the economic capability, internally, to implement a successful development policy, it is suggested that they will need to depend on economic assistance from outside the county. These areas do have the advantage of cheaper labor costs which may be utilized to attract low growing or declining industries which are seeking relocation in areas with cheaper labor cost [Paraskevopoulos, 1974; Randall, 1973].

Regional Category III

(positive industry mix; negative regional share)

Oregon counties in this regional grouping are generally located along the coast and the northwest portion of the Columbia River as shown by Figure 7. When compared to the growth sustained by the Pacific Northwest region as a whole, Clatsop County is the only one to experience a positive net relative change value. Table 14 presents descriptive profiles of each county in this grouping. Compared to both the State of Oregon and the Pacific Northwest region

Table 14. Counties in Regional Category III (+ IM; - RS).

County[a]	Total Population			Total Income			Standard Growth	Net Relative Change	Industry Mix	Regional Share	Sectors Contributing to the Net Relative Change Component[b]		Sectors Contributing to the Industry Mix Component[b]		Sectors Contributing to the Regional Share Component[b]	
	Thousands		Percent Change	Thousands of Dollars		Percent Change	Percent				Favorably	Adversely	Favorably	Adversely	Favorably	Adversely
	1973	1978	1973-1978	1973	1978	1973-1978										
Clatsop[c]	28.7	30.5	6.3	100,091	187,178	82.0	81.1	1.0	2.5	- 1.6	MFG; ASFF; FARM; RT	MNG; WT; C; FI&RE; FED GOV	MFG; ASFF; RT; ST&LOC GOV	MNG; WT; SRVS; FI&RE; FED GOV	FARM; SRVS; ASFF; FI&RE	T&PU; C; MNG; WT; MFG
Coos	59.4	62.4	5.1	199,062	349,825	75.7	81.1	- 5.3	1.3	- 6.7	MFG; FARM; ST& LOC GOV; T&PU	SRVS; WT; C; FI&RE	MFG; T&PU; ASFF; RT	SRVS; WT; C; FI&RE	FARM; ST&LOC GOV; FED GOV	T&PU; MFG; RT; SRVS
Douglas	79.8	89.1	12.2	280,725	493,453	75.4	81.1	- 5.6	1.8	- 7.4	MFG; MNG; FARM; FED GOV	RT; SRVS; FI&RE; C	MFG; MNG; ASFF	SRVS; WT; FI&RE; T&PU	FARM; FED GOV; SRVS; ST&LOC GOV	MFG; C; RT; ASFF
Curry	13.6	15.6	14.7	43,267	74,898	73.2	81.1	- 7.9	.4	- 8.3	ASFF; FARM; ST& LOC GOV; FED GOV	SRVS; WT; FI& RE; T&PU	MFG; ASFF; C; RT	SRVS; WT; T&PU; FI&RE	FED GOV; FARM; ST& LOC GOV; ASFF	MFG; C; FI&RE; MNG
Multnomah	511.8	523.7	- 3.9	3,212,430	5,407,050	68.3	81.1	-12.8	7.0	-19.8	FI&RE; WT; T&PU	MFG; C; ST& LOC GOV; RT	WT; SRVS; FI&RE; T&PU	MFG; ST&LOC GOV; FARM; FED GOV	FARM; MNG	SRVS; WT; MFG; C
Columbia	31.0	32.6	5.2	88,773	157,308	54.7	81.1	-76.4	5.9	-32.5	ST&LOC GOV; T&PU; MFG; MNG	C; SRVS; WT; FED GOV	C; MFG; MNG	SRVS; WT; FI&RE; FED GOV	ST&LOC GOV; SRVS; T&PU; FARM	C; MFG; RT

a/ Counties are ranked based on the actual growth component starting with the one experiencing the largest percentage change in income.

b/ Sectors are ranked in order of importance to each shift-share component. The first sector in each category of four represents the one contributing the most favorably (adversely) to each component. The remaining four sectors fall between both extremes.

The following sector abbreviations are used: (ASFF) Agricultural Services, Forestry, Fisheries, and Other; (MNG) Mining; (C) Construction; (MFG) Manufacturing; (T&PU) Transportation and Public Utilities; (WT) Wholesale Trade; (RT) Retail Trade; (FI&RE) Finance, Insurance and Real Estate; (SRVS) Services; (FED GOV) Civilian and Military Federal Government; (ST&LOC GOV) State and Local Government.

c/ The following sectors are combined due to missing data: MNG and WT.

both Curry and Douglas experienced above-average increases in population while the remaining four counties only sustained below-average population gains. An actual loss in population is noted in Multnomah County (refer to Figure 5).

A county's negative regional share component implies a loss of income and competitive advantage to other regions. When combined with a positive industry mix component, the county is losing competitive advantage in sectors which contribute proportionately more to county income than to reference region income.

With the exception of Multnomah County, the Manufacturing sector was the main contributor to individual county income via the industry mix effect. Because the growth in Manufacturing did not keep up with the rate established by the Manufacturing sector in the Pacific Northwest region, this industry contributed to each county's loss in income due to negative regional share components. In Multnomah County, only the Farm and Mining sectors realized larger income gains than their counterparts in the Pacific Northwest, and thus helped offset the loss in income due to other industries with adverse regional share values. It appears that the rapid growth rate of the Farm sector in the remaining counties also helps counteract the loss in income due to negative regional share components.

The status of the Manufacturing sector in these counties, as evidenced by a positive industry mix and negative regional share value, might signal to the county official a need to improve the local competitive advantage in this sector. Morentz and Deaton recommend the following policies necessary to improve the local environment for attracting new industry: public investment in in-

dustrial sites; decreased utility rates; specialized training programs for workers; and improvement in the locale's social infrastructure, e.g., schools, museums and recreation centers.

Regional Category IV

(negative industry mix; positive regional share)

Almost one-third of the Oregon counties are classified in the remaining category, which describes a region which is losing income in terms of industry mix but is gaining in terms of regional share effects. As revealed in Figure 7, these counties are located in the northern Willamette Valley and along the northern Oregon boundary of the Columbia River. Tillamook is the sole coastal county. All experienced above-average population gains, except for Linn, Sherman, Tillamook and Wasco Counties. Sherman County actually sustained the largest population loss in the state between 1973 and 1978, as noted in Figure 5. Table 15 summarizes the salient characteristics of the counties in this regional category.

Counties in this grouping appear to have a relatively adverse industrial composition but are still gaining in income due to a favorable comparative advantage in sectors which are slowly growing in the reference region [Paraskevopoulos, 1974]. In general, the unfavorable industrial composition of the county is because the Manufacturing and Services sectors account for less than the standard proportion of total income in the county. Recall that the standard is defined by these same sectors' contribution to total Pacific Northwest income. The favorable influence of State and Local Government and Farm sectors was not able to offset the negative impact of

Table 15. Counties in Regional Category IV (- IM; + RS).

County[a]	Total Population			Total Income			Standard Growth	Net Relative Change	Industry Mix	Regional Share	Sectors Contributing to the Net Relative Change Component[b]		Sectors Contributing to the Industry Mix Component[b]		Sectors Contributing to the Regional Share Component[b]	
	Thousands		Percent Change	Thousands of Dollars		Percent Change	Percent				Favorably	Adversely	Favorably	Adversely	Favorably	Adversely
	1975	1976	1975-1976	1975	1976	1975-1976										
Morrow	6.8	7.1	54.4	15,232	75,467	382.3	81.1	301.5	-12.5	313.8	FARM; C; MFG; T&PU	SRVS; FED GOV; MNG; FI&RE	ST&LOC GOV; FARM; T&PU; ASFF	SRVS; MFG; C; FI&RE	FARM; C; MFG; T&PU	FED GOV; MNG
Gilliam[c]	2.0	2.2	10.0	5,617	12,052	114.6	81.1	33.5	-55.6	49.1	FARM; ST&LOC GOV; FED GOV	ASFF, C, MFG, WT; SRVS; RT; T&PU	ST&LOC GOV; RT; FED GOV; T&PU	ASFF, C, MFG, WT; SRVS; FI&RE; MNG	FARM; FI&RE; ASFF, C, MFG, WT	RT; T&PU; SRVS; FED GOV
Benton	58.2	65.8	11.2	161,209	316,142	94.8	81.1	13.8	- 2.1	16.0	ST&LOC GOV; MFG; SRVS; RT	WT; C; T&PU; FI&RE	ST&LOC GOV; SRVS; FED GOV; ASFF	WT; MFG; T&PU; FI&RE	MFG; SRVS; RT; FI&RE	C; T&PU; ASFF; FED GOV
Tillamook	18.3	18.8	8.3	53,580	103,880	93.9	81.1	12.8	- 6.9	17.7	FARM; ASFF	WT; C; SRVS; T&PU	MFG; ASFF; ST& LOC GOV, RT	SRVS; WT; T&PU; C	FARM; SRVS; FI&RE; ASFF	MIN; ST&LOC GOV; WT; C
Yamhill	43.3	49.7	14.6	126,117	239,976	90.3	81.1	9.2	- 7.5	16.7	MFG; ASFF; MNG; RT	T&PU; FED GOV; WT; SRVS	MFG; FARM; ASFF; MNG	WT; FED GOV; T&PU; C; SRVS	MFG; C; ST&LOC GOV; WT	FARM, T&PU; ASFF; FED GOV
Marion	156.5	182.2	15.0	573,880	1,086,663	89.7	81.1	8.6	- 2.1	10.8	ST&LOC GOV; FARM; FI&RE; RT	MFG; FED GOV; WT; ASFF	ST&LOC GOV; RT; C; SRVS	MFG; WT; T&PU; FED GOV	ST&LOC GOV; T&PU, FARM; WT	C; ASFF
Linn	78.4	85.7	8.3	271,021	498,531	82.6	81.1	1.5	- 3.5	3.0	MFG; C; ASFF	SRVS; FARM; FED GOV; FI&RE	MFG; FARM; ASFF	SRVS; WT; FI&RE; FED GOV	WT; MFG; ST&LOC GOV; FI&RE	FARM; MNG; RT; ASFF
Nasco	20.3	21.0	3.3	67,784	123,749	82.6	81.1	1.4	- 4.8	6.3	FARM; MFG; MNG	C; SRVS; T&PU; FI&RE	RT; ST&LOC GOV; T&PU; FARM	WT; FI&RE; MFG; ASFF	FARM, MFG; WT, MNG	C; T&PU; ST&LOC GOV; RT
Sherman	2.1	1.7	- 19.1	7,566	13,672	80.7	81.1	- .8	-16.8	16.0	FARM; FED GOV; RT; WT	MFG; C; SRVS; FI&RE	RT; FED GOV; FARM; ST&LOC GOV	MFG; SRVS; FI&RE; T&PU	FARM; WT; FED GOV	C; ST&LOC GOV; RT; ASFF
Jefferson	8.2	11.0	19.6	33,300	57,336	72.9	81.1	- 8.2	-16.4	8.2	SRVS; MFG; ST&LOC GOV	FARM; C; T&PU; FI&RE	FARM; RT; ASFF	SRVS; C; FI&RE; WT	SRVS; MFG; ST&LOC GOV; WT	FARM; RT; T&PU; C
Hood River	13.5	13.3	13.3	54,024	93,042	72.2	81.1	- 8.8	-10.9	2.1	FARM; MFG; WT; T&PU	SRVS; C; FI&RE; FED GOV	FARM; T&PU; WT, MFG	SRVS; FI&RE; C; FED GOV	FARM, MFG; WT, FI&RE	C, SRVS, ST&LOC GOV; RT

a/ Counties are ranked based on the actual growth component starting with the one experiencing the largest percentage change in income.

b/ Sectors are ranked in order of importance to each shift-share component. The first sector in each category of four represents the one contributing the most favorably (adversely) to each component. The remaining four sectors fall between both extremes.

The following sector abbreviations are used: (ASFF) Agricultural Services, Forestry, Fisheries and Other; (MNG) Mining; (C) Construction; (MFG) Manufacturing; (T&PU) Transportation and Public Utilities; (WT) Wholesale Trade; (RT) Retail Trade; (FI&RE) Finance, Insurance and Real Estate; (SRVS) Services; (FED GOV) Civilian and Military Federal Government; (ST&LOC GOV) State and Local Government.

c/ The following sectors are combined due to missing data: ASFF, C, MFG, WT.

the indicated sectors on the county's adverse industry mix component.

With the exception of Jefferson and Linn Counties, attention should be given to the important contribution of the Farm sector to the county's gain in income due to favorable regional share effect. Irrigation projects in the counties bordering the Columbia River and fertile soils in the Willamette Valley favored the large increase in farm income relative to Pacific Northwest farm income. In all but three counties (Hood River, Jefferson, and Sherman), the regional share effect was large enough to compensate for the county's income loss due to adverse industrial composition; these counties actually experienced positive net relative change values. Note the extraordinary percent increase in Morrow County's income between 1973 and 1978 —— both the Farm and Construction sectors are the main contributors.

Conclusion

The selected regional classifications presented in this chapter separates the Oregon counties into four categories, depending on the sign of their industry mix and regional share effects. This classification scheme allows the regional analyst to more effectively describe the patterns of income change sustained by the counties during the period of shift-share analysis. Both potential growth industries and sectors exhibiting declining competitive advantage for each county are identified in rank order in the respective regional categories.

The thesis continues with further analyses of the modified shift-share results for the Oregon counties. Specifically, regression

analysis is utilized in the next chapter to determine the influence of selected social and economic characteristics on each county's regional share component. Theory suggests that this value reflects competitive advantage of an area vis-a-vis other regions.

CHAPTER V

FACTORS INFLUENCING THE REGIONAL SHARE COMPONENT IN OREGON COUNTIES

Introduction

It is important to reiterate that shift-share analysis only be used as a descriptive tool; by itself, it does not provide an explanation on how counties grow and to what extent interregional growth differences, as measured by income in the research can be explained. The technique simply describes the income implications for a county not exhibiting standard performance, as established by the Pacific Northwest region, in the various sectors. Therefore, while shift-share analysis may identify potential growth industries and areas of declining competitive advantage, it cannot identify the causes of such income changes [Andrikopoulos, 1977; Ashby, 1968; Brown, 1971; Curtis, 1972; Morentz and Deaton; Stilwell, 1969, 1970].

Similar to the shift-share results attained by Bretzfelder [1970] and summarized in Table 1, the computed regional share component for each Oregon county appears to provide the major explanation of the relative income experience of the county. Figure 9 notes each county's regional share value, both in terms of percent increase or decrease on the overall county growth rate and converted actual income gains and losses sustained during the analysis period, 1973-1978. As expected, a high correlation between the county's regional share component and its relative growth in total income as noted in Figure 6 on page 101, is evident. With few exceptions,

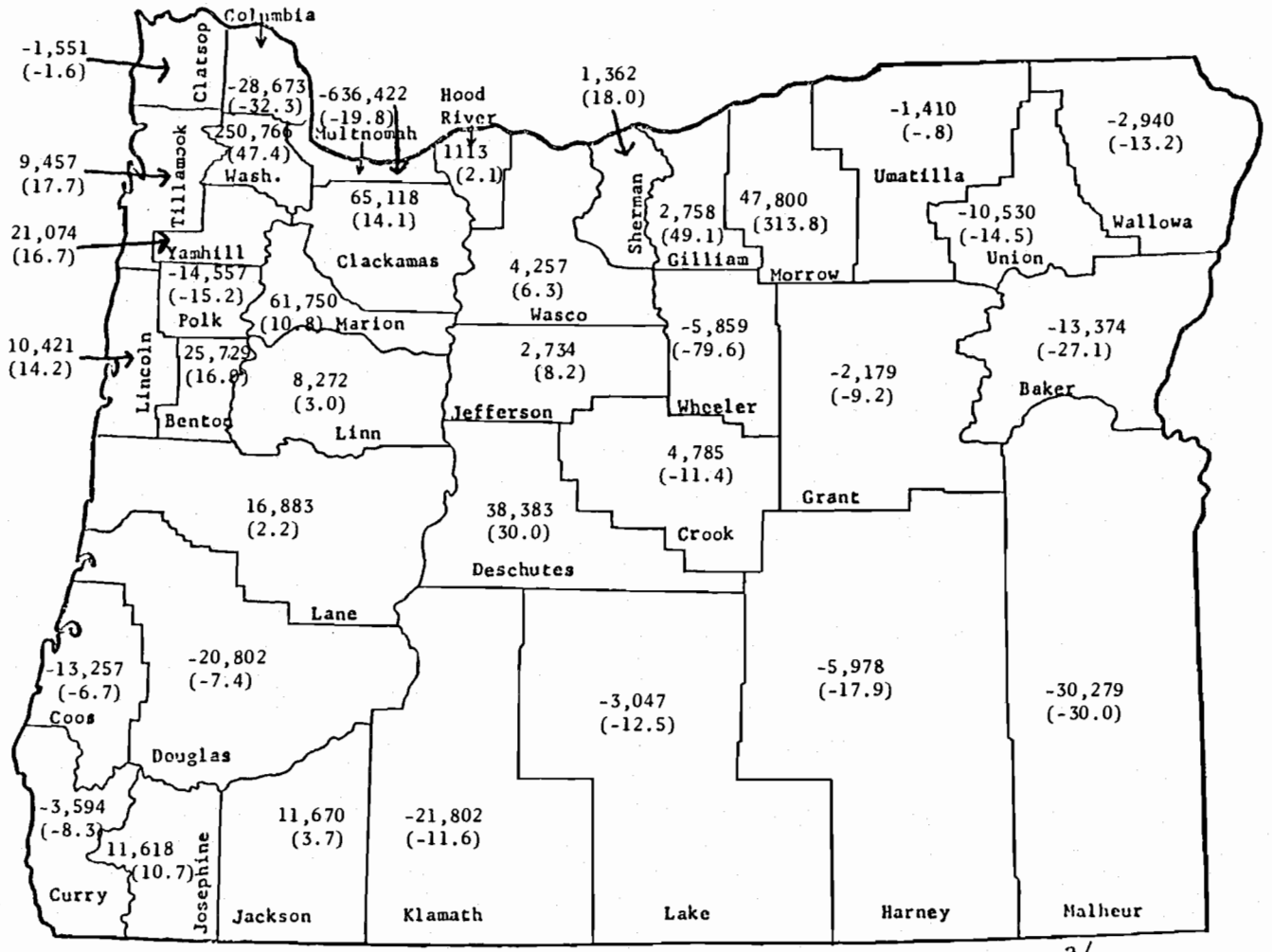

Figure 9. Modified Regional Share Components for Oregon Counties, 1973-1978.[a/]

[a/] Income figures are in thousands of dollars, whereas percentages (in parentheses) are rounded to the first decimal place.

each county for which the regional share effect was positive recorded above-average growth in total income. Similarly, each county in which the effect was negative experienced a below-average income gain.

