Estimating Oregon's Private Nonfarm Gross State Product: A Review of Literature and Methodological Extension

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ESTIMATING OREGON'S PRIVATE NONFARM GROSS STATE PRODUCT:

A REVIEW OF LITERATURE AND METHODOLOGICAL EXTENSION

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and
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ABSTRACT

There is a conceptual bias in the most common method of estimating gross state product: the Kendrick-Jaycox technique. This report explains the concept of gross product and critically reviews the most common methods of gross state product estimation, identifying their major limitations. It then demonstrates that, in states like Oregon with a higher than average ratio of proprietor to labor and proprietor income, the Kendrick-Jaycox method probably overestimates private nonfarm gross product. The report concludes by proposing an extension of this technique which eliminates the bias. The extension is used to estimate Oregon's private nonfarm gross product for the period 1958-79.

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INTRODUCTION

The paucity of consistent time-series data that provide a comprehensive measure of regional economic activity hinders regional analysis for economic forecasting and development planning.

Personal income and employment data, available for subnational economies, are extremely useful in regional analysis. Employment data, however, relate only to one of the production factors in a region, namely labor, and then only to the quantity of labor employed. The data fail to capture important qualitative differences in labor's contributions to economic activity in a region and the contribution of capital to regional economic activity is not represented.

The wage and salary component of personal income does contain some indication of qualitative differences in labor to the extent that these are captured in wage rates. The proprietor component of personal income adds a measure of the contribution of proprietary labor and capital as well. However, personal income fails to measure the contribution of corporate capital returns to regional economic activity and this is critically important.

Gross product is a more comprehensive measure of economic activity in that it measures not only labor's contribution (in both qualitative and quantitative aspects) but also capital's contribution to economic activity. Because of its comprehensiveness, gross product is the standard measure of economic activity for the nation, and estimates of gross national product (GNP) are published regularly.

But there is no comparable gross state product data series. The absence of a published gross product data series on the subnational level has led to a body of literature on the construction of time-series estimates of the gross product of states and other subnational regions. (Kendrick and Jaycox, 1965; Kort, 1976; L'Esperance *et al.*, 1969; L'Esperance and Fromm, 1974; L'Esperance *et al.*, 1979; Neimi, 1972; Ratajczak and Williams, 1972; Renshaw, 1975). The growth of applied research in regional analysis and in construction of regional econometric forecasting models has intensified interest in this topic.

Unfortunately there is a conceptual bias in the most common method of estimating gross state product. This method probably yields overestimates of private nonfarm gross product in states like Oregon with a higher than average ratio of proprietor income to labor and proprietor income. This report introduces a method of gross state product estimation which eliminates the bias and uses this method to estimate private nonfarm gross product in Oregon for the 1958-1979 period.

There are three sections to the report. To appreciate the implications of various methods proposed for estimating gross state product, an understanding of how gross product is measured on the national level and a familiarity with its major components are required. The first section of the report provides a review of the concept, definition, and methods of measuring gross product on the national level.

The second section of the report is a critical review of methods of estimating gross state product. It builds on a recent review of methods by Weber (1979), and identifies major limitations of some of the methods reviewed by Weber which he either does not expand upon or does not discuss. It also attempts to extend Weber's synthesis of methods for estimating gross state product.

Finally, in the third section, a different method for estimating the gross state product of private nonfarm sectors is introduced. This method should eliminate a potential bias that may result from the most widely employed method of gross state product construction, the Kendrick-Jaycox method, and thereby improve validity of the estimates.

I. THE CONCEPT AND MEASUREMENT OF GROSS PRODUCT

An understanding of the concepts and terminology used in the literature dealing with the construction of gross state product estimates requires some knowledge of how the national income and product accounts are constructed.

It is logical to introduce the subject of gross state product measurement by summarizing the way gross national product is measured by the Bureau of Economic Analysis (BEA) in constructing the national income and product accounts (Jaszi and Carson, 1979). In essence, these accounts are intended to offer a summary picture of the production, distribution, and use of output. Accordingly, production may be measured either in terms of the value of the goods and services produced or in terms of the value of the income generated in production.