The reader may recall that the regional share component is the residual after reference region trends (the standard growth component) and a county's industrial composition (the industry mix component) have been accounted for. This third component of change in the shift-share equation, the regional share effect, is assumed to measure the ability of the local economy to capture an increasing (decreasing) share of a particular industry relative to other counties.[1/] This component refers to the local influences that cause industries in a county to grow at a faster (slower) rate than their counterparts in the reference region, the Pacific Northwest. These locational and other competitive advantages (vis-a-vis other regions) may indicate the existence of some regional comparative advantage available to individual county industries [Shaffer, 1979].

If the regional share component does represent a measure of comparative advantage of a locale, then one could recognize that identification of the conditions creating regional comparative advantage may help explain part of the economic growth sustained by the region during a specific period. The major economic implication of this hypothesis is that a county's ability to attract industries

---

1/ Utilizing the modified shift-share approach, the regional share value for a particular sector is computed by multiplying the proportion of total county income that sector accounts for by the difference in sectoral growth rates in the county and the Pacific Northwest region. The summation of each sector's regional share value yields the overall county regional share component for the period of analysis.

is associated with the comparative advantage that county possesses at any point in time. Identification of these factors may provide useful information for citizens concerned with economic development policy decisions. One may suggest that policies which can affect a region's economic conditions and/or alter regional comparative advantage can be used either to reduce income disparities among counties or to achieve self-sustained development [Andrikopoulos, 1980; Shaffer, 1979].

To summarize, the regional share component is net of standard growth and industry mix effects. This allows state and county policy makers to identify those areas with local conditions that result in more (less) rapid growth rates regardless of economic conditions in the Pacific Northwest region or the county's industrial composition. The main objective of this chapter is to determine what influence, if any, selected social and economic characteristics have in explaining the regional share component of the 36 Oregon counties in the period of shift-share analysis, 1973 to 1978.

Several researchers have attempted to identify possible determinants of a region's (or an industry's) regional share component. A summary of the previous studies and their results is described briefly in the next section. The remainder of the chapter is devoted to a discussion of the selected determinants of an Oregon county's comparative advantage (disadvantage) during the six year analysis period. Ordinary Least Squares (OLS) regression analysis is utilized in both the preliminary and revised models specified in the research.

Review of Prior Research

Shift-share results provide a framework for planners and citizens to analyze their local economy and to identify local factors which may affect growth and the region's competitive ability to attract industry. While some researchers have only suggested local factors which may influence an area's regional share value, others have utilized regression analysis, with varying results, in their attempts to identify those factors most significant in explaining a region's comparative advantage, as related by its regional share component.

Although Davis and Goldberg [1972] did not empiricize their model, they commented that the regional share component is the only one regional in character and therefore subject to analysis in order to improve the understanding of regional growth processeses. They suggested the following as potential explanatory variables: factors of density, pollution, congestion and agglomeration. Density could pertain to either population or employment. To measure the effect of pollution on a region's competitive position, the researchers suggest using indices developed for air and water quality. Travelling time and accessibility measures provide insights to congestion. Included in the category to measure agglomeration are suggested size of available labor pool and number of libraries.

Locational advantages in an area (vis-a-vis other regions) may also be captured by the following factors: natural resource endowments; government subsidy and tax policies; ease of access to final and intermediate markets; availability and price of various factors of production; and economies of scale [Petrulis, 1979]. Similarly, Morentz and Deaton suggest the following to consider: unique labor/

management relationships; special tax burdens and/or benefits; efficiency of public service delivery; and development of the local human and natural resource base. Not one of these authors conducted an empirical evaluation of the relative importance of these factors to an area's regional share component.

Several researchers utilized regression analysis to determine whether or not the regional share component actually measures what it is expected to —— competitive advantage and disadvantage. One empirical work by Brown [1969] attempted to explain the regional share component for 16 Standard Metropolitan Statistical Areas (SMSAs). Twenty-five variables were grouped into five categories designated as final markets, intermediate markets, labor supply, other inputs, and catch-up. The latter variable tested the hypothesis that faster growing areas started growing late and were 'just catching up' with the rest of the country. Brown [1969] found that the regression model only explained two to ten percent of the variation in the SMSA's competitive position and therefore concluded that the explanatory variables and the regional share component were randomly related rather than systematically related as suggested by previous researchers.[2/]

[2/] Brown's conclusion that the regional share component was not a useful way of classifying industrial sectors over time sparked much debate in the shift-share literature. Several researchers strongly challenged his results and subsequent investigations revealed that the restrictive size of the sample may have significantly contributed to the poor association found between the explanatory variables and the regional share component [Ashby, 1973; Floyd and Sirmans, 1973; James and Hughes, 1973; Paraskevopoulos, 1971]. A summary of this debate is described by Stevens and Moore [1980].

Chalmers and Beckhelm [1976] challenged Brown's contention that the regional share component is not associated with forces indicating locational advantage. In their study of the regional share component in a cross section of cities, the results indicated that variables expected to affect spatial variations in profits, as suggested by the theory of industrial location, were significant in explaining regional share. The most significant variable was the proxy representing consumer market potential (CMP) in region r at time t:

$$CMP_r^t = \frac{P_j^t}{D_{rj}}$$

where

P_j^t = population in region j in year t, and

D_{rj} = distance from region r to region j.

The underlying rationale is that a region's competitive share is more positively influenced the more populated the region is and the closer it is to metropolitan areas.

Buck [1970] found no support for the comparative (locational) advantage interpretation of the regional share component in his study of England, although he did concede that his conclusion may not be appropriate for a geographically larger entity, such as the United States.

Shaffer [1979] considered proxies for four general classes of determinants of locational advantage to determine if governmental policies had any influence on the regional share value of a Wisconsin county. Categories considered were: access to markets; labor

force; economic activity; and policy variables. Only variables in the first two categories (number of cities over 10,000 population, distance to Milwaukee/Minneapolis, percent employed in trade and service activities, and median family income) were found to be significant in explaining the county's regional share. Shaffer [1979] concludes that the proxies for state and local economic policy choices (per capita local government expenditures, 1962 and 1967; per capita property taxes, 1962 and 1967; and dummy variables for presence of an employment training center, state employment service center, and state office building) were inadequate or the county's regional share was not influenced by government action.

Reviewed in this section are studies which attempted to explain the regional share component for a specific area. A similar spatial perspective underlies the endeavor to explain each Oregon county's regional share component presented in this chapter.

A structural viewpoint was adopted by two researchers who empirically tested selected variables in their efforts to explain the regional share component in the Manufacturing sector among various regions. Andrikopoulos [1977] examined the performance of the Manufacturing sector among Canadian provinces, whereas Weaver and McMillan [1976] looked at factors influencing Manufacturing employment change in small Wisconsin cities. Of interest is the observation that variables selected by these authors to explain the regional share component of the Manufacturing sector coincide with those suggested by authors to explain an area's competitive advantages or disadvantages.

The influence of factors depicting locational advantages on each Oregon county's regional share component is presented in the remainder of this chapter. A discussion of the variables selected as proxies of county characteristics accompanies the results from the original and revised models specified by the researcher. Also considered is the validity of the results from an econometric standpoint.

Model Formulation

The dependent (endogenous) variable to be explained is the regional share component calculated from the modified shift-share analysis of the 36 Oregon counties for the period 1973 to 1978. Both the percent and actual values are used in the original and revised models, respectively. The reader is referred to Figure 9 for the location of the individual county and its regional share value. The explanatory, or exogenous, variables included are suggested by industrial location theory and prior research in this area.[3/]

The Preliminary Model

Ordinary Least Squares (OLS) regression analysis was utilized to assess the influence of regional social and economic characteristics on a county's regional share (RS) component. The preliminary model included the following explanatory variables and was determined as:

$$RS = f(P83, Y83, DSMSA, TAX3, PD, ED),$$

3/ For a more general discussion than that found in the references already cited, see Isard [1960].

where

P83 = percent change in county population between 1973 and 1978,

Y83 = percent change in county per capita income between 1973 and 1978,

DSMSA = distance from the largest city in each county to the nearest SMSA,

TAX3 = average county tax rate in 1973 (percent),

PD = dummy variable for the existence of a Port District (1 if the county has a Port District, and 0 if otherwise), and

ED = dummy variable representing the existence of a college offering at least a four year program (1 if college exists, and 0 if otherwise).

The growth in each county's population and per capita income over the time of the shift-share analysis, 1973 to 1978, are both expected to have a positive influence on a county's level of economic activity and therefore a positive effect on the county's regional share value. A proxy used by Shaffer [1979] to determine access to market is the explanatory variable representing distance in miles from the largest city in each county to the nearest Standard Metropolitan Statistical Area (SMSA).[4/] The greater the

[4/] Clackamas, Lane, Marion, Multnomah, Polk, and Washington Counties are considered SMSAs in Oregon. County population figures for 1970 determined the largest city in each county. These cities maintained their position in 1978 [Oregon Blue Book, 1979].

distance between a county and a large population center, the lesser its influence on a county's competitive position. For example, counties close to an SMSA have an access to a larger labor pool than do counties located farther from a population center. The coefficient is expected to be negative.

A policy variable for the average county tax rate in 1973 was determined by dividing Total Gross Ad Valorem Levies in 1973-74 by the Total Taxable Real, Personal and Utility Property in 1973. This explanatory variable is expected to have a positive influence on a county's regional share as it is assumed to be a measure of expenditure by local governments. Higher expenditures reflect the provision of municipal services necessary for economic development [Shaffer, 1979]. A negative impact is also possible. If this variable acts as a proxy for the cost of local services, a relatively high tax rate may deter the location of new industries within the county.

Two binary shift or dummy variables are included. The existence of a Port District (which is involved in promoting economic development in a county) is expected to have a positive effect on a county's regional share value. The presence of a college offering at least a four year program is used as a proxy to measure quality of labor force. Education is expected to be positively related to the regional share component of a county if it does in fact measure labor skills.

Empirical Results

Table 16 gives the results of the preliminary regression model using the Ordinary Least Squares (OLS) estimation procedure. The county re-

Table 16. Regression Results for the Preliminary Model.[a/]

Independent Variables	Estimated Coefficient (Standard error)
Percent county population change, 1973-1978	3.1104 * (.2757)
Percent county per capita income change, 1973-1978	1.84622 * (.1593)
Distance from county to nearest SMSA (miles)	.13899 * (.0411)
Average county tax rate, 1973	8.4699 (8.679)
Existence of a Port District (dummy variable)	2.4203 (7.797)
Existence of four year college (dummy variable)	.9594 (8.8837)
Constant	-188.447 * (22.221)
R^2	.911
F-statistic	49.4657
df	29

[a/] The dependent variable is the county regional share component in percentage form.

* Denotes significance at the one percent level (one-tailed).

gional share component in percentage form is the dependent variable.

To determine whether a relationship existed between the county's competitive position, as related by its regional share component and the independent variables specified, an F test was conducted for the complete model. The null hypothesis states that all the coefficients are equal to zero versus the alternative that this was not true. Since the observed F* value in Table 16 ($\frac{SSR/K-1}{SSE/N-K} = \frac{MRS}{MSE} = F_{K-1,\ N-K} = 49.4657$, where N = 36 and K = 7) is greater than the table $F_{6,\ 29} \sim F_{6,\ 30} = 3.47$, the conclusion that the null hypothesis is not rejected at the one percent level of significance is appropriate.

The coefficient of determination (R^2) is a summary statistic which measures the proportion of variation in the dependent variable that is 'explained' by the independent variables. As noted in Table 16, the R^2 value suggests that 91 percent of total variation in a county's regional share component is associated with the suggested variables describing county characteristics.

Use is made of the t test in determining the significance of the estimated coefficients. The null hypothesis is that the coefficient equals zero versus it not equalling zero and possibly being significant. The calculated t* for each coefficient is obtained by dividing the estimated coefficient by its standard error. For the one-tailed test, the table t value from a student's t distribution at the one percent level of significance ($\alpha = .01$) is t^{α}_{n-k} or $t^{.01}_{29} = 2.462$ If the calculated t* is greater than the table t, one may conclude that the specific variable is significant in explaining the regression at the corresponding level of significance.

Both percent change in population and per capita income between 1973 and 1978 and the variable indicating distance from the county to the nearest SMSA are significant at the one percent level or better in explaining the county's regional share component.

With exception of the distance variable, the estimated coefficients have the expected sign. One possible explanation may be that the farther the location of a county from the SMSA, the more attractive it becomes to prospective business and in-migrants. This hypothesis considers the negative externalities of a large population center such as increased congestion, crime, pollution, and so on.

The section continues by outlining the statistical assumptions necessary in using Ordinary Least Squares (OLS) estimators and then testing the model for violation of these assumptions. According to the Gauss-Markov theorem, the estimated equation provides unbiased estimates, that is, the distribution of the OLS estimate of any of the parameters is centered around the true values. Furthermore, the OLS estimates are the least variance estimates in the family of linear unbiased estimates. This is known as the Best Linear Unbiased Estimate (BLUE) or the minimum variance unbiased estimate [Murphy, 1973].

The residuals, e_i, are the differences between what is actually observed and what is predicted by the regression equation —— that is, the amount which the regression model has not been able to explain. In performing regression analysis, assumptions were made concerning the residuals; the usual assumptions are that the errors are independent, have zero mean, a constant variance, σ^2, and

follow a normal distribution. The latter assumption is required for performing F tests. Thus, if the fitted model is correct, the residuals should not exhibit a violation of these assumptions [Murphy, 1973; Rao and Miller, 1971]. Because the true value of the parameters are unknown, statistical tests are available to detect and correct for violations of the assumptions of the classical model. Tests for the conditions of heteroskedasticity and multicollinearity were conducted for both the preliminary and revised models.

Heteroskedasticity in the Preliminary Model

The problem of heteroskedasticity is present when the variances of the error terms are not equal across cross-sectional observations. The classical linear regression model's assumption of a constant variance, σ^2, is violated. This has two implications for estimation. First, while the OLS estimators are still linear and unbiased, they no longer provide minimum variance among the class of linear unbiased estimators; thus, they no longer are efficient. Secondly, the estimated variances of the least squares estimators are biased which renders the usual t and F tests for statistical significance invalid [Intriligator, 1978]. To test for heteroskedasticity among observations which are not consecutive, Murphy [1973] suggests plotting the estimated residuals ($\hat{e}_t$) against the estimated values of the endogenous variable, $\hat{Y}_t$. V-shaped, egg-timer shaped or football shaped distributions indicate that the variance of the residual differs among observations. Examination of the plot of $\hat{e}_t$ with $\hat{Y}_t$ for the original model revealed that the assump-

tion of homoskedasticity was not violated, i.e., the residuals tended to fall within approximately parallel lines.

Multicollinearity in the Preliminary Model

One of the assumptions of the classical linear model states that the exogenous (explanatory) variables are independent of each other so that each has a separate, measurable effect on the dependent variable. Both Koutsoyiannis [1977] and Murphy [1973] agree that the use of economic and related variables makes it unusual to obtain column vectors of observations on the exogenous variables which are uncorrelated.

Because the existence of intercorrelation among presumably independent variables depicting county attributes was the most severe statistical problem encountered in both the preliminary and revised models, Appendix C presents a summary of the Farrar-Glauber test for multicollinearity. Briefly, this test consists of three parts. The first is a Chi-Square test for the presence and severeity of multicollinearity in an equation; the second is an F test for the location of the multicollinearity; and the third is a t test for the pattern of multicollinearity. Conducting this test for the preliminary model in Table 16, revealed its existence. Interpretation of the remaining two parts of the Farrar-Glauber test of multiple and partial correlations between variables determined that the distance to the nearest SMSA, the average county tax rate, and both the dummy variables for the existence of a Port District and a college, contributed to the multicollinearity among variables. It was concluded that the problem was not severe enough to merit addi-

tional deletion of variables ($*X^2$ = 35.8803 and table X^2 = 25 at the five percent level of significance when the degrees of freedom are 15).[5/]

The Revised Model

Although three factors relating county attributes (percent change in population and per capita income between 1973 and 1978 and each county's distance from the nearest SMSA) were found to be significantly related to a county's regional share component, several considerations led to the specification of a revised model. Inclusion of additional variables describing a county's competitive advantage vis-a-vis other counties was the first consideration. For example, the proxy for the quality of labor force (dummy variable reflecting the existence of a four year college) could be improved by using explanatory variables such as percentage unemployed in county,

---

5/ The specified model provided the most satisfactory results from an econometric standpoint. To reflect the economic and material resources of the population of a county in relation to other counties, an index representing socio-economic status was originally included as an explanatory factor expected to have a positive influence on a county's competitive position. Based on 1970 Census data, the socio-economic status index is defined by four indicators: median family income; families with employed male heads not in proverty; school attainment; and dwelling units with complete plumbing. The application of the Farrar-Glauber test for multicollinearity to the regression model including this variable, revealed that the index describing socio-economic status was significantly correlated with three explanatory variables: the average county tax rate; the distance to the nearest SMSA; and the dummy variable indicating the existence of a college offering at least a four year program. This high degree of intracorrelation is probably due to the catch-all definition of the socio-economic index of which two of the indicators are taken into account by the change in per capita personal income variable and the dummy variable indicating the existence of a college. Since the socio-economic status index was not statistically significant in explaining the regression, it was not included in the preliminary model.

median age of the county population and/or level of educational attainment. It is anticipated that individual proxies for social, economic and locational county attributes will better the explanatory value of the model.

Secondly, no consideration is made of the dominance of the lumber and wood products industry to the Oregon county's regional share value in the original model. As observed in Chapter I, wood products employment accounted for 45 percent of total manufacturing employment in the State of Oregon in 1973 [Oregon 2000 Report, 1980]. Figure 1 reveals the extent of timber dependence among the individual counties.

Finally, it is possible that both the percent change in population and percent change in per capita income variables only are spuriously related to the county's regional share component due to misspecification of the original model. Significant association may be found between variables if they happen to be moving in the same direction because of the general economic activity or because of population growth, and not due to a causal relation [Rao and Miller, 1971]. It is expected that the improved specification of the relation between variables in the revised model will alleviate this concern.

Numerous regression runs were conducted in the attempt to determine those factors most significant in explaining each county's competitive advantage (disadvantage), as related by its regional share component. Variables selected as proxies for a county's social and economic attributes proved to be highly correlated. Similar to the original model, minimization of the condition of multicollinearity

dictated the selection of the variables in the revised model.

The regional share component for each county (the dependent variable) was converted into actual dollar gains and losses and weighted by the county's population in order to reduce the possible spurious relation between the two variables. Results from this modification proved to be unsatisfactory both in terms of lack of significant coefficients and explanatory power, i.e., the signs were contrary to what theory would suggest.

The 'best' model was determined to be of a log-linear form.[6/] Table 17 summarizes the selected explanatory variables, its information source, and the expected sign of the estimated coefficients.

Due to the high correlation between the population and income change variables, only county per capita income data is used in the revised model. As a reflection of a county's level of economic activity, the percent change in per capita income between 1973 and 1978 is expected to have a favorable effect on the county's regional share value.

The distance in miles from the largest city in each county to the nearest Standard Metropolitan Statistical Area (SMSA) coincides with the distance variable in the original model. It represents a measure of proximity to larger external markets, supplies, service and shopping centers and urban amenities [Weaver and McMillan, 1976]. A negative sign is expected — the farther the county from a large

---

6/ Prior to taking the log of the regional share (RS) component, measured in terms of actual income gains and losses, it was necessary to convert each one into a positive value. This was accomplished by adding the greatest loss in income (experienced by Multnomah County and noted in Figure 9.) to each county's regional share value. Thus, the relative magnitude of each county's component is maintained.

Table 17. Determinants of the Regional Share Component in Oregon Counties.

Independent Variables	Expected Sign	Data Source[a/]
Percent county per capita income change, 1973-1978	+	Local Area Personal Income, 1973-78, Bureau of Economic Analysis
Distance from largest city in each county to nearest SMSA (miles)	-	Oregon Rand McNalley road map
County log production, 1973 (millions of board feet)	+	Oregon Economic Statistics, Bureau of Business Research
Ratio of change in county population age 65 and over to change in Oregon population age 65 and over (1970-1980 Census years)	+	Population age 65 and over, 1970 - Oregon Economic Statistics; population age 65 and over, 1980 - per phone conversation with Karen Seidel, Bureau of Governmental Research & Service
County unemployment rate, 1973	?	State of Oregon Employment Division, Department of Human Resources
Level of educational attainment - Adults who have not finished high school	-	Social Accounting for Oregon, Socio-Economic Indicators, Department of Human Resources
Average county tax rate, 1973	?	Oregon State Department of Revenue
Existence of a Port District (dummy variable)	+	Extension Circular 979 OSU Extension Service

[a/] The complete reference for each data source is noted in the bibliography.

population center, the less it is able to rely on these amenities to attract industries looking for new sites. Recall that this variable was found to have a positive significant influence on the county's regional share component in the original model, which was contrary to expectations.

In order to account for the importance of the timber industry to a county's economy, several proxies were tried. A dummy variable indicating whether or not the county depended on wood products employment for more than 75 percent of manufacturing employment (Figure 1 in Chapter I) was determined to be highly correlated with factors depicting county characteristics, and thus was not selected. Similarly, the ratio of the dollar value of all goods produced by manufacturing plants in each county in 1973 to dollar value of all manufacturing goods in the Pacific Northwest reference region in this same base year caused a significant multicollinearity problem. Another measure depicting county log production in millions of board feet in 1973 (base year of the shift-share analysis) proved to be the best proxy relating timber dependence in a county. Due to the dominance of the timber industry to the Oregon economy, a positive relation is expected. Recall that the period of analysis begins and ends in non-recession years, 1973 and 1978. During this time, the lumber and wood products sectors were healthy and productive activities. A more recent period of shift-share analysis may suggest different conclusions —— the variable relating timber dependency could be negatively related to the county's competitive component. The latter assumes that counties dependent on this sector are the ones suffering the most in income losses.

Oregon's scenic amenities as well as mild climate has made the state a popular destination for retirement [Oregon 2000 Report, 1980]. Due to the lack of county data depicting number of retired people, a proxy was developed to measure the influence of a county's locational advantage to its regional share component. Data on the number of people age 65 and older by county is available for only census years, 1970 and 1980. The ratio of the change in the population of this age group in each county to the change in Oregon's population in this group between 1970 and 1980 is expected to provide a relative indication of a county's locational attractiveness to potential retirees. A positive influence on a county's regional share component is anticipated.

The impact of a county's unemployment rate on its regional share component is difficult to assess. If the variable reflects surplus labor, a positive influence is possible; industry may want to locate in those areas with an existing labor supply. On the other hand, a large unemployment rate may indicate the economic condition of the surrounding area and thereby result in an unfavorable impact on the county's change in income due to the regional share effect.

Another possible determinant of a county's regional share component is the county population's level of educational attainment. As a possible proxy for quality of labor force, the variable is defined as the proportion of county population which have not completed high school.[7/] It is generally accepted sociologically and economically that the lower the educational level of attainment of an

---

7/ The level of education attainment is defined by 1970 Census data; this information was not available for the base year of the analysis.

individual, the lower the earning power, and, thus the lower the income level [Social Accounting for Oregon, Socio-Economic Indicators, 1977]. Needless to say, a negative relation between this variable and the county's regional share component is expected.[8/]

The remaining two explanatory variables may be considered as policy variables subject to local control by decision-makers. Included are the county's average tax rate in 1973 and a dummy variable denoting the existence of a Port District, which is involved in industrial promotion activities.[9/]

Both variables were included in the preliminary model and their influence is expected to be similar — the latter one be favorably related to a county's regional share component, while the former's influence is indeterminate.

A county's average tax rate is computed by dividing Total Gross Ad Valorem Levies in 1973-74 by the Total Taxable Real, Personal and Utility Property in 1973. If higher expenditures by local governments reflect extensive provision of municipal services, this variable may positively influence a county's competitive advantage as described by its regional share value [Shaffer, 1979]. On the

---

8/ In addition to the dummy variable indicating the existence of a four year college in the county, a measure denoting per pupil expenditure was utilized as a proxy for quality of labor force. Each county's property tax levy for school districts in the 1973-1974 fiscal year was weighted by the district's average daily membership in the computation of the latter. Both variables were determined to be significant contributors to the multicollinearity problem.

9/ Port districts are located in the following Oregon counties: Clackamas, Clatsop, Columbia, Coos, Curry, Douglas, Gilliam, Hood River, Lane, Lincoln, Morrow, Multnomah, Tillamook, Umatilla, Wasco, and Washington.

other hand, this variable may also act as a proxy for the cost of local services.[10/] A relatively high tax rate may serve as a disincentive to new industries locating within the county.

Empirical Results

The Ordinary Least Squares (OLS) results for the revised model are presented in Table 18. Compared to the original model, the log-linear revised model is an improvement in terms of increased number of explanatory variables. Results indicate that a county's regional share value depends positively and significantly on county log production (proxy for a county's timber dependence); the relative increase in county population age 65 and over (proxy for county's locational advantage as a retirement destination); and the average county tax rate.[11/] A county population's level of educational attainment (measured by its proportion who have not finished high school) is negatively and significantly related to the county's

---

10/ Weaver and McMillan [1976] note that differences among tax rates may not reflect service costs if some communities make specific charges for certain services while others finance them through the property tax.

11/ Interestingly, the favorable influence of the latter variable on a county's comparative advantage vis-a-vis other counties supports the hypothesis suggested by Shaffer [1979]. In the attempt to determine the influence of government policies on the regional share value of a Wisconsin county, Shaffer utilized information on both per capita local government expenditure and per capita property taxes. Although neither proxy for government policy proved significant, a positive influence was expected due to the assumption that higher local government expenditures reflect a higher level of municipal services.

Table 18. Regression Results for the Revised Model.[a/]

Independent Variables	Estimated Coefficient (Standard error)
Percent county per capita income change, 1973-1978	.00154 (.00243)
Distance from county to nearest SMSA (miles)	-.000153 (.000588)
County log production, 1973 (million board feet)	.0006344 * (.00015)
Ratio of change in county population age 65 and over to change in population age 65 and over in Oregon (1970-1980)	32.026 * (2.242)
County unemployment rate, 1973	.0124 (.0497)
Level of educational attainment - Adults who have <u>not</u> finished high school	-.00012 * (.0000027)
Average county tax rate, 1973	.4242 ** (.1143)
Existence of a Port District (dummy variable)	-.013 (.1061)
Constant	12.44 * (.4854)
R^2	.988
F-statistic	285.57
df	27

[a/] The dependent variable is the log of the converted regional share value.

* Denotes significance at one percent level (one-tailed).

** Denotes significance at one percent level (two-tailed).

competitive position.[12/] The estimated coefficients of both the change in a county's per capita income and its distance from the nearest SMSA had the expected sign but were not significant in explaining the dependent variable.

The remaining two variables, the county unemployment rate and the dummy variable for the existence of a Port District had insignificant impacts on the county's regional share component, although their signs are interesting. Recall that the expected sign of the unemployment variable was indeterminate. Its favorable influence on a county's competitive position may be due to its reflection of excess labor supply in the county. Contrary to expectations, the existence of a Port District is determined to be negatively related to the county's regional share component. It is possible that, as a measure of a county's promotion of industrial activities, this dummy variable was an inadequate indicator.

Although the coefficient of determination (.988) is higher than the original model, it is not an appropriate measure of comparison due to the different number of explanatory variables and the converted dependent variable [Rao and Miller, 1971]. Nevertheless, the high value indicates that a large amount of the total variation in county regional share components is associated with these independent variables. The observed F value for the revised model is significantly greater than the table $F_{8,27}$ ($\sim F_{8,30} = 3.17$). Thus the null

---

12/ A variable is determined significant if its calculated t* (estimated coefficient divided by its standard error) is greater than the table t value. For a one-tailed t test, the table t value is t^{α}_{n-k} or $t^{.01}_{27} = 2.473$. To test the significance of the two variables whose expected sign is indeterminate, a two-tailed t test is appropriate ($t^{\alpha/2}_{n-k}$ or $t^{.005}_{27} = 2.771$).

hypothesis that all of the coefficients taken together are equal to zero can be rejected at the one percent level of significance.

Heteroskedasticity in the Revised Model

Recall that heteroskedasticity violates the classical linear regression model's assumption of constant variance.[13/] Consequently, an attempt was made to address this problem. Residual plots of the OLS regression in Table 18 against each explanatory variable revealed that the assumption of homoskedasticity was not violated in the revised model which utilized the log of the dependent variable, the regional share component in actual income.[14/]

Multicollinearity in the Revised Model

Intercorrelation among the explanatory variables relating county characteristics to the dependent variable, the county's regional share component, proved to be the most prevalent statistical problem encountered in the revised model.[15/] Although location theory and prior research in this area suggested many potential determinants of an area's regional share component, the condition of multicollinearity necessitated the selection of those explanatory vari-

---

13/ A more detailed description and the consequences of this statistical problem is related in an earlier section describing heteroskedasticity in the preliminary model.

14/ Heteroskedasticity was present in the linear model with the same explanatory variables. Because a majority of these variables were not significant or had signs contrary to what theory would suggest, the log-linear model was preferred.

15/ A more extensive discussion of the problem of multicollinearity is denoted in a prior section describing this condition in the preliminary model. A summary of the Farrar-Glauber test for multicollinearity is presented in Appendix C.

ables which minimized the problem. The independent variables in the revised model were selected with the intent of satisfying both economic theory and statistical considerations. Although multicollinearity is not completely eliminated ($*X^2$ = 69.8551 and table X^2 = 41.34 at the five percent level of significance when the degrees of freedom are 28), the revised model includes variables which regional economic theory suggests are relevant.

Examination of the results from the latter two sections of the Farrar-Glauber test revealed that the pattern of multicollinearity was due to the correlation between the proxy representing a county's retirement population and both the level of a county population's educational attainment and the county's log production. Due to its representation of a county's locational advantage, deletion of this variable was not considered appropriate by the researcher.

Conclusion

Although industrial location theory and research suggest a number of factors influential in determining comparative advantage of an area vis-a-vis other regions, the statistical condition of multicollinearity precluded the usage of many relevant determinants of the Oregon county's regional share component. Ordinary Least Squares regression results for the final model identified the following factors as having favorable and significant impacts on the county's competitive advantage (disadvantage), as related by its regional share value for the period of shift-share analysis, 1973 to 1978: county log production (proxy for county's timber dependence); the relative increase of county population aged 65 and older (proxy

for relative increase of retired people who are assumed to consider a locale's scenic amenities in their decision to retire); and the average county tax rate (proxy for a county's level of municipal services). The level of educational attainment of the county population (measured by the proportion of the county's population who have not finished high school) was adversely and significantly related to the dependent variable.

Two factors, the county's average tax rate and the dummy variable indicating the existence of a Port District which encourages industrial activities, are considered policy variables subject to local control. Past research suggests that both be used as instruments of industrial development policy, to reduce the income disparities among counties. Only the former was determined to be positively and significantly related to the county's regional share component. Contrary to theory, the existence of a Port District had an adverse, however insignificant, impact on a county's competitive position. It is possible that this variable is not an adequate measure of a county's promotion of industrial activities.

CHAPTER VI

CONCLUSIONS AND POLICY IMPLICATIONS

Research Objectives

The stated objectives of the thesis were defined as: first, to describe the performance of each Oregon county (industrial sector) in the context of the modified shift-share framework proposed by Kalbacher [1979]; second, to identify those sectors which contribute favorably (adversely) to each Oregon county's status as implied by the shift-share analysis; and finally, to evaluate the influence of selected social and economic attributes on each county's regional share component. This chapter sets out with a brief summary of the research results and continues with a discussion of the limitations noted in the modified shift-share formulation, and their possible influence on policy implications drawn from the results. Suggestions for further research are also presented in the concluding section.

Research Summary

In order for concerned citizens and local government officials in Oregon counties to respond to the objective concerning diversification and improvement of the Oregon economy mandated by the Land Conservation and Development Commission (LCDC), factors influencing diversification in Oregon counties need to be identified. Descriptive information concerning the economic structure of the Oregon county is often a prerequisite to policy decisions dealing with future population growth and economic development. Knowledge about the strengths and weaknesses of each county allows the planning

agent to make a more realistic assessment of a region's prospects for future growth or decline.

Despite its limitations, the descriptive tool of shift-share analysis has sustained widespread usage in the description of regional growth patterns. In Chapter II, a review of applications based on the classical shift-share equation is succeeded by a summary of the literature dealing with its limitations.

Taking into account that the modified shift-share variant proposed by Kalbacher [1979] does not resolve all the classical shift-share limitations, it is selected as the methodology most useful in describing the Oregon economy. Similar to the classical equation, the modified shift-share formulation is a descriptive tool which permits an orderly assessment of the changes occurring in a region. The present usage of the modified shift-share approach describes changes in labor and proprietors' income between 1973 and 1978 for the 12 industrial sectors in each of the 36 Oregon counties. Results are detailed in Appendix A. Emphasis is given to the fact that the research is a study of relative change; all conclusions about county and industry performances are made with reference to the Pacific Northwest region as the standard for comparison.

A classification scheme based on the modified shift-share results is utilized to separate the 36 Oregon counties into four regional categories, ranging from counties gaining income due to both industry mix and regional share effects to counties losing income on both accounts. Counties in the latter category should not necessarily be considered 'depressed' areas; industries in these counties simply grew slower than their counterparts in the Pacific Northwest

reference region. Individual county profiles, presented in Chapter IV, provide a descriptive overview of the population and income changes sustained during the period of shift-share analysis, 1973 to 1978. Specifically, sectors are ranked in order of their importance to each shift-share component. This allows the regional planner to discern the strengths and weaknesses of each county which is useful to planning for future economic development or decline.

Shift-share analysis should only be used as a tool for description of historical changes in the level of economic activity of a region (industry); it does not identify the causes of the divergency in income experienced by the region (industry). According to theory, the third component of change in the shift-share equation, the regional share effect, represents a measure of comparative advantage of a locale. Several factors were found to have significant impacts on a county's competitive advantage (disadvantage), as related by its regional share component, in the regression results presented in Chapter V. A county's log production (proxy for county's timber dependence), the relative increase in county population age 65 or over (proxy for county's locational advantage as a retirement destination) and the average county tax rate were found to be positively and significantly related to a county's regional share value, whereas the level of the county population's educational attainment (measured by its proportion who have not finished high school) had an adverse and significant impact. The favorable regression results supports the previous literature which suggests that the comparative advantage (disadvantage) of a locale underlies its regional share component.

Research Problems and Suggestions for Further Analysis

The modified shift-share methodology suggested by Kalbacher [1979] appears to overcome several but not all the limitations of the classical shift-share formulation. The possible impact of these limitations on policy implications is considered as well as suggestions for additional avenues of research.