The measurement of GNP as the value of goods and services produced attributes the value produced by the individual business unit according to the following identity:

Value of Production = (sales) + (inventory change) - (current-account purchases)

Current-account purchases represent the intermediate products purchased by the business unit. This method of valuing the production of a business unit is also identified as the value added or product originating approach. Conceptually, the aggregate production of the economy is measured by the sum of the value of production of the business units. In this sum the current-account purchases cancel since the intermediate goods purchased by one business unit will reflect the sales of another. Consequently, the sum of products, or gross product originating summed over all business units consists of "final sales" including net inventory change. Final sales, in turn, must reflect purchases. In the national income and product accounts, these purchases are identified as purchases for personal consumption, gross private domestic investment, net exports, and government purchases. These components of "final sales" comprise the elements of final demand commonly identified with the Keynesian or income-expenditure approach to national macroeconomic modeling. Table 1 summarizes the final form given to the sum of products approach to measuring the aggregate gross product of the economy. Allowing for greater detail, tables of a similar form are published by BEA as a summary of the national income and product accounts.

A second approach taken by BEA to measure GNP proceeds from valuing production by the income generated in production:

Value of Production = (Cost of Production) + (Profits)

As with the sum of products approach, the intermediate costs of production cancel when measuring the aggregate value of the production of the economy by way of the incomes generated in the production process. In the national income and product accounts, the "final costs" are attributed to four broad income categories: compensation of employees, net interest, capital consumption allowances, and indirect business taxes. Profits consist of corporate profits, proprietory income, and rental income. This method of measuring GNP is referred to as the gross income approach and is summarized in Table 2. The components of this table are conventionally ordered into two groups. The first group represents the incomes accruing to labor and property or the factors employed in production. The sum of all factor incomes is identified as National Income and consists of compensation of employees, proprietors' income, rental income, corporate profits, and net interest. Added to national income (to provide a total measure of GNP using

Table 1. Sum of Products - Gross Expenditures Approach

Personal consumption expenditures
Gross private domestic investment
Nonresidential structures
Producers durable equipment
Residential construction
Changes in business inventory
Net exports of goods and services
Governmental purchases of goods and services
Federal
State and local
GROSS NATIONAL PRODUCT

this approach) are the nonfactor charges identified in Table 2 as indirect business taxes, other charges, and capital consumption allowances.

The statistical discrepancies listed in Table 2 under "Other charges" arise because the "sum of products" and "gross income" measures of GNP are estimated independently and are subject to error. Again, Table 2 is of a form very similar to that published by BEA.

The two approaches to measuring gross product that have been introduced are applicable to business production, which accounts for about 85 percent of GNP. Modifications are made in these approaches to measure the production outside the business system, i.e., of the household and public sectors. A discussion of these modifications is provided by Jaszi and Carson (1979) and will not be presented here.

A common format for presenting GNP data (Table 3) identifies gross product by the originating industry. Conceptually, this does not represent a method of measurement distinct from the sum of products or the gross income approaches. This construction of gross product could coneivably be interpreted as either the sum of products-gross expenditures for each industry, or as the gross income-value added by industry. In fact, the national gross product for individual industries is calculated by BEA using the gross income approach, i.e., as a sum of the returns to the factors of production and certain nonfactor charges. It is the construction of gross product estimates by industry represented in Table 3, using the gross income approach of measurement represented in Table 2, that underlies the most widely employed methods for constructing annual time-series estimates of gross state product using published secondary data.