Although the modified shift-share approach does provide a measure of industrial composition of the region not present in the classical formulation, no account is made of changes in a county's industrial composition during the period of shift-share analysis. Similar to the classical equation, the modified approach only considers a county's industrial composition in the base year of analysis. Policy suggestions based on the shift-share results may not be appropriate if the industrial composition of a county changed during the analysis period. For example, a county classified as 'depressed' in 1973 may have expanded its economic base during the six year period and thus, no longer be considered a declining economy by 1978, the terminal year of the shift-share analysis. Similarly, the reverse may also occur. Consequently, it is important to observe that shift-share describes the extent to which regional growth rates have been conditioned by a county's initial industrial composition. This leads to the first recommendation for future research. To examine whether counties classified in the four regional categories denoted in Chapter IV, maintain their respective status, a shift-share analysis should be conducted for a more recent study period such as 1976 to 1982. One should recognize that because the latter are

recession years, comparison of the results may not be a valid way of determining whether the industrial composition of a region changes during the analysis period. Recall that the years selected for the shift-share analysis in the thesis are non-recession years.

Another limitation of the classical shift-share formulation which is also applicable to the modified approach is the interdependence between the industry mix and regional share effects. Several researchers claim that the industry mix effect will normally be understated because of the influence of interindustry linkages and multiplier effects causing the size of the regional share value to be overstated [Craig, 1959; MacKay, 1968; Miller, 1974; Stilwell, 1969]. To alleviate this concern, Stilwell [1969] suggests including the value of the industry mix component as an independent variable in the regression analysis utilized to determine factors which influence an area's competitive advantage, as related by its regional share value. Inclusion of the industry mix component in the empirical analysis conducted in the thesis yielded poor results with respect to both severe multicollinearity and lack of significant results. Therefore, one may suggest that the regional share component is an inadequate measure of an area's competitive advantage (disadvantage) vis-a-vis other regions. The favorable results attained by the present empirical analysis tends to reject this supposition, but further research may yield more conclusive results.

Further analysis of the revised regression model should include a more detailed test for heteroskedasticity, the statistical problem typically evident in cross-sectional data in which the variances are not constant over the sample. As noted in Chapter V, the presence

of heteroskedasticity was not detected in the scatter diagrams. Due to the sample size (36 Oregon counties), the Goldfeld-Quandt test detailed by Koutsoyiannis [1977], is suggested to affirm this author's assumption of homoskedasticity in the revised model.

The majority of past shift-share applications utilized the nation as the reference region. Both Houston [1967] and Brown [1969] argue that there is excessive dependence on what happened in the nation as opposed to the region in the classical shift-share formulation. The Pacific Northwest region was determined as the base for comparison in the modified shift-share analysis conducted in the thesis. It was anticipated that information concerning the performance of the Oregon economy relative to a more similar geographic and economic area such as the Pacific Northwest region rather than the nation as a whole, be more appropriate to citizens involved in economic development planning. In retrospect, descriptive information comparing the performance of the state of Oregon to national trends may be relevant because of the important impact of national policies (interest rates and mortgage regulations) to the state's timber dependent economy. Consequently, a shift-share analysis of the Oregon economy utilizing the nation as the standard of comparison, may provide a more realistic appraisal of Oregon's prospects for growth, than does the present research.

BIBLIOGRAPHY

Andrikopoulos, A.A. 1980. "A Synthesis of the Production Function and the Shift-Share Model —— A New Regional Modelling Approach," Regional Science and Urban Economics 10(4):539-560.

_____. 1977. "Regional Growth Differential in Manufacturing Employment: The Case of the Province of Ontario, Canada," Review of Regional Studies 7(3):45-61.

Ashby, L.D. 1964. "The Geographical Redistribution of Employment: An Examination of the Elements of Change," Survey of Current Business 44(10):13-20.

_____. 1968. "The Shift and Share Analysis: A Reply," Southern Economic Journal 34(3):423-425.

_____. 1970. "Changes in Regional Industrial Structure: A Comment," Urban Studies 7(3):298-304.

_____. 1973. "Employment Change Patterns: Some Empirical Tests," Review of Regional Studies 3(2):25-29.

Bishop, K.C. and C.E. Simpson. 1972. "Components of Change Analysis: Problems of Alternative Approaches to Industrial Structure," Regional Studies 6(1):59-68.

Blair, D.W. and R.H. Mabry. 1980. "Regional Crime Growth: An Application of the Shift-Share Technique," Growth and Change: A Journal of Regional Development 11(1):48-51.

Borts, G.H. and J.L. Stein. 1964. Economic Growth in a Free Market. Columbia University Press, New York.

Bretzfelder, R.B. 1970. "Geographic Trends in Personal Income in the 1960's," Survey of Current Business 50(8):14-44.

Brown, H.J. 1969. "Shift and Share Projections of Regional Economic Growth: An Empirical Test," Journal of Regional Science 9(1): 1-18.

_____. 1971. "The Stability of the Regional-Share Component: Reply," Journal of Regional Science 11(1):113-114.

Buck, T.W. 1970. "Shift and Share Analysis —— A Guide to Regional Policy?" Regional Studies 4(4):445-450.

Chalmers, J.A. 1971. "Measuring Changes in Regional Industrial Structure: A Comment on Stilwell and Ashby," Urban Studies 8(3):289-292.

Chalmers, J.A. and T.L. Beckhelm. 1976. "Shift and Share and the Theory of Industrial Location," Regional Studies 10(1):15-23.

Craig, P.G. 1959. "Comments on the Papers by Fuchs and Isard and Schooler: Discussion Paper," Journal of Regional Science 1(2): 35-42.

Creamer, D. 1942. "Shifts of Manufacturing Industries," Chapter 4 of Industrial Location and National Resources, Washington, D.C.: U.S. Government Printing Office 85-104.

Curtis, W.C. 1972. "Shift-Share Analysis as a Technique in Rural Development Research," American Journal of Agricultural Economics 54(2):267-270.

Davis, H.C. and M.A. Goldberg. 1972. "Combining Intersectoral Flows and Shift-Share Techniques: A Hybrid Regional Forecasting Model," The Annals of Regional Science 6(1):106-115.

Dutrow, G.F. 1972. "Shift-Share Analysis of Southern Forest Industry, 1958-1967," Forest Product Journal 22(12):10-14.

Edwards, J.A. 1976. "Industrial Structure and Regional Change: A Shift-Share Analysis of the British Columbia Economy, 1961-1970," Regional Studies 10(3):307-317.

Edwards, J.A., K.F. Harniman, and J.S. Morgan. 1978. "Regional Growth and Structural Adaptation: A Correction to the Stilwell Modification," Urban Studies 15(1):97-100.

Esteban-Marquillas, J.M. 1972. "A Reinterpretation of Shift-Share Analysis," Regional and Urban Economics 2(3):249-261.

Floyd, C.F. 1973. "Shift and Share Projection Models: A Reformation," Paper presented to the Western Regional Science Association.

Floyd, C.F. and C.F. Sirmans. 1973. "Shift and Share Projections Revisited," Journal of Regional Science 13(1):115-120.

Fuchs, V.R. 1959. "Changes in the Location of U.S. Manufacturing Since 1929," Journal of Regional Science 1(2):1-17.

Fuguitt, G. and P.R. Voss. 1979. "Recent Nonmetropolitan Population Trends," Growth and Change in Rural America, Urban Land Institute, Washington, D.C.

Garrett, M.A., Jr. 1968. "Growth in Manufacturing in the South, 1947-1958: A Study in Regional Industrial Development," Southern Economic Journal 34(3):352-364.

Grant, C. 1973. "Employment Change Patterns: Some Empirical Tests: Comments," Review of Regional Studies 3(2):35-37.

Herzog, H.W., Jr. and R.J. Olsen. 1977. "Shift-Share Analysis Revisited: The Allocation Effect and the Stability of Regional Structure," Journal of Regional Science 17(3):441-454.

Houston, D.B. 1967. "The Shift and Share Analysis of Regional Growth: A Critique," Southern Economic Journal 33(4):577-581.

Indexes and Rankings for Indicators of Social Well Being for U.S. Counties. 1979. Statistical Supplement for Rural Development Research Report Number 10; Economics, Statistics, and Cooperatives Service, U.S. Department of Agriculture, Washington, D.C.

Intriligator, M.D. 1978. Econometric Models, Techniques, and Applications. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

Isard, W. 1960. Methods of Regional Analysis: An Introduction to Regional Science. The M.I.T. Press, Cambridge, Massachusetts.

James, F., Jr. and J. Hughes. 1973. "A Test of Shift and Share Analysis as a Predictive Device," Journal of Regional Science 13(2):223-231.

Kalbacher, J.Z. 1979. "Shift-Share Analysis: A Modified Approach," Agricultural Economics Research 31(1):12-25.

Koutsoyiannis, A. 1977. Theory of Econometrics. Second Edition, The MacMillan Press, Ltd., London, England.

Lasuen, J.R. 1971. "Venezuela: An Industrial Shift-Share Analysis, 1941-1961," Regional and Urban Economics 1(2):153-220.

Lindley, S. (editor). 1979. Oregon Blue Book, 1979-1980. Daily Journal Journal of Commerce, Salem, Oregon.

Little, I., T. Scitovsky, and M. Scott. 1970. Industry and Trade in Some Developing Countries — A Comparative Study. Oxford University Press, Great Britain.

Local Area Personal Income: 1973-1978, A Summary. 1980. Bureau of Economic Analysis, U.S. Department of Commerce (1).

MacKay, D.I. 1968. "Industrial Structure and Regional Growth: A Methodological Problem," Scottish Journal of Political Economy 15(2):129-143.

Maki, W.R. and D.L. Schweitzer. 1973. "Importance of Timber-Based Employment to the Douglas-Fir Region, 1959-1971," U.S.D.A. Forest Service Research Note, Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, Portland, Oregon.

Miller, E. 1974. "The Role of Factor Supplies in Employment Growth," Review of Regional Studies 3(3):61-77.

Morentz, D.S. and B.J. Deaton. "An Analysis of the Local Economies of Montgomery, King and Queen, Goochland, and Prince Edward Counties in Virginia Based on Shift-Share Analysis," Department of Agricultural Economics, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Morey, D. 1981. "Unpublished Employment Data by County," Bonneville Power Administration, Portland, Oregon.

Murphy, J.L. 1973. Introductory Econometrics. Richard D. Irwin, Inc., Homewood, Illinois.

Oregon 2000 Report. 1980. Oregon 2000 Commission, Salem, Oregon.

Oregon Economic Statistics. 1975. Bureau of Business Research, University of Oregon, Eugene, Oregon.

Owen, L.P. 1979. "Migration and Economic Change in Timber Reliant Counties: An Econometric Analysis," Unpublished M.S. Thesis, Oregon State University, Corvallis, Oregon.

Paraskevopoulos, C.C. 1974. "Patterns of Regional Economic Growth," Regional and Urban Economics 4(1):77-105.

_____. 1971. "The Stability of the Regional-Share Component: An Empirical Test," Journal of Regional Science 11(1):107-112.

Paris, J.D. 1970. "Regional/Structural Analysis of Population Changes," Regional Studies 4:425-443.

Perloff, H.S., E.S. Dunn, Jr., E.E. Lampard, and R.F. Muth. 1960. Regions, Resources, and Economic Growth, published for Resources for the Future, Inc., The John Hopkins Press, Baltimore, Maryland.

Perloff, H.S. with V.W. Dodds. 1973. "How a Region Grows — Area Development in the U.S. Economy," Supplementary Paper No. 17, Committee for Economic Development.

Peterson, R.J. and G.C. Davis. 1981. Education Directory, Colleges and Universities, 1979-1980. National Center for Education Statistics, U.S. Department of Education, Washington, D.C.

Petrulis, M.F. 1979. "Regional Manufacturing Employment Growth Patterns," Rural Development Research Report No. 13, Economic Development Division; Economics, Statistics and Cooperatives Service, U.S. Department of Agriculture, Washington, D.C.

Randall, J.N. 1973. "Shift-Share Analysis as a Guide to the Employment Performance of West Central Scotland," Scottish Journal of Political Economy 20(1):1-26.

Rao, P. and R.L. Miller. 1971. Applied Econometrics. Wadsworth Publishing Company, Inc., Belmont, California.

Sales and Marketing Management, Survey of Buying Power. 1974. New York.

Seidel, K. 1982. "Data on county population age 65 and over." Per phone conversation with Bureau of Governmental Research and Service, University of Oregon, Eugene, Oregon.

Shaffer, R. 1979. "Determinants of the Competitive Share in Wisconsin Counties, 1962-1972: The Role of Government Policy," Annals of Regional Science 13(2):67-79.

Shaffer, R., R. Dunford, and P. Langrish. "Changes in Wisconsin's Nonfarm Private Employment 1962-1972: A Shift and Share Analysis," Research Bulletin R2806, College of Agricultural and Life Sciences, University of Wisconsin, Madison, Wisconsin.

"Statewide Planning Goals and Guidelines; Adopted by the Land Conservation and Development Commission," 1974. Department of Land Conservation and Development, Salem, Oregon.

Stevens, B.H. and C.L. Moore. 1980. "A Critical Review of the Literature on Shift-Share as a Forecasting Technique," Journal of Regional Science 20(4):419-437.

Stilwell, F.J.B. 1969. "Regional Growth and Structural Adaptation," Urban Studies 6(2):162-178.

_____. 1970. "Further Thoughts on the Shift and Share Approach," Regional Studies 4(4):451-458.

Summary of 1973 Assessment Roll and Tax Roll for the 1973-74 Fiscal Year and 1971-72 and 1972-73 Property Tax Collections. 1974. Research and Special Services Divison, Department of Revenue, Salem, Oregon.

Thompson, W.R. 1968. "Internal and External Factors in the Development of Urban Economics," in H.S. Perloff and L. Wingo, Jr., Issues in Urban Economics, published for the Resources for the Future, Inc., John Hopkins Press, Baltimore, Maryland.

"Unemployment Data." (1977 revised). Research and Statistics, State of Oregon Employment Division, Department of Human Resources.

Weaver, R. and M. McMillan. 1976. "Factors Influencing Manufacturing Employment Change in Small Wisconsin Counties: 1960-1970," Research Bulletin R2776, College of Agricultural and Life Sciences, University of Wisconsin, Madison, Wisconsin.

Weber, B.A., W.E. Schmisseur, and J.W. Oyala. 1979. "Oregon Smaller Ports: What They Do and How They Are Financed," Extension Circular 979, Extension Service, Oregon State University, Corvallis, Oregon.

APPENDIX A

MODIFIED SHIFT-SHARE RESULTS FOR THE 36 OREGON COUNTIES, 1973 TO 1978

Table A-1. Baker County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	10,832	21.92	5,251	7.45	-51.52	-11.29	.94	-12.23	2.06	-14.29
2) Agricultural Services, Forestry, Fisheries, and Other	658	-	(D)	-	-	-	-	-	-	-
3) Mining	. (D)	-	(D)	-	-	-	-	-	-	-
4) Construction	(D)	-	8,492	-	-	-	-	-	-	-
5) Manufacturing	8,417	17.03	13,358	18.95	58.70	10.00	18.79	-8.79	-4.60	-4.19
6) Transportation and Public Utilities	3,202	6.48	4,604	6.53	43.79	2.84	5.76	-2.92	-.82	-2.10
7) Wholesale Trade	1,655	3.35	3,506	4.97	111.84	3.75	6.23	-2.48	-2.92	.44
8) Retail Trade	6,206	12.56	8,856	12.56	42.70	5.37	8.50	-3.13	.90	-4.03
9) Finance, Insurance, and Real Estate	1,479	2.99	2,732	3.88	84.72	2.53	5.34	-2.81	-1.88	-.93
10) Services	3,658	7.40	8,471	12.02	131.58	9.74	14.17	-4.43	-6.62	2.19
11) Civilian and Military Federal Government	3,889	7.87	6,245	8.86	60.58	4.77	3.78	.99	.65	.34
12) State and Local Government	5,023	10.16	7,286	10.34	45.05	4.58	8.40	-3.82	-1.71	-2.11
Combined Sectors: Agricultural Services, Forestry, Fisheries, and Other; Mining; Construction	5,062	10.24	10,176	14.44	101.03	10.35	9.15	1.20	3.58	-2.38
TOTAL:	49,423	-	70,485	-	42.62	42.64	81.06	-38.42	-11.36	-27.06

[a/] Please refer to notes following the tables.

Table A-2. Benton County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	5,819	3.61	7,251	2.31	24.61	.89	.94	-.05	-.45	.40
2) Agricultural Services, Forestry, Fisheries, and Other	1,193	.74	2,621	.83	119.70	.89	1.01	-.12	.16	-.28
3) Mining	181	.11	405	.13	123.76	.14	.39	-.25	-.26	.01
4) Construction	7,853	4.87	15,660	4.98	99.41	4.84	7.75	-2.91	-1.84	-1.07
5) Manufacturing	29,735	18.44	71,662	22.81	141.00	26.00	18.79	7.21	-3.42	10.63
6) Transportation and Public Utilities	7,939	4.93	13,402	4.27	68.81	3.39	5.76	-2.37	-2.00	-.37
7) Wholesale Trade	2,956	1.83	7,237	2.30	144.82	2.66	6.23	-3.57	-4.42	.85
8) Retail Trade	17,399	10.79	32,776	10.43	88.38	9.54	8.50	1.04	-.43	1.47
9) Finance, Insurance, and Real Estate	4,841	3.00	12,785	4.07	164.10	4.92	5.34	-.42	-1.87	1.45
10) Services	24,146	14.98	52,344	16.67	116.78	17.49	14.17	3.32	1.11	2.21
11) Civilian and Military Federal Government	11,552	7.17	17,962	5.72	55.49	3.98	3.78	.20	.25	-.05
12) State and Local Government	47,595	29.53	80,077	25.49	68.25	20.15	8.40	11.75	11.04	.71
TOTAL:	161,209	-	314,182	-	94.89	94.89	81.06	13.83	-2.13	15.96

[a/] Please refer to notes following the tables.

Table A-3. Clackamas County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	24,281	5.27	31,929	3.49	31.50	1.66	.94	.72	-.22	.94
2) Agricultural Services, Forestry, Fisheries, and Other	2,838	.62	6,618	.72	133.19	.83	1.01	-.18	-.03	-.15
3) Mining	940	.20	2,192	.24	133.19	.27	.39	-.12	-.15	.03
4) Construction	44,901	9.75	88,441	9.68	96.97	9.46	7.75	1.71	4.08	-2.37
5) Manufacturing	117,957	25.61	233,985	25.60	98.36	25.19	18.79	6.40	2.56	3.84
6) Transportation and Public Utilities	18,223	3.96	34,120	3.73	87.24	3.45	5.76	-2.31	-2.74	.43
7) Wholesale Trade	33,627	7.30	72,023	7.89	114.18	8.35	6.23	2.12	.97	1.15
8) Retail Trade	62,757	13.63	125,461	13.73	99.92	13.62	8.50	5.12	1.70	3.42
9) Finance, Insurance, and Real Estate	14,895	3.23	39,951	4.37	168.22	5.43	5.34	.09	-1.60	1.69
10) Services	66,647	14.47	151,219	16.54	126.90	18.37	14.17	4.20	.60	3.60
11) Civilian and Military Federal Government	9,698	2.11	17,701	1.94	82.52	1.74	3.78	-2.04	-2.59	.55
12) State and Local Government	63,757	13.85	110,387	12.08	73.14	10.12	8.40	1.72	.71	1.01
TOTAL:	460,521	-	914,027	-	98.48	98.49	81.06	17.43	3.29	14.14

[a/] Please refer to notes following the tables.

Table A-4. Clatsop County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	1,530	1.53	4,553	2.50	197.58	3.02	.94	2.08	-.74	2.82
2) Agricultural Services, Forestry, Fisheries, and Other	2,223	2.22	7,422	4.07	233.87	5.19	1.01	4.18	2.48	1.70
3) Mining	(D)	-	(D)	-	-	-	-	-	-	-
4) Construction	5,260	5.25	9,138	5.02	73.73	3.88	7.75	-3.87	-1.37	-2.50
5) Manufacturing	35,278	35.25	63,753	35.00	80.72	28.44	18.79	9.65	10.59	-.94
6) Transportation and Public Utilities	9,025	9.02	13,350	7.33	47.92	4.33	5.76	-1.43	1.12	-2.55
7) Wholesale Trade	(D)	-	(D)	-	-	-	-	-	-	-
8) Retail Trade	13,534	13.52	23,541	12.92	73.94	10.00	8.50	1.50	1.62	-.12
9) Finance, Insurance, and Real Estate	2,095	2.09	5,060	2.78	141.53	2.96	5.34	-2.38	-2.92	.54
10) Services	10,077	10.07	22,212	12.19	120.42	12.12	14.17	-2.05	-3.90	1.85
11) Civilian and Military Federal Government	3,328	3.33	5,036	2.76	51.32	1.71	3.78	-2.07	-1.91	-.16
12) State and Local Government	15,106	15.09	24,940	13.69	65.10	9.83	8.40	1.43	1.54	-.11
Combined Sectors: Mining; Wholesale Trade	2,635	2.63	3,173	1.74	20.42	.55	6.62	-6.07	-3.99	-2.08
TOTAL:	100,091	-	182,178	-	82.01	82.03	81.06	.97	2.52	-1.55

[a/] Please refer to notes following the tables.

Table A-5. Columbia County.[a/]

SHIFT-SHARE COEFFICIENTS

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	3,170	3.57	4,911	3.58	54.92	1.96	.94	1.02	-.46	1.48
2) Agricultural Services, Forestry, Fisheries, and Other	214	.24	1,433	1.04	569.63	1.37	1.01	.36	-.63	.99
3) Mining	803	.90	2,095	1.53	160.90	1.45	.39	1.06	.67	.39
4) Construction	17,099	19.26	9,234	6.72	-46.00	-8.85	7.75	-16.60	15.61	-32.21
5) Manufacturing	36,047	40.61	54,086	39.39	50.04	20.31	18.79	1.52	15.06	-13.54
6) Transportation and Public Utilities	5,697	6.42	12,594	9.17	121.06	7.77	5.76	2.01	-.87	2.88
7) Wholesale Trade	1,216	1.37	2,456	1.79	101.97	1.41	6.23	-4.82	-4.87	.05
8) Retail Trade	7,220	8.13	12,549	9.14	73.81	6.01	8.50	-2.49	-2.41	-.08
9) Finance, Insurance, and Real Estate	1,545	1.74	3,829	2.79	147.83	2.56	5.34	-2.78	-3.33	.55
10) Services	4,723	5.32	12,123	8.83	156.68	8.34	14.17	-5.83	-8.74	2.91
11) Civilian and Military Federal Government	1,109	1.25	1,795	1.31	61.86	.78	3.78	-3.00	-3.07	.07
12) State and Local Government	9,930	11.19	20,203	14.71	103.45	11.58	8.40	3.18	-1.03	4.21
TOTAL:	88,773	-	137,308	-	54.67	54.69	81.06	-26.37	5.93	-32.30

[a/] Please refer to notes following the tables.

Table A-6. Coos County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	5,228	2.63	9,902	2.83	89.40	2.35	.94	1.41	-.58	1.99
2) Agricultural Services, Forestry, Fisheries, and Other	2,496	1.25	6,063	1.73	142.91	1.79	1.01	.78	.96	-.18
3) Mining	255	.13	523	.15	105.10	.13	.39	-.26	-.24	-.02
4) Construction	8,851	4.45	18,814	5.38	112.56	5.01	7.75	-2.74	-2.35	-.39
5) Manufacturing	69,290	34.81	120,986	34.58	74.61	25.97	18.79	7.18	10.23	-3.05
6) Transportation and Public Utilities	26,302	13.21	39,356	11.25	49.63	6.56	5.76	.80	4.32	-3.52
7) Wholesale Trade	5,779	2.90	11,247	3.22	94.62	2.76	6.23	-3.47	-3.36	-.11
8) Retail Trade	24,713	12.41	37,978	10.86	53.68	6.67	8.50	-1.83	.79	-2.62
9) Finance, Insurance, and Real Estate	5,397	2.71	11,555	3.30	114.10	3.08	5.34	-2.26	-2.21	-.05
10) Services	20,215	10.16	39,976	11.43	97.75	9.92	14.17	-4.25	-3.81	-.44
11) Civilian and Military Federal Government	6,824	3.43	10,854	3.10	59.06	2.03	3.78	-1.75	-1.85	.10
12) State and Local Government	23,712	11.91	42,571	12.17	79.53	9.47	8.40	1.07	-.56	1.63
TOTAL:	199,062	-	349,825	-	75.74	75.74	81.06	-5.32	1.34	-6.66

[a/] Please refer to notes following the tables.

Table A-7. Crook County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	4,427	10.52	3,754	5.39	-15.20	-1.60	.94	-2.54	.50	-3.04
2) Agricultural Services, Forestry, Fisheries, and Other	386	.92	794	1.14	105.70	.97	1.01	-.04	.44	-.48
3) Mining	0	0	82	.12	-	0	.39	-.39	-.39	0
4) Construction	2,093	4.97	3,493	5.02	66.89	3.33	7.75	-4.42	-1.71	-2.71
5) Manufacturing	17,364	41.26	31,447	45.15	81.10	33.46	18.79	14.67	15.61	-.94
6) Transportation and Public Utilities	2,002	4.76	2,123	3.05	6.04	.29	5.76	-5.47	-2.13	-3.34
7) Wholesale Trade	2,064	4.90	4,168	5.98	101.94	5.00	6.23	-1.23	-1.40	.17
8) Retail Trade	3,338	7.93	6,088	8.74	82.38	6.54	8.50	-1.96	-2.56	.60
9) Finance, Insurance, and Real Estate	520	1.24	1,002	1.44	92.69	1.14	5.34	-4.20	-3.92	-.28
10) Services	3,147	7.48	5,899	8.47	87.45	6.54	14.17	-7.63	-6.54	-1.09
11) Civilian and Military Federal Government	2,813	6.68	4,384	6.29	55.85	3.74	3.78	-.04	-.02	-.02
12) State and Local Government	3,931	9.34	6,417	9.21	63.24	5.91	8.40	-2.49	-2.25	-.24
TOTAL:	42,085	-	69,651	-	65.50	65.32	81.06	-15.74	-4.37	-11.37

[a/] Please refer to notes following the tables.

Table A-8. Curry County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	2,094	4.84	3,568	4.76	70.39	3.40	.94	2.46	-.28	2.74
2) Agricultural Services, Forestry, Fisheries, and Other	631	1.46	2,457	3.28	289.38	4.23	1.01	3.22	1.29	1.93
3) Mining	50	.12	50	.07	0	0	.39	-.39	-.25	-.14
4) Construction	2,907	6.72	5,339	7.13	83.66	5.62	7.75	-2.13	.40	-2.53
5) Manufacturing	19,075	44.11	27,730	37.02	45.37	20.01	18.79	1.22	17.98	-16.76
6) Transportation and Public Utilities	1,114	2.58	2,276	3.04	104.31	2.69	5.76	-3.07	-3.79	.72
7) Wholesale Trade	431	1.00	1,174	1.57	172.39	1.72	6.23	-4.51	-5.24	.73
8) Retail Trade	5,118	11.83	9,092	12.14	77.65	9.20	8.50	.70	.36	.34
9) Finance, Insurance, and Real Estate	1,026	2.37	1,778	2.37	73.29	1.73	5.34	-3.61	-2.60	-1.01
10) Services	3,487	8.06	7,116	9.50	104.07	8.39	14.17	-5.78	-5.94	.16
11) Civilian and Military Federal Government	2,026	4.69	4,442	5.93	119.25	5.59	3.78	1.81	-1.14	2.95
12) State and Local Government	5,288	12.23	9,876	13.19	86.76	10.61	8.40	2.21	-.35	2.56
TOTAL:	43,247	-	74,898	-	73.19	73.19	81.06	-7.87	.44	-8.31

[a/] Please refer to notes following the tables.

Table A-9. Deschutes County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	4,625	3.61	2,257	.82	-51.20	-1.85	.94	-2.79	-.45	-2.34
2) Agricultural Services, Forestry, Fisheries, and Other	898	.70	2,097	.76	133.52	.93	1.01	-.08	.09	-.17
3) Mining	598	.47	1,505	.55	151.67	.72	.39	.33	.17	.16
4) Construction	14,042	10.96	33,235	12.08	136.68	14.99	7.75	7.24	5.55	1.69
5) Manufacturing	29,412	22.97	61,578	22.39	109.36	25.11	18.79	6.32	.35	5.97
6) Transportation and Public Utilities	10,254	8.00	22,859	8.31	122.93	9.85	5.76	4.09	.35	3.74
7) Wholesale Trade	4,695	3.67	13,115	4.77	179.34	6.58	6.23	.35	-2.61	2.96
8) Retail Trade	19,424	15.17	40,589	14.76	108.96	16.53	8.50	8.03	2.85	5.18
9) Finance, Insurance, and Real Estate	7,132	5.57	18,209	6.62	155.31	8.65	5.34	3.31	1.11	2.20
10) Services	14,870	11.61	40,405	14.69	171.72	19.94	14.17	5.77	-2.32	8.09
11) Civilian and Military Federal Government	6,574	5.13	12,205	4.44	85.66	4.40	3.78	.62	-.89	1.51
12) State and Local Government	15,547	12.14	27,031	9.83	73.87	8.97	8.40	.57	-.41	.98
TOTAL:	128,071	-	275,085	-	114.79	114.82	81.06	33.76	3.79	29.97

[a/] Please refer to notes following the tables.

Table A-10. Douglas County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	6,248	2.23	11,032	2.24	76.57	1.70	.94	.76	-.64	1.40
2) Agricultural Services, Forestry, Fisheries, and Other	2,060	.73	4,472	.91	117.09	.86	1.01	-.15	.14	-.29
3) Mining	3,273	1.17	7,152	1.45	118.52	1.39	.39	1.00	.99	.01
4) Construction	15,927	5.67	31,127	6.32	95.44	5.42	7.75	-2.33	-.87	-1.46
5) Manufacturing	129,498	46.13	210,682	42.79	62.69	28.92	18.79	10.13	19.67	-9.54
6) Transportation and Public Utilities	13,592	4.84	25,240	5.13	85.70	4.15	5.76	-1.61	-2.07	.46
7) Wholesale Trade	4,876	1.74	9,271	1.88	90.14	1.57	6.23	-4.66	-4.51	-.15
8) Retail Trade	27,795	9.90	47,255	9.60	70.01	6.94	8.50	-1.56	-1.09	-.47
9) Finance, Insurance, and Real Estate	5,555	1.98	13,293	2.70	139.30	2.75	5.34	-2.59	-3.05	.46
10) Services	25,229	8.99	52,828	10.73	109.39	9.83	14.17	-4.34	-5.00	.66
11) Civilian and Military Federal Government	16,159	5.76	27,707	5.63	71.47	4.12	3.78	.34	-.54	.88
12) State and Local Government	30,511	10.87	52,353	10.63	71.59	7.78	8.40	-.62	-1.25	.63
TOTAL:	280,723	-	492,412	-	75.41	75.43	81.06	-5.63	1.78	-7.41

[a/] Please refer to notes following the tables.

Table A-11. Gilliam County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	861	15.33	4,892	40.59	468.18	71.76	.94	70.82	1.16	69.66
2) Agricultural Services, Forestry, Fisheries, and Other	90	-	(D)	-	-	-	-	-	-	-
3) Mining	0	-	0	-	0	0	.39	-.39	-.39	0
4) Construction	(D)	-	202	-	-	-	-	-	-	-
5) Manufacturing	27	-	(D)	-	-	-	-	-	-	-
6) Transportation and Public Utilities	559	9.95	751	6.23	34.35	3.42	5.76	-2.34	1.83	-4.17
7) Wholesale Trade	(D)	-	(D)	-	-	-	-	-	-	-
8) Retail Trade	1,106	19.69	1,264	10.49	14.29	2.82	8.50	-5.68	6.23	-11.91
9) Finance, Insurance, and Real Estate	101	1.80	270	2.24	167.33	3.01	5.34	-2.33	-3.25	.92
10) Services	445	7.92	776	6.44	74.38	5.89	14.17	-8.28	-6.09	-2.19
11) Civilian and Military Federal Government	594	10.58	817	6.78	37.54	3.97	3.78	.19	2.17	-1.98
12) State and Local Government	1,543	27.47	2,459	20.40	59.36	16.31	8.40	7.91	9.68	-1.77
Combined Sectors: Agricultural Services, Forestry, Fisheries, and Other; Construction; Manufacturing; Wholesale Trade	408	7.26	823	6.83	101.72	7.38	33.78	-26.40	-26.94	.54
TOTAL:	5,617	-	12,052	-	114.56	114.56	81.06	33.5	-15.6	49.10

[a/] Please refer to notes following the tables.

Table A-12. Grant County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	4,966	18.67	4,945	11.68	-.42	-.09	.94	-1.03	1.61	-2.64
2) Agricultural Services, Forestry, Fisheries, and Other	222	.83	297	.70	33.78	.28	1.01	-.73	.30	-1.03
3) Mining	50	.19	331	.78	562.00	1.07	.39	.68	-.16	.84
4) Construction	1,001	3.76	1,447	3.42	44.56	1.68	7.75	-6.07	-3.18	-2.89
5) Manufacturing	7,830	29.43	14,634	34.56	86.90	25.57	18.79	6.78	5.74	1.04
6) Transportation and Public Utilities	795	2.99	1,362	3.22	71.32	2.13	5.76	-3.63	-3.48	-.15
7) Wholesale Trade	402	1.51	460	1.07	14.43	.22	6.23	-6.01	-4.74	-1.27
8) Retail Trade	2,496	9.38	4,155	9.81	66.47	6.24	8.50	-2.26	-1.48	-.78
9) Finance, Insurance, and Real Estate	340	1.28	631	1.49	85.59	1.08	5.34	-4.26	-3.87	-.39
10) Services	1,494	5.62	2,783	6.57	86.28	4.84	14.17	-9.33	-8.44	-.89
11) Civilian and Military Federal Government	3,201	12.03	4,751	11.22	48.42	5.83	3.78	2.05	2.99	-.94
12) State and Local Government	3,806	14.31	6,553	15.47	72.18	10.33	8.40	1.93	1.02	.91
TOTAL:	26,603	-	42,349	-	59.19	59.18	81.06	-21.88	-13.69	-8.19

[a/] Please refer to notes following the tables.

Table A-13. Harney County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	9,172	27.49	8,365	17.48	-8.80	-2.42	.94	-3.36	2.83	-6.19
2) Agricultural Services, Forestry, Fisheries, and Other	117	.35	345	.72	194.87	.68	1.01	-.33	-.46	.13
3) Mining	50	.15	0	0	0	0	.39	-.39	-.21	-.18
4) Construction	670	2.01	1,215	2.54	81.34	1.64	7.75	-6.11	-5.31	-.80
5) Manufacturing	9,976	29.90	16,191	33.84	62.30	18.63	18.79	-.16	6.14	-6.30
6) Transportation and Public Utilities	1,618	4.85	2,531	5.29	56.43	2.74	5.76	-3.02	-2.06	-.96
7) Wholesale Trade	467	1.40	1,134	2.37	142.83	2.01	6.23	-4.22	-4.84	.62
8) Retail Trade	2,753	8.25	4,060	8.48	47.48	3.93	8.50	-4.57	-2.32	-2.25
9) Finance, Insurance, and Real Estate	431	1.29	661	1.38	53.36	.68	5.34	-4.66	-3.85	-.81
10) Services	1,523	4.57	2,766	5.78	81.62	3.73	14.17	-10.44	-9.51	-.93
11) Civilian and Military Federal Government	2,585	7.75	4,029	8.42	55.86	4.33	3.78	.55	.58	-.03
12) State and Local Government	3,998	11.98	6,555	13.70	63.96	7.67	8.40	-.73	-.51	-.22
TOTAL:	33,360	-	47,852	-	43.44	43.62	81.06	-37.44	-19.52	-17.92

[a/] Please refer to notes following the tables.