Table 2. Gross Income Approach

Compensation of employees
Wages and salaries
Supplements to wages and salaries
Employer contributions to social insurance
Other labor income
Proprietor's income
Rental income
Corporate profits
Net interest
NATIONAL INCOME
Indirect business taxes
Other charges
Indirect business tax and nontax liabilities
Less: Subsidies less current surplus of government enterprises
Statistical discrepancies
Capital consumption allowances
GROSS NATIONAL PRODUCT

Table 3. Gross Product by Industry

Farm
Private nonfarm
Agricultural services, forestry and fisheries
Mining
Construction
Manufacturing
Non-durable
Durable
Transportation
Communication
Public utilities
Wholesale trade
Retail trade
Finance, insurance, and real estate
Services
Government
Federal
State and local

Although the gross product of a state may conceptually be measured using either the sum of products or the gross income approaches, the availability of data dictates that the latter approach be used. The sum of products approach is not feasible particularly because of the absence of data on imports and exports, as well as gross investment, for the individual states. The State Personal Income series published on the industry level represents the sum of wages and salaries, other labor income, and proprietory income. Therefore, the sum of these components for the gross income derivation of gross state product is known at the two digit (SIC) industry level. In 1978, these components comprised roughly 62 percent of total GNP. The unknown portion of gross state product (Table 2) is made up of: (1) the employer contributions to social insurance portion of the compensation of employees; (2) the rental income and corporate profit part of the profits; (3) the net interest share of property income; and (4) indirect business taxes, other charges, and capital consumption allowances representing nonfactor charges. The principal source for measuring these components on the national level is income tax data. However, the geographic origin of these components, as they relate to nationwide corporate enterprises, is not reported in the federal income tax returns and therefore remains unknown.

The methods for estimating gross product outlined in the following section all involve construction of estimates for the unknown components of the gross income measure for gross state product by individual industries. An estimate of the total gross product of the state is derived using the industry of origin construction of gross product as represented in Table 3.

It should be noted that there are two alternative measures of gross product. One is identified as gross national product, and the other as gross domestic product. The gross national product of the United States, for example, is intended as a measure of the gross income only of U.S. residents regardless of the national or geographic origin of the income. That is, in measuring gross national product the gross income of U.S. residents originating from abroad is included and the gross income of nonresidents originating within the U.S. is excluded. Alternatively, gross domestic product is intended as a measure of the gross income originating from current production within the U.S. regardless of the residence of the owner of the factors of production. The state labor and proprietor income data published by BEA for each industry are by place of work. These data conform to the gross domestic product concept. Therefore, most measures of gross state product estimated at the industry level are based upon the gross domestic product concept and focus on the location of production and the origin of gross income within the state. The relative importance of the difference in these two concepts depends on the degree of openness of the state economy. Renshaw (1975) offers an expanded discussion of the distinction between these concepts and an interpretation of their implication as measures for gross state product.

II. METHODS FOR CONSTRUCTING ESTIMATES OF PRIVATE NONFARM GROSS STATE PRODUCT

The work of Kendrick and Jaycox (1965) represents the seminal effort in developing a method to construct time-series estimates of gross state product for state econometric modeling. Their approach, which relies exclusively on the use of published secondary data, has been widely used in the econometric modeling of state economies.

There are important differences in the secondary data available for the farm, private nonfarm, and government sectors. Based on these differences, Kendrick and Jaycox proposed a different approach for constructing gross product estimates for each of these sectors. The approaches they originally proposed for estimating the gross product of the farm and government sectors have remained essentially unchanged. The reader is directed to Weber's (1979) survey for reference to these approaches.

To outline and discuss the Kendrick-Jaycox method for estimating the gross product of the private nonfarm sector, as well as various proposed modifications, it helps to first develop a system of symbolic notation relating to the accounting framework from which the estimates are to be constructed. Such a system is developed in Table 4. The contents of this table represent the accounting system used in the gross income approach to measuring gross product outlined in the previous section. A notational symbol accompanies each element of this system, and identities are introduced where appropriate. Reference is also made in Table 4 of some additional notation relevant to discussing the Kendrick-Jaycox approach and various proposed modifications.