Table A-14. Hood River County.[a/]

SHIFT-SHARE COEFFICIENTS

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	11,252	20.83	16,091	17.29	43.01	8.95	.94	8.01	1.91	6.10
2) Agricultural Services, Forestry, Fisheries, and Other	323	.60	790	.85	144.58	.87	1.01	-.14	-.06	-.08
3) Mining	50	.09	50	.05	0	0	.39	-.39	-.28	-.11
4) Construction	2,263	4.19	4,164	4.48	84.00	3.52	7.75	-4.23	-2.67	-1.56
5) Manufacturing	12,261	22.70	22,774	24.48	85.74	19.46	18.79	.67	.13	.54
6) Transportation and Public Utilities	4,402	8.15	7,637	8.21	73.49	5.99	5.76	.23	.45	-.22
7) Wholesale Trade	3,618	6.70	7,198	7.74	98.95	6.63	6.23	.40	.37	.03
8) Retail Trade	6,024	11.15	10,408	11.19	72.78	8.13	8.50	-.37	-.15	-.22
9) Finance, Insurance, and Real Estate	852	1.58	1,857	2.00	117.96	1.85	5.34	-3.49	-3.52	.03
10) Services	5,553	10.28	10,385	11.16	87.02	8.95	14.17	-5.22	-3.68	-1.54
11) Civilian and Military Federal Government	1,409	2.61	2,138	2.30	51.74	1.35	3.78	-2.43	-2.31	-.12
12) State and Local Government	6,017	11.14	9,550	10.26	58.72	6.54	8.40	-1.86	-1.07	-.79
TOTAL:	54,024	-	93,042	-	72.22	72.24	81.06	-8.82	-10.88	2.06

[a/] Please refer to notes following the tables.

Table A-15. Jackson County.[a/]

SHIFT-SHARE COEFFICIENTS

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	9,272	2.90	11,065	1.84	19.34	.55	.94	-.39	-.55	.16
2) Agricultural Services, Forestry, Fisheries, and Other	3,278	1.03	8,263	1.38	151.07	1.57	1.01	.56	.61	-.05
3) Mining	388	.12	1,561	.26	302.32	.36	.39	-.03	-.25	.22
4) Construction	23,994	7.5	46,874	7.80	95.36	7.16	7.75	-.59	1.35	-1.94
5) Manufacturing	84,204	26.34	144,162	24.00	71.21	18.74	18.79	-.05	3.16	-3.21
6) Transportation and Public Utilities	23,627	7.39	43,934	7.31	85.95	6.36	5.76	.60	-.12	.72
7) Wholesale Trade	15,140	4.74	36,937	6.15	143.97	6.82	6.23	.59	-1.56	2.15
8) Retail Trade	49,159	15.37	94,384	15.71	92.00	14.15	8.50	5.65	3.00	2.65
9) Finance, Insurance, and Real Estate	9,730	3.04	21,993	3.66	126.03	3.83	5.34	-1.51	-1.82	.31
10) Services	47,485	14.85	95,799	15.95	101.75	15.11	14.17	.94	.98	-.04
11) Civilian and Military Federal Government	15,063	4.71	27,876	4.64	85.06	4.01	3.78	.23	-1.13	1.36
12) State and Local Government	38,393	12.01	67,897	11.3	76.85	9.22	8.4	.82	-.50	1.32
TOTAL:	319,733	-	600,745	-	87.89	87.88	81.06	6.82	3.17	3.65

[a/] Please refer to notes following the tables.

Table A-16. Jefferson County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	8,871	26.64	4,922	8.55	-44.52	-11.86	.94	-12.80	2.71	-15.51
2) Agricultural Services, Forestry, Fisheries, and Other	325	.98	634	1.10	95.08	.93	1.01	-.08	.53	-.61
3) Mining	45	.14	31	.05	-31.11	-.04	.39	-.43	-.22	-.21
4) Construction	939	2.82	1,810	3.14	92.76	2.62	7.75	-5.13	-4.33	-.80
5) Manufacturing	7,110	21.35	14,780	25.68	107.88	23.03	18.79	4.24	-.99	5.23
6) Transportation and Public Utilities	1,733	5.20	2,481	4.31	43.16	2.25	5.76	-3.51	-1.79	-1.72
7) Wholesale Trade	1,243	3.73	2,661	4.62	114.08	4.26	6.23	-1.97	-2.55	.58
8) Retail Trade	4,176	12.54	6,714	11.66	60.78	7.62	8.50	-.88	.88	-1.76
9) Finance, Insurance, and Real Estate	539	1.62	1,184	2.06	119.67	1.93	5.34	-3.41	-3.47	.06
10) Services	2,836	8.52	12,968	22.53	357.26	30.43	14.71	16.26	-5.48	21.74
11) Civilian and Military Federal Government	1,278	3.84	2,123	3.69	66.12	2.54	3.78	-1.24	-1.62	.38
12) State and Local Government	4,205	12.63	7,250	12.60	72.41	9.14	8.40	.74	-.09	.83
TOTAL:	33,300	-	57,558	-	72.85	72.85	81.06	-8.21	-16.42	8.21

[a/] Please refer to notes following the tables.

Table A-17. Josephine County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	905	.84	3,525	1.67	289.50	2.42	.94	1.48	-.83	2.31
2) Agricultural Services, Forestry, Fisheries, and Other	997	.92	2,365	1.12	137.21	1.27	1.01	.26	.44	-.18
3) Mining	743	.69	706	.33	-4.98	-.03	.39	-.42	.42	-.84
4) Construction	7,413	6.85	14,788	7.01	99.49	6.82	7.75	-.93	.56	-1.49
5) Manufacturing	33,503	30.97	66,808	31.65	99.41	30.78	18.79	11.99	7.03	4.96
6) Transportation and Public Utilities	6,422	5.94	11,837	5.61	84.32	5.01	5.76	-.75	-1.23	.48
7) Wholesale Trade	2,957	2.73	6,762	3.20	128.68	3.53	6.23	-2.70	-3.53	.83
8) Retail Trade	18,858	17.43	32,058	15.19	70.00	12.21	8.50	3.71	4.54	-.83
9) Finance, Insurance, and Real Estate	3,355	3.10	8,720	4.13	159.91	4.95	5.34	-.39	-1.75	1.36
10) Services	12,916	11.94	31,057	14.72	140.45	16.77	14.17	2.60	-1.99	4.59
11) Civilian and Military Federal Government	4,377	4.05	6,487	3.07	48.21	1.96	3.78	-1.82	-1.50	-.32
12) State and Local Government	15,727	14.54	25,939	12.29	64.93	9.44	8.40	1.04	1.17	-.13
TOTAL:	108,173	-	211,052	-	95.11	95.13	81.06	14.07	3.33	10.74

[a/] Please refer to notes following the tables.

Table A-18. Klamath County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	13,653	7.25	10,444	3.32	-23.50	-1.71	.94	-2.65	.05	-2.70
2) Agricultural Services, Forestry, Fisheries, and Other	(D)	-	1,645	-	-	-	-	-	-	-
3) Mining	(D)	-	267	-	-	-	-	-	-	-
4) Construction	9,019	4.79	16,240	5.17	80.06	3.84	7.75	-3.91	-1.94	-1.97
5) Manufacturing	53,821	28.59	104,130	33.15	93.47	26.72	18.79	7.93	5.04	2.89
6) Transportation and Public Utilities	20,796	11.05	30,995	9.87	49.04	5.42	5.76	-.34	2.66	-3.00
7) Wholesale Trade	6,701	3.56	12,790	4.07	90.87	3.24	6.23	-2.99	-2.71	-.28
8) Retail Trade	23,645	12,56	37,370	11.90	58.05	7.30	8.50	-1.20	.90	-2.10
9) Finance, Insurance, and Real Estate	4,374	2.32	10,183	3.24	132.81	3.08	5.34	-2.26	-2.66	.40
10) Services	20,832	11.07	39,254	12.50	88.43	9.78	14.17	-4.39	-2.88	-1.51
11) Civilian and Military Federal Government	14,166	7.52	18,774	5.98	32.53	2.45	3.78	-1.33	.45	-1.78
12) State and Local Government	19,258	10.23	32,027	10.20	66.30	6.78	8.40	-1.62	-1.67	.05
Combined Sectors: Agricultural Services, Forestry, Fisheries, and Other; Mining	2,004	1.06	1,912	.61	-4.59	-.05	1.40	-1.45	.13	-1.58
TOTAL:	188,269	-	314,119	-	66.85	66.85	81.06	-14.21	-2.63	-11.58

[a/] Please refer to notes following the tables.

Table A-19. Lake County.[a/]

SHIFT-SHARE COEFFICIENTS

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	5,875	24.07	6,428	17.56	9.41	2.25	.94	1.31	2.36	-1.05
2) Agricultural Services, Forestry, Fisheries, and Other	(D)	-	493	-	-	-	-	-	-	-
3) Mining	(L)	-	(D)	-	-	-	-	-	-	-
4) Construction	545	2.23	1,734	4.74	218.17	4.88	7.75	-2.87	-5.04	2.17
5) Manufacturing	5,011	20.52	7,579	20.71	51.25	10.51	18.79	-8.28	-1.68	-6.60
6) Transportation and Public Utilities	724	2.97	1,176	3.21	62.43	1.85	5.76	-3.91	-3.50	-.41
7) Wholesale Trade	(D)	-	(D)	-	-	-	-	-	-	-
8) Retail Trade	2,735	11.20	3,677	10.05	34.44	3.86	8.50	-4.64	-.12	-4.52
9) Finance, Insurance, and Real Estate	427	1.75	637	1.74	49.18	.85	5.34	-4.49	-3.32	-1.17
10) Services	1,400	5.73	2,333	6.37	66.64	3.82	14.17	-10.35	-8.32	-2.03
11) Civilian and Military Federal Government	3,581	14.67	5,727	15.65	59.93	8.80	3.78	5.02	4.47	.55
12) State and Local Government	3,213	13.16	5,609	15.32	74.57	9.82	8.40	1.42	.26	1.16
Combined Sectors: Agricultural Services, Forestry, Fisheries, and Other; Mining; Wholesale Trade	902	3.69	1,702	4.65	88.69	3.29	7.63	-4.34	-3.76	-.58
TOTAL:	24,413	-	36,602	-	49.93	49.93	81.06	-31.13	-18.65	-12.48

[a/] Please refer to notes following the tables.

Table A-20. Lane County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	15,269	1.94	19,795	1.35	29.64	.57	.94	-.37	-.68	.31
2) Agricultural Services, Forestry, Fisheries, and Other	3,401	.43	9,186	.63	170.10	.74	1.01	-.27	-.33	.06
3) Mining	3,458	.44	4,072	.28	17.76	.08	.39	-.31	.13	-.44
4) Construction	53,870	6.86	116,550	7.95	116.35	7.99	7.75	.24	.57	-.33
5) Manufacturing	244,142	31.09	404,249	27.57	65.58	20.39	18.79	1.60	7.13	-5.53
6) Transportation and Public Utilities	60,135	7.66	102,207	6.97	69.96	5.36	5.76	-.40	.08	-.48
7) Wholesale Trade	42,626	5.43	95,449	6.51	123.92	6.73	6.23	.50	-.88	1.38
8) Retail Trade	98,246	12.51	185,286	12.64	88.59	11.09	8.50	2.59	.86	1.73
9) Finance, Insurance, and Real Estate	23,949	3.05	61,528	4.20	156.91	4.78	5.34	-.56	-1.81	1.25
10) Services	107,601	13.70	233,458	15.92	116.97	16.03	14.17	1.86	-.19	2.05
11) Civilian and Military Federal Government	22,470	2.86	39,598	2.70	76.23	2.18	3.78	-1.60	-2.17	.57
12) State and Local Government	110,087	14.02	194,944	13.29	77.08	10.81	8.40	2.41	.83	1.58
TOTAL:	785,254	-	1,466,322	-	86.73	86.75	81.06	5.69	3.54	2.15

[a/] Please refer to notes following the tables.

Table A-21. Lincoln County.[a/]

SHIFT-SHARE COEFFICIENTS

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	1,597	2.18	2,193	1.50	37.32	.81	.94	-.13	-.65	.52
2) Agricultural Services, Forestry, Fisheries, and Other	2,177	2.97	8,086	5.52	271.43	8.05	1.01	7.04	3.65	3.39
3) Mining	847	1.15	1,759	1.20	107.67	1.24	.39	.85	.97	-.12
4) Construction	6,674	9.09	12,283	8.38	84.04	7.65	7.75	-.10	3.28	-3.38
5) Manufacturing	17,134	23.35	37,277	25.43	117.56	27.44	18.79	8.65	.67	7.98
6) Transportation and Public Utilities	4,777	6.51	7,294	4.98	52.69	3.43	5.76	-2.33	-.80	-1.53
7) Wholesale Trade	1,282	1.75	2,663	1.82	107.72	1.89	6.23	-4.34	-4.50	.16
8) Retail Trade	12,380	16.87	24,941	17.02	101.46	17.12	8.50	8.62	4.12	4.50
9) Finance, Insurance, and Real Estate	2,012	2.74	4,728	3.23	134.99	3.69	5.34	-1.65	-2.17	.52
10) Services	9,352	12.74	20,214	13.79	116.15	14.80	14.17	.63	-1.17	1.80
11) Civilian and Military Federal Government	2,953	4.02	4,051	2.76	37.18	1.50	3.78	-2.28	-1.51	-.77
12) State and Local Government	12,206	16.63	21,073	14.38	72.64	12.08	8.40	3.68	2.55	1.13
TOTAL:	73,391	-	146,562	-	99.70	99.70	81.06	18.64	4.44	14.20

[a/] Please refer to notes following the tables.

Table A-22. Linn County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	22,481	8.23	17,355	3.48	-22.80	-1.88	.94	-2.82	.18	-3.00
2) Agricultural Services, Forestry, Fisheries, and Other	2,057	.75	5,161	1.04	150.90	1.13	1.01	.12	.17	-.05
3) Mining	889	.33	771	.15	-13.27	-.04	.39	-.43	0	-.43
4) Construction	16,378	6.00	38,105	7.64	132.66	7.96	7.75	.21	-.47	.68
5) Manufacturing	122,873	45.00	228,416	45.82	85.90	38.65	18.79	19.86	18.73	1.13
6) Transportation and Public Utilities	14,244	5.22	26,399	5.30	85.33	4.45	5.76	-1.31	-1.78	.47
7) Wholesale Trade	4,860	1.78	16,765	3.36	244.96	4.37	6.23	-1.86	-4.47	2.61
8) Retail Trade	26,529	9.72	45,644	9.16	72.05	7.01	8.50	-1.49	-1.23	-.26
9) Finance, Insurance, and Real Estate	5,601	2.05	14,421	2.89	157.47	3.22	5.34	-2.12	-2.97	.85
10) Services	23,967	8.78	48,319	9.69	101.61	8.92	14.17	-5.25	-5.21	-.04
11) Civilian and Military Federal Government	7,275	2.66	11,317	2.27	55.56	1.49	3.78	-2.29	-2.28	-.01
12) State and Local Government	25,867	9.47	45,858	9.20	77.28	7.32	8.40	-1.08	-2.16	1.08
TOTAL:	273,021	-	498,531	-	82.60	82.60	81.06	1.54	-1.49	3.03

[a/] Please refer to notes following the tables.

Table A-23. Malheur County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	35,017	34.67	24,585	18.53	-29.79	-10.33	.94	-11.27	3.81	-15.08
2) Agricultural Services, Forestry, Fisheries, and Other	1,936	1.92	3,916	2.66	102.27	1.96	1.01	.95	2.01	-1.06
3) Mining	47	.05	50	.33	6.38	0	.39	-.39	-.33	-.06
4) Construction	3,545	3.51	6,412	4.83	80.87	2.84	7.75	-4.91	-3.49	-1.42
5) Manufacturing	10,868	10.76	20,238	15.25	86.22	9.27	18.79	-9.52	-9.82	.30
6) Transportation and Public Utilities	4,651	4.61	8,599	6.48	84.88	3.91	5.76	-1.85	-2.25	.40
7) Wholesale Trade	4,815	4.77	10,140	7.64	110.59	5.28	6.23	-.95	-1.52	.57
8) Retail Trade	13,851	13.71	19,044	14.35	37.49	5.15	8.50	-3.35	1.76	-5.11
9) Finance, Insurance, and Real Estate	2,231	2.21	4,245	3.20	90.27	1.99	5.34	-3.35	-2.79	-.56
10) Services	10,808	10.70	15,601	11.76	44.35	4.75	14.17	-9.42	-3.25	-6.17
11) Civilian and Military Federal Government	2,713	2.69	4,023	3.03	48.29	1.30	3.78	-2.48	-2.27	-.21
12) State and Local Government	10,514	10.41	15,837	11.94	50.63	5.27	8.40	-3.13	-1.55	-1.58
TOTAL:	100,996	-	132,690	-	31.38	31.39	81.06	-49.67	-19.69	-29.98

[a/] Please refer to notes following the tables.

Table A-24. Marion County.[a/]

SHIFT-SHARE COEFFICIENTS

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	44,958	7.83	62,227	5.72	38.41	3.00	.94	2.06	.13	1.93
2) Agricultural Services, Forestry, Fisheries, and Other	3,815	.66	8,938	.82	134.29	.89	1.01	-.12	.03	-.15
3) Mining	1,453	.25	3,405	.31	134.34	.34	.39	-.05	-.09	.04
4) Construction	39,589	6.90	86,157	7.91	117.63	8.12	7.75	.37	.62	-.25
5) Manufacturing	88,349	15.40	169,007	15.52	91.29	14.05	18.79	-4.74	-5.96	1.22
6) Transportation and Public Utilities	25,542	4.45	58,670	5.39	129.70	5.77	5.76	.01	-2.37	2.38
7) Wholesale Trade	20,543	3.58	48,138	4.42	134.33	4.81	6.23	-1.42	-2.70	1.28
8) Retail Trade	71,987	12.54	126,821	11.65	76.17	9.56	8.50	1.06	.89	.17
9) Finance, Insurance, and Real Estate	26,859	4.68	64,505	5.93	140.16	6.55	5.34	1.21	.08	1.13
10) Services	80,676	14.06	163,303	15.00	102.42	14.40	14.17	.23	.17	.06
11) Civilian and Military Federal Government	16,355	2.85	28,344	2.60	73.30	2.09	3.78	-1.69	-2.17	.48
12) State and Local Government	153,754	26.79	269,150	24.72	75.05	20.11	8.40	11.71	9.24	2.47
TOTAL:	573,880	-	1,088,665	-	89.70	89.69	81.06	8.63	-2.13	10.76

[a/] Please refer to notes following the tables.

Table A-25. Morrow County.[a/]

SHIFT-SHARE COEFFICIENTS

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	3,047	20.00	28,958	39.42	850.38	170.10	.94	169.16	1.80	167.36
2) Agricultural Services, Forestry, Fisheries, and Other	158	1.04	479	.65	203.17	2.11	1.01	1.10	.63	.47
3) Mining	0	0	0	0	0	0	.39	-.39	-.39	0
4) Construction	613	4.02	13,581	18.49	2115.50	85.14	7.75	77.39	-2.87	80.26
5) Manufacturing	2,818	18.50	12,764	17.37	352.95	65.29	18.79	46.50	-3.37	49.87
6) Transportation and Public Utilities	1,409	9.25	3,335	4.54	136.69	12.65	5.76	6.89	1.29	5.60
7) Wholesale Trade	615	4.04	1,918	2.61	211.87	8.56	6.23	2.33	-2.25	4.58
8) Retail Trade	1,667	10.94	3,232	4.40	93.88	10.28	8.50	1.78	-.31	2.09
9) Finance, Insurance, and Real Estate	366	2.40	1,139	1.55	211.20	5.07	5.34	-.27	-2.56	2.29
10) Services	1,173	7.70	2,751	3.74	134.53	10.36	14.17	-3.81	-6.31	2.50
11) Civilian and Military Federal Government	906	5.95	1,126	1.53	24.28	1.45	3.78	-2.33	-.43	-1.90
12) State and Local Government	2,460	16.15	4,184	5.70	70.08	11.32	8.40	2.92	2.23	.69
TOTAL:	15,232	-	73,467	-	382.32	382.33	81.06	301.27	-12.54	313.81

[a/] Please refer to notes following the tables.

Table A-26. Multnomah County.[a/]

SHIFT-SHARE COEFFICIENTS

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	9,162	.29	18,349	.34	100.27	.28	.94	-.66	-.91	.25
2) Agricultural Services, Forestry, Fisheries, and Other	5,299	.16	11,980	.22	126.08	.20	1.01	-.81	-.75	-.06
3) Mining	2,030	.06	7,343	.14	261.72	.16	.39	-.23	-.32	.09
4) Construction	193,026	6.01	330,637	6.11	71.29	4.29	7.75	-3.46	-.46	-3.00
5) Manufacturing	617,948	19.23	1,034,938	19.14	67.48	12.97	18.79	-5.82	-2.76	-3.06
6) Transportation and Public Utilities	370,317	11.53	594,884	11.00	60.64	6.99	5.76	1.23	3.03	-1.80
7) Wholesale Trade	383,049	11.92	632,824	11.70	65.21	7.78	6.23	1.55	5.52	-3.97
8) Retail Trade	353,844	11.01	559,363	10.35	58.08	6.40	8.50	-2.10	-.26	-1.84
9) Finance, Insurance, and Real Estate	235,965	7.34	459,647	8.50	94.79	6.95	5.34	1.61	3.16	-1.55
10) Services	557,852	17.36	993,841	18.38	78.15	13.57	14.17	-.60	3.55	-4.15
11) Civilian and Military Federal Government	168,370	5.24	252,881	4.68	50.19	2.64	3.78	-1.14	-.83	-.31
12) State and Local Government	315,768	9.83	510,363	9.44	61.63	6.06	8.40	-2.34	-1.93	-.41
TOTAL:	3,212,630	-	5,407,050	-	68.31	68.29	81.06	-12.77	7.04	-19.81

[a/] Please refer to notes following the tables.

Table A-27. Polk County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	18,797	19.65	14,216	9.56	-24.37	-4.79	.94	-5.73	1.75	-7.48
2) Agricultural Services, Forestry, Fisheries, and Other	739	.77	2,736	1.84	270.23	2.08	1.01	1.07	.20	.87
3) Mining	233	.24	293	.20	25.75	.06	.39	-.33	-.11	-.22
4) Construction	4,859	5.08	11,256	7.57	131.65	6.69	7.75	-1.06	-1.59	.53
5) Manufacturing	37,699	39.41	58,448	39.32	55.04	21.69	18.79	2.90	14.07	-11.17
6) Transportation and Public Utilities	2,008	2.10	2,847	1.92	41.78	.88	5.76	-4.88	-4.16	-.72
7) Wholesale Trade	1,190	1.24	3,513	2.36	195.21	2.44	6.23	-3.79	-5.00	1.21
8) Retail Trade	7,418	7.76	13,020	8.76	75.52	5.86	8.50	-2.64	-2.69	.05
9) Finance, Insurance, and Real Estate	2,133	2.23	5,811	3.91	172.43	3.84	5.34	-1.50	-2.76	1.26
10) Services	5,844	6.11	12,933	8.70	121.30	7.41	14.17	-6.76	-7.94	1.18
11) Civilian and Military Federal Government	1,493	1.56	3,041	2.05	103.68	1.62	3.78	-2.16	-2.90	.74
12) State and Local Government	13,236	13.84	20,545	13.82	55.22	7.64	8.40	-.76	.71	-1.47
TOTAL:	95,649	-	148,659	-	55.42	55.42	81.06	-25.64	-10.42	-15.22

[a/] Please refer to notes following the tables.

Table A-28. Sherman County.[a/]

SHIFT-SHARE COEFFICIENTS

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	2,028	26.80	5,153	37.69	154.09	41.29	.94	40.35	2.73	37.62
2) Agricultural Services, Forestry, Fisheries, and Other	101	1.33	121	.89	19.80	.26	1.01	-.75	1.08	-1.83
3) Mining	0	0	0	0	0	0	.39	-.39	-.39	0
4) Construction	624	8.25	262	1.92	-58.01	-4.79	7.75	-12.54	2.25	-14.79
5) Manufacturing	0	0	28	.20	-	0	18.79	-18.79	-18.79	0
6) Transportation and Public Utilities	329	4.35	531	3.88	61.40	2.67	5.76	-3.09	-2.44	-.65
7) Wholesale Trade	355	4.69	903	6.60	154.37	7.25	6.23	1.02	-1.60	2.62
8) Retail Trade	1,363	18.01	2,204	16.12	61.70	11.12	8.50	2.62	4.97	-2.35
9) Finance, Insurance, and Real Estate	95	1.26	203	1.48	113.68	1.42	5.34	-3.92	-3.89	-.03
10) Services	369	4.88	639	4.67	73.17	3.57	14.17	-10.60	-9.20	-1.40
11) Civilian and Military Federal Government	1,062	14.03	1,747	12.78	64.50	9.06	3.78	5.28	4.11	1.17
12) State and Local Government	1,242	16.41	1,881	13.76	51.45	8.44	8.40	.04	2.40	-2.36
TOTAL:	7,568	-	13,672	-	80.66	80.29	81.06	-.77	-18.77	18.00

[a/] Please refer to notes following the tables.

Table A-29. Tillamook County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	5,660	10.56	21,457	20.66	279.10	29.47	.94	28.53	.50	28.03
2) Agricultural Services, Forestry, Fisheries, and Other	881	1.64	2,848	2.74	2.23	3.66	1.01	2.65	1.57	1.08
3) Mining	98	.18	203	.20	107.14	.19	.39	-.20	-.18	-.02
4) Construction	2,145	4.00	4,299	4.14	100.42	4.02	7.75	-3.73	-2.90	-.83
5) Manufacturing	18,821	35.13	28,733	27.66	52.66	18.50	18.79	-.29	10.50	-10.79
6) Transportation and Public Utilities	2,004	3.74	3,493	3.36	74.30	2.78	5.76	-2.98	-2.91	-.07
7) Wholesale Trade	988	1.84	2,294	2.21	132.19	2.43	6.23	-3.80	-4.41	.61
8) Retail Trade	6,693	12.49	10,878	10.47	62.53	7.81	8.50	-.69	.85	-1.54
9) Finance, Insurance, and Real Estate	1,185	2.21	3,340	3.22	181.86	4.02	5.34	-1.32	-2.78	1.46
10) Services	4,686	8.75	10,466	10.08	123.35	10.79	14.17	-3.38	-5.25	1.87
11) Civilian and Military Federal Government	2,666	4.98	3,864	3.72	44.94	2.24	3.78	-1.54	-.98	-.56
12) State and Local Government	7,753	14.47	12,005	11.56	54.84	7.94	8.40	-.46	1.13	-1.59
TOTAL:	53,580	-	103,880	-	93.88	93.85	81.06	12.79	-4.86	17.65

[a/] Please refer to notes following the tables.

Table A-30. Umatilla County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	41,489	23.54	30,690	10.52	-26.03	-6.13	.94	-7.07	2.28	-9.35
2) Agricultural Services, Forestry, Fisheries, and Other	874	.50	3,824	1.31	337.53	1.69	1.01	.68	-.22	.90
3) Mining	393	.22	445	.15	13.23	.03	.39	-.36	-.13	-.23
4) Construction	8,067	4.58	16,209	5.55	100.93	4.63	7.75	-3.12	-2.20	-.92
5) Manufacturing	28,996	16.45	59,831	20.50	106.34	17.49	18.79	-1.30	-5.08	3.78
6) Transportation and Public Utilities	14,466	8.21	28,599	9.80	97.70	8.02	5.76	2.26	.50	1.76
7) Wholesale Trade	6,359	3.61	15,515	5.32	143.98	5.20	6.23	-1.03	-2.67	1.64
8) Retail Trade	20,061	11.38	34,529	11.83	72.12	8.22	8.50	-.28	.02	-.30
9) Finance, Insurance, and Real Estate	3,558	2.02	8,939	3.06	151.24	3.04	5.34	-2.30	-3.01	.71
10) Services	16,413	9.31	36,340	12.45	121.41	11.31	14.17	-2.86	-4.67	1.81
11) Civilian and Military Federal Government	10,818	6.14	15,473	5.30	43.03	2.65	3.78	-1.13	-.33	-.80
12) State and Local Government	24,754	14.04	41,402	14.19	67.25	9.45	8.40	1.05	.85	.20
TOTAL:	176,248	-	291,796	-	65.56	65.60	81.06	-15.46	-14.66	-.80

[a/] Please refer to notes following the tables.

Table A-31. Union County.[a/]

SHIFT-SHARE COEFFICIENTS

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	10,202	14.04	6,156	5.30	-39.66	-5.57	.94	-6.51	.98	-7.49
2) Agricultural Services, Forestry, Fisheries, and Other	708	.97	781	.67	10.31	.10	1.01	-.91	.52	-1.43
3) Mining	50	.07	50	.04	0	0	.39	-.39	-.31	-.08
4) Construction	4,152	5.71	4,641	4.00	11.78	.68	7.75	-7.07	-.82	-6.25
5) Manufacturing	17,659	24.30	31,624	27.25	79.08	19.21	18.79	.42	1.47	-1.05
6) Transportation and Public Utilities	8,283	11.40	15,815	13.63	90.93	10.37	5.76	4.61	2.93	1.68
7) Wholesale Trade	2,178	3.00	4,592	3.96	110.84	3.33	6.23	-2.90	-3.27	.37
8) Retail Trade	8,468	11.65	12,945	11.15	52.87	6.17	8.50	-2.33	.22	-2.55
9) Finance, Insurance, and Real Estate	1,529	2.10	3,102	2.67	102.88	2.16	5.34	-3.18	-2.91	-.27
10) Services	6,717	9.24	15,104	13.02	124.86	11.54	14.17	-2.63	-4.74	2.11
11) Civilian and Military Federal Government	2,116	2.91	3,830	3.30	81.00	2.36	3.78	-1.42	-2.14	.72
12) State and Local Government	10,608	14.60	17,410	15.00	64.12	9.36	8.40	.96	1.21	-.25
TOTAL:	72,670	-	116,050	-	59.69	59.71	81.06	-21.35	-6.86	-14.49

[a/] Please refer to notes following the tables.

Table A-32. Wallowa County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	9,033	40.55	8,214	25.94	-9.07	-3.68	.94	-4.62	4.62	-9.24
2) Agricultural Services, Forestry, Fisheries, and Other	440	1.98	421	1.33	-4.32	- .08	1.01	-1.09	2.10	-3.19
3) Mining	90	.40	53	.17	-41.11	-.16	.39	-.55	.09	-.64
4) Construction	951	4.27	1,327	4.19	39.54	1.69	7.75	-6.06	-2.57	-3.49
5) Manufacturing	2,217	9.95	5,879	18.56	165.18	16.44	18.79	-2.35	-10.49	8.14
6) Transportation and Public Utilities	516	2.32	957	3.02	85.47	1.98	5.76	-3.78	-3.99	.21
7) Wholesale Trade	486	2.18	1,048	3.31	115.64	2.52	6.23	-3.71	-4.08	.37
8) Retail Trade	2,394	10.75	3,564	11.25	48.87	5.26	8.50	-3.24	-.46	-2.78
9) Finance, Insurance, and Real Estate	404	1.81	886	2.80	119.31	2.16	5.34	-3.18	-3.24	.06
10) Services	1,429	6.42	2,734	8.63	91.32	5.85	14.17	-8.32	-7.63	-.69
11) Civilian and Military Federal Government	1,370	6.15	1,990	6.28	45.26	2.79	3.78	- .99	-.32	-.67
12) State and Local Government	2,944	13.22	4,596	14.51	56.11	7.42	8.40	- .98	.30	-1.28
TOTAL:	22,274	-	31,669	-	42.18	42.19	81.06	-38.87	-25.67	-13.20

[a/] Please refer to notes following the tables.

Table A-33. Wasco County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	7,104	10.48	16,882	13.64	137.64	14.42	.94	13.48	.49	12.99
2) Agricultural Services, Forestry, Fisheries, and Other	280	.41	902	.73	222.14	.91	1.01	-.10	-.36	.26
3) Mining	23	.03	368	.30	1,500.00	.45	.39	.06	-.35	.41
4) Construction	4,584	6.76	6,530	5.28	42.45	2.88	7.75	-4.87	.45	-5.32
5) Manufacturing	13,182	19.45	30,122	24.34	128.51	24.98	18.79	6.19	-2.58	8.77
6) Transportation and Public Utilities	5,607	8.27	7,648	6.18	36.40	3.01	5.76	-2.75	.55	-3.30
7) Wholesale Trade	1,530	2.26	3,918	3.17	156.08	3.53	6.23	-2.70	-4.00	1.30
8) Retail Trade	10,159	14.99	15,793	12.76	55.46	8.32	8.50	-.18	2.71	-2.89
9) Finance, Insurance, and Real Estate	1,551	2.29	3,340	2.70	115.34	2.63	5.34	-2.71	-2.70	-.01
10) Services	9,242	13.63	16,880	13.64	82.64	11.27	14.17	-2.90	-.26	-2.64
11) Civilian and Military Federal Government	5,041	7.44	7,056	5.70	39.97	2.98	3.78	-.80	.40	-1.20
12) State and Local Government	9,485	13.99	14,310	11.56	50.87	7.12	8.40	-1.28	.81	-2.90
TOTAL:	67,788	-	123,749	-	82.55	82.50	81.06	1.44	-4.84	6.28

[a/] Please refer to notes following the tables.

Table A-34. Washington County.[a/]

SHIFT-SHARE COEFFICIENTS

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	24,712	4.67	32,784	2.66	32.66	1.52	.94	.58	-.30	.88
2) Agricultural Services, Forestry, Fisheries, and Other	2,784	.53	6,945	.56	149.46	.79	1.01	-.22	-.18	-.04
3) Mining	1,948	.37	4,284	.35	119.92	.44	.39	.05	.04	.01
4) Construction	42,468	8.02	113,076	9.19	166.26	13.33	7.75	5.58	1.97	3.61
5) Manufacturing	193,163	36.47	454,707	36.95	135.40	49.38	18.79	30.59	11.62	18.97
6) Transportation and Public Utilities	20,119	3.80	44,707	3.63	122.21	4.65	5.76	-1.11	-2.86	1.75
7) Wholesale Trade	33,416	6.31	88,810	7.22	165.77	10.46	6.23	4.23	-.01	4.24
8) Retail Trade	64,896	12.25	155,878	12.67	140.20	17.19	8.50	8.69	.67	8.02
9) Finance, Insurance, and Real Estate	22,088	4.17	62,134	5.05	181.30	7.56	5.34	2.22	-.51	2.73
10) Services	67,289	12.71	166,781	13.55	147.86	18.78	14.17	4.61	-1.21	5.82
11) Civilian and Military Federal Government	6,691	1.26	11,957	.97	78.70	.99	3.78	-2.79	-3.07	.28
12) State and Local Government	50,027	9.45	88,659	7.20	77.22	7.30	8.40	-1.10	-2.18	1.08
TOTAL:	529,601	-	1,230,722	-	132.39	132.39	81.06	51.33	3.98	47.35

[a/] Please refer to notes following the tables.

Table A-35. Wheeler County.[a/]

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	SHIFT-SHARE COEFFICIENTS: Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	1,769	24.03	788	12.48	-55.46	-13.33	.94	-14.27	2.35	-16.62
2) Agricultural Services, Forestry, Fisheries, and Other	(D)	-	(D)	-	-	-	-	-	-	-
3) Mining	0	-	0	-	0	0	.39	-.39	-.39	0
4) Construction	50	.68	157	2.49	214.00	1.46	7.75	-6.29	-6.92	.63
5) Manufacturing	3,361	-	(D)	-	-	-	-	-	-	-
6) Transportation and Public Utilities	131	1.78	166	2.63	26.72	.48	5.76	-5.28	-4.40	-.88
7) Wholesale Trade	34	.46	57	.90	67.65	.32	6.23	-5.91	-5.77	-.14
8) Retail Trade	311	4.23	425	6.73	36.66	1.56	8.50	-6.94	-5.33	-1.61
9) Finance, Insurance, and Real Estate	179	2.43	198	3.14	10.61	.25	5.34	-5.09	-2.53	-2.56
10) Services	179	2.43	287	4.55	60.34	1.47	14.17	-12.70	-11.69	-1.01
11) Civilian and Military Federal Government	194	2.64	204	3.23	5.15	.14	3.78	-3.64	-2.29	-1.35
12) State and Local Government	1,095	14.88	1,879	29.77	71.60	10.65	8.40	2.25	1.39	.86
Combined Sectors: Agricultural Services, Forestry, Fisheries, and Other; Manufacturing	3,419	46.45	2,151	34.08	-37.09	-17.23	19.80	-37.03	19.88	-56.91
TOTAL:	7,361	-	6,312	-	-14.25	-14.23	81.06	-95.29	-15.7	-79.59

[a/] Please refer to notes following the tables.

Table A-36. Yamhill County.[a/]

SHIFT-SHARE COEFFICIENTS

Sector	Income 1973	Percent of County Income	Income 1978	Percent of County Income	Growth Rate 1973-78	Actual Growth	Standard Growth	Net Relative Change	Industry Mix	Regional Share
1) Farm	23,151	18.36	22,790	9.50	-1.56	-.29	.94	-1.23	1.57	-2.80
2) Agricultural Services, Forestry, Fisheries, and Other	2,073	1.64	4,786	1.99	130.87	2.15	1.01	1.14	1.57	-.43
3) Mining	485	.38	1,861	.78	283.71	1.08	.39	.69	.06	.63
4) Construction	5,386	4.27	14,893	6.21	176.51	7.54	7.75	-.21	-2.57	2.36
5) Manufacturing	38,714	30.70	89,513	37.30	131.22	40.27	18.79	21.48	6.80	14.68
6) Transportation and Public Utilities	5,061	4.01	6,570	2.74	29.82	1.20	5.76	-4.56	-2.70	-1.86
7) Wholesale Trade	3,207	2.54	7,777	3.24	142.50	3.63	6.23	-2.60	-3.72	1.12
8) Retail Trade	13,545	10.74	25,046	10.44	84.91	9.13	8.50	.63	-.46	1.09
9) Finance, Insurance, and Real Estate	4,272	3.39	9,629	4.01	125.40	4.24	5.34	-1.10	-1.42	.32
10) Services	14,334	11.37	29,160	12.15	103.43	11.76	14.17	-2.41	-2.57	.16
11) Civilian and Military Federal Government	2,149	1.70	3,065	1.28	42.62	.73	3.78	-3.05	-2.82	-.23
12) State and Local Government	13,740	10.89	24,884	10.37	81.11	8.84	8.40	.44	-1.23	1.67
TOTAL:	126,117	-	239,974	-	90.28	90.28	81.06	9.22	-7.49	16.71

[a/] Please refer to notes following the tables.

NOTES FOR APPENDIX A

(1) D = Not shown to avoid disclosure of confidential information, data are included in the totals.

(2) L = Less than $50,000, data are included in the totals.

(3) Income estimates for 1973 are based on the 1967 Standard Industrial Classification (SIC) while 1978 estimates are based on the 1972 SIC. Because shift-share anlaysis is used to describe growth performances of broad industrial categories (one-digit SIC code level), this is not expected to affect the results.

(4) Income estimates consist of wage and salary disbursements; other labor income; and proprietors' income.

(5) Income figures are expressed in thousands of dollars. Growth rates are rounded to the second decimal place.

(6) Shift-share components are presented in percentage form rounded to the second decimal place. Due to rounding, some of the expressed equalities did not exactly balance. In such cases, results were adjusted to compensate for rounding error.

(7) In several counties, individual sector data is not revealed by the Bureau of Economic Analysis in order to avoid disclosure of confidential information. Sectors with missing data were combined in the following counties: Baker, Clatsop, Gilliam, Klamath, Lake, and Wheeler. The shift-share results only apply to the combined sectors as it is not possible to distinguish

the growth performance of each one.

(8) A program written by Mr. D. Holst (Instructor, Department of Agricultural and Resource Economics, Oregon State University) on the Hewlett-Packard 41C was utilized to generate the modified shift-share results for each county. Currently, a program written by the author for the APPLE II_+ micro-computer is available for the shift-share computations for the individual Oregon counties. A list of the program is noted in Appendix B.

Data Source: Local Area Personal Income: 1973-78, A Summary. Bureau of Economic Analysis, U.S. Department of Commerce (1), 1980.

APPENDIX B

MODIFIED SHIFT-SHARE PROGRAM LISTING

FOR THE APPLE II_+ MICRO-COMPUTER

```
5  PRINT "MODIFIED SHIFT-SHARE II"
7  PRINT "BY M. VIVIAN LEDEBOER"
10  PRINT "NOVEMBER, 1981"
11  PRINT : PRINT
20  DIM K$(100)
25  DIM A$(100)
30  DIM AA$(100)
35  DIM C$(100)
40  DIM W$(100)
45  DIM WW$(100)
50  DIM Y$(100)
60  DIM Q$(100)
65  DIM N$(100)
70  DIM P$(100)
75  DIM IM$(100)
80  DIM RS$(100)
85 I = 0
90  PRINT "SHIFT-SHARE ANALYSIS--A MODIFIED APPROACH": PRINT
95  PRINT "THIS PROGRAM EVALUATES THE FACTORS WHICH CONTRIBUTE TO THE DIF
    FERENCES BETWEEN  THE RATES OF GROWTH OF A STUDY REGION TO A REFEREN
    CE REGION."
100  PRINT : PRINT "REFERENCE--KALBACHER,JUDITH Z."
115  PRINT "AGRICULTURAL ECONOMICS RESEARCH"
120  PRINT " 31(1): 12-24   JANUARY,1979"
125  PRINT : INPUT "PRESS RETURN KEY TO CONTINUE";MM$
130  HOME
150  INPUT "PARAMETER TO BE ANALYZED:";J$
155  PRINT
160  INPUT "REFERENCE REGION:";H$
165  PRINT
170  INPUT "STUDY REGION:";G$
175  PRINT
180  INPUT "1ST YEAR OF COMPARISON:";L$
185  PRINT
190  INPUT "2ND YEAR OF COMPARISON:";LL$
192  PRINT
195  PRINT : PRINT "THIS PROGRAM USES VALUES WITH A MAXIMUM"
200  PRINT "OF 8 DIGITS.  THEREFORE, PLEASE"
205  PRINT "ABBREVIATE TO SCALE."
210  PRINT "SCALE TO BE USED (TENS, HUNDREDS,ETC."
215  INPUT ";PRESS RETURN IF NONE)?";SCALE$
218  PRINT : PRINT
220  PRINT "TOTAL ";J$;" FOR ALL INDUSTRIES IN ";H$;"--";L$;": ";
225  INPUT X$
230  PRINT
235  IF  LEN (X$) > 9 THEN  PRINT "INPUT IS TOO LONG--RESUBMIT": GOTO 225

240  PRINT "TOTAL ";J$;" FOR ALL INDUSTRIES IN ";H$;"--";LL$": ";
244  INPUT XX$
246  PRINT
248  IF  LEN (XX$) > 9 THEN  PRINT "INPUT IS TOO LONG--RESUBMIT": GOTO 24
    4
250 Z = ( VAL (XX$) /  VAL (X$) - 1) * 100
252 Z$ =  STR$ (Z)
254  PRINT "TOTAL ";J$;" FOR ALL INDUSTRIES IN ";G$;"--";L$;":";
256  INPUT B$
258  PRINT
260  PRINT "TOTAL ";J$;" FOR ALL INDUSTRIES IN ";G$;"--";LL$":";
262  INPUT BB$
264  PRINT
266 D = ( VAL (BB$) /  VAL (B$) - 1) * 100
268 D$ =  STR$ (D)
270  HOME
275 I = I + 1
280  PRINT : PRINT "INDUSTRY ";I;":";
285  INPUT K$(I)
290  PRINT
```

```
295  PRINT "TOTAL ";J$;" IN ";K$(I);" INDUSTRY IN ";H$;"--";L$;":";
300  INPUT W$(I)
305  PRINT
310  IF  LEN (W$(I)) > 9 THEN  PRINT "INPUT IS TOO LONG--RESUBMIT"; GOTO
     300
315  PRINT "TOTAL ";J$;" IN ";K$(I);" INDUSTRY IN ";H$;"--";LL$;":";
320  INPUT WW$(I)
325  PRINT
335  PRINT "TOTAL ";J$;" IN ";K$(I);" INDUSTRY IN ";G$;"--";L$;": ";
340  INPUT A$(I)
345  PRINT
355  PRINT "TOTAL ";J$;" IN ";K$(I);" INDUSTRY IN ";G$;"--";LL$;": ";
357  INPUT AA$(I)
358  PRINT
375  INPUT "DO YOU WISH TO ADD MORE INDUSTRIES (Y/N)?";M$
380  IF M$ = "Y" GOTO 275
385  HOME : GOTO 410
390  PR# 1
395  PRINT  CHR$ (9) +  CHR$ (1);
400  PRINT  CHR$ (1) + "NO 80";
405  PRINT  CHR$ (1) + "I";
410  PRINT "SHIFT-SHARE ANALYSIS--MODIFIED APPROACH": PRINT
415  INVERSE : PRINT J$;" CHANGES (";SCALE$;") IN SELECTED INDUSTRIES--";
     L$;" TO ";LL$: NORMAL
420  PRINT : PRINT  TAB( 9) LEFT$ (J$,10); TAB( 20) LEFT$ (J$,10); TAB( 3
     2)"% CHANGE"
425  PRINT "INDUS"; TAB( 9)"("; LEFT$ (SCALE$,8);")"; TAB( 20)"("; LEFT$
     (SCALE$,8);")" TAB( 31) LEFT$ (J$,10)
430  PRINT "-TRY"; TAB( 12)L$; TAB( 23)LL$; TAB( 31)L$;"-";LL$
435  PRINT "-------"; TAB( 9)"----------"; TAB( 20)"----------"; TAB( 31)
     "----------"
440  PRINT "TOTAL:"; TAB( 9)X$; TAB( 20)XX$; TAB( 33) LEFT$ (Z$,7)
445  PRINT "("; LEFT$ (H$,5);")"
446  PRINT
447  PRINT "TOTAL:"; TAB( 9)B$; TAB( 20)BB$; TAB( 33) LEFT$ (D$,7)
448  PRINT "("; LEFT$ (G$,6);")": PRINT
450  FOR F = 1 TO I
451 Y = ( VAL (WW$(F)) /  VAL (W$(F)) - 1) * 100
452 Y$(F) =  STR$ (Y)
455 C = ( VAL (AA$(F)) /  VAL (A$(F)) - 1) * 100
460 C$(F) =  STR$ (C)
465 E =  VAL (A$(F)) /  VAL (B$)
470 V =  VAL (W$(F)) /  VAL (X$)
475 Q = C * E
480 Q$(F) =  STR$ (Q)
485 N = Y * V
490 N$(F) =  STR$ (N)
520 IM = Y * (E - V)
525 IM$(F) =  STR$ (IM)
530 RS = E * (C - Y)
535 RS$(F) =  STR$ (RS)
540 Q = N + IM + RS
545 Q$(F) =  STR$ (Q)
550 P = IM + RS
555 P$(F) =  STR$ (P)
560  PRINT : PRINT  LEFT$ (K$(F),7);":"
565  PRINT  TAB( 2) LEFT$ (H$,5); TAB( 9)W$(F); TAB( 20)WW$(F); TAB( 33) LEFT$
     (Y$(F),7)
570  PRINT  TAB( 2) LEFT$ (G$,6); TAB( 9)A$(F); TAB( 20)AA$(F); TAB( 33) LEFT$
     (C$(F),7)
575  NEXT F
580  IF Y$ = "Y" THEN  GOTO 590
585  PRINT : INPUT "PRESS RETURN KEY TO CONTINUE";MM$
590  PRINT : PRINT : PRINT "THIS MODIFIED VERSION OF SHIFT-SHARE ANALYSIS
      PRESENTS COMPONENTS OF REGIONAL ECONOMIC GROWTH IN PERCENTAGE TERMS
     .";
592  PRINT " CHANGES IN SELECTED INDUSTRIES RELATED TO:"
595  PRINT : PRINT  TAB( 16)"STAN-"; TAB( 24)"NET"
600  PRINT "INDUS"; TAB( 8)"ACTUAL"; TAB( 16)"DARD"; TAB( 23)"RELA-"; TAB(
     29)"INDUS"; TAB( 35)"REGION"
605  PRINT "-TRY"; TAB( 8)"GROWTH"; TAB( 15)"GROWTH"; TAB( 23)"TIVE"; TAB(
     29)"-TRY"; TAB( 37)"-AL"
```

```
610  PRINT  TAB( 8)"("; LEFT$ (G$,4);")"; TAB( 15)"("; LEFT$ (H$,4);")"; TAB(
     22)"CHANGE"; TAB( 30)"MIX"; TAB( 36)"SHARE"
615  PRINT "------"; TAB( 8)"------"; TAB( 15)"------"; TAB( 22)"------";
      TAB( 29)"-----"; TAB( 35)"------"
620  FOR R = 1 TO F
625  PRINT  LEFT$ (K$(R),6); TAB( 8) LEFT$ (Q$(R),6); TAB( 15) LEFT$ (N$(
     R),6); TAB( 22) LEFT$ (P$(R),6); TAB( 29) LEFT$ (IM$(R),5); TAB( 35)
      LEFT$ (RS$(R),6)
630  NEXT R
635  PRINT : PRINT "REFERENCE--KALBACHER, JUDITH Z."
640  PRINT  TAB( 12)"AGRICULTURAL ECONOMICS RESEARCH"
645  PRINT  TAB( 12)"31(1): 12-25  JANUARY, 1979"
650  IF Y$ <  > "Y" THEN  GOTO 665
655  PRINT  CHR$ (1) + "A";
660  PR# 0
665  PRINT : PRINT : INPUT "WOULD YOU LIKE A HARD COPY (Y/N)?";Y$
670  IF Y$ = "Y" THEN  GOTO 390
675  END
680  RETURN
```

APPENDIX C

FARRAR-GLAUBER TEST FOR MULTICOLLINEARITY

APPENDIX C

FARRAR-GLAUBER TEST FOR MULTICOLLINEARITY

One of the assumptions of the classical linear model states that the explanatory variables are independent of each other so that each has a separate measurable effect on the endogenous variable, i.e., the data X matrix has full rank and therefore the inverse of (X'X) exists. Multicollinearity is the condition which occurs when there exists the lack of independence among the exogenous (explanatory) variables. The degree of multicollinearity is more or less severe depending on the degree of intracorrelation among the presumably independent variables [Koutsoyiannis, 1977; Murphy, 1973].

The Farrar-Glauber test for multicollinearity in a regression model is a set of three tests. The first is a Chi-Square test for the presence and severity of multicollinearity within the function; the second is an F test for the location of the multicollinearity; and the third is a t test for the pattern of multicollinearity. The following discussion of the three parts of this test is based on Koutsoyiannis [1977].

Part 1

Ho: X's are orthogonal (independent)

Ha: X's are not orthogonal

Farrar and Glauber determined the following test statistic, which has a chi-square (X^2) distribution with $v = \frac{1}{2}K(K-1)$ degrees of freedom:

$$*X^2 = -[N-1-1/6(2K+5)] \cdot \log_e (\text{value of the standardized determination of the correlation matrix})$$

where

$*X^2$ is observed (computed from sample),

N = number of observations in the sample,

K = number of explanatory variables, excluding the constant.

If $*X^2$ is greater than the theoretical value of X^2, the assumption of orthogonality is rejected; that is, the presence of multicollinearity in the model is accepted. The higher the observed $*X^2$, the more severe the multicollinearity.

Part 2

To determine which variables are multicollinear, the multiple correlation coefficients among the explanatory variables are computed and tested for statistical significance with an F test.

$$\text{Ho: } R^2X_i \cdot X_1, X_2 \ldots X_k = 0$$
$$\text{Ha: } R^2X_i \cdot X_1, X_2 \ldots X_k \neq 0$$

The following test statistic is used:

$$F^* = \frac{(R^2X_i \cdot X_1, X_2 \ldots X_k)/(K-1)}{(1 - R^2X_i \cdot X_1, X_2 \ldots X_k)/(N-K)}$$

where, N and K are as previously defined. The null hypothesis is rejected (accept that the variable X_i is multicollinear) when the

observed F* is greater than the theoretical F value with $V_1 = (K-1)$ and $V_2 = (N-K)$ degrees of freedom as obtained from an F table.

Part 3

Finally, to detect which variables are paired with the multicollinear variables identified in Part 2 in producing the multicollinearity, the partial correlation coefficients among the explanatory variables are computed and tested for statistical significance with the use of the t statistic. The partial correlation coefficient between any two variables, X_i and X_j, indicates the degree of correlation between these two variables, all others being held constant. The basic hypothesis is:

$$\text{Ho: } r_{x_i x_j \cdot x_1 x_2 \ldots x_K} = 0$$

$$\text{Ha: } r_{x_i x_j \cdot x_1 x_2 \ldots x_K} \neq 0$$

The following test statistic is used:

$$t^* = \frac{(r_{x_i x_j \cdot x_1 x_2 \ldots x_K}) \sqrt{N-K}}{\sqrt{1-r^2_{x_i x_j \cdot x_1 x_2 \ldots x_K}}}$$

where N and K are as previously defined. The null hypothesis is rejected (accept that the partial correlation coefficient between x_i and x_j is significant, i.e., variables x_i and x_j are responsible for the multicollinearity in the model) when t* is greater than the theoretical value of t obtained from the student's t table with $v = (N-K)$ degrees of freedom.