The Kendrick-Jaycox Method

From the labor and proprietor income data published by BEA, the only known components of gross state product for the individual industries of the private nonfarm sector are wages and salaries (WS*), other labor income (OL*), and proprietor's income (PI*). Kendrick and Jaycox proposed estimating the major remaining unknown components by a three-step process "... based on

Table 4. Symbolic Notation for the Gross Income Approach for Estimating Private Nonfarm Gross Product by Industry a/

Gross Income	
Compensation of employees, CE	(CE = WS* + SW)
Wages and salaries, WS*	
Supplements to wages and salaries, SW	(SW = ES + OL*)
Employer contributions to social insurance, ES	
Other labor income, OL*	
Proprietor's income, PI*	
Rental income, RI	
Corporate profits, CP	
Net interest, NI	
NATIONAL (STATE) INCOME, IO	(IO = CE + PI + RI + CP + NI)
Indirect business taxes, IBT	
Other charges, OC	(OC = BTP + LS + SD)
Business transfer payments, BTP	
Less: subsidies, LS	
Statistical discrepancies, SD	
Capital consumption allowance, CCA	
GROSS NATIONAL (STATE) PRODUCT, GP	(GP = IO + IBT + OC + CCA)

a/ Asterisks (*) identify the known components of gross state product by industry published as labor and proprietor income, LPI,* where:

LPI* = WS* + OL* + PI*

Labor income (LI*) is identified as:

LI* = WS* + OL*

Additional symbolic notation relevant to various modifications of the Kendrick-Jaycox approach based on Census of Manufacturers data include:

Value Added, VA   Labor Payroll, LP

Subscripts applied in the above notation include:

i representing industry
s representing state
n representing nation
(example WS_{is} = wages and salaries of industry i of state s).

the assumption that the structure within each private nonfarm industry group of the state is similar to that of the nation, or that the divergences are off-setting" Kendrick and Jaycox, 1965, p. 159). Accordingly, in the first step the known ratio of national income (IO^*_{in}) to national labor and proprietor income (LPI^*_{in}) is multiplied by the known state labor and proprietors' income (LPI^*_{is}) to estimate state income (IO_{is}), that is,

$$(1) \quad IO_{is} = \frac{IO^*_{in}}{LPI^*_{in}} (LPI^*_{is}) .$$

Thus, the sum of the unknown components of the state factor income is estimated by the difference between the estimated state income and the published labor and proprietors' income, that is,

$$(2) \quad IO_{is} - LPI^*_{is} = ES_{is} + RI_{is} + CP_{is} + NI_{is}$$

The second and third steps involve estimating the nonfactor charges against state gross product, represented by indirect business taxes (IBT_{is}) and capital consumption allowances (CCA_{is}), by allocating to the state a share of each of the nonfactor charges as determined by the state's estimated share of national factor income, or

$$(3) \quad IBT_{is} = \frac{IO_{is}}{IO^*_{in}} (IBT^*_{in}) ,$$

and

$$(4) \quad CCA_{is} = \frac{IO_{is}}{IO^*_{in}} (CCA^*_{in}) .$$

The Kendrick-Jaycox procedure of gross product estimation may be summarized by the following expression:

$$(5)\quad GP_{is} = \frac{IO^*_{in}}{LPI^*_{in}} (LPI^*_{is}) + \frac{IO_{is}}{IO^*_{in}} (IBT^*_{in}) + \frac{IO_{is}}{IO^*_{in}} (CCA^*_{in}) ,$$

or

$$(6)\quad GP_{is} = IO_{is} + IBT_{is} + CCA_{is} .$$

According to Weber these procedures may be greatly simplified, "... if it is assumed that business transfer payments, subsidies less current surplus of government enterprises, and statistical discrepancies are negligible or offsetting in the state" (Weber, 1979, p. 222). The IO_{is} expression in equation (1) may be substituted into the second and third terms in the right hand side of equation (5), yielding

$$(7)\quad GP_{is} = \frac{IO^*_{in}}{LPI^*_{in}} (LPI^*_{is}) + \frac{IO^*_{in}}{LPI^*_{in}} \frac{LPI^*_{is}}{IO^*_{in}} (IBT^*_{in}) + \frac{IO^*_{in}}{LPI^*_{in}} \frac{LPI^*_{is}}{IO^*_{in}} (CCA^*_{in}) ,$$

which may be expressed as

$$(8)\quad GP_{is} = (IO^*_{in} + IBT^*_{in} + CCA^*_{in}) \frac{LPI^*_{is}}{LPI^*_{in}} ,$$

or based on the assumption proposed by Weber,

$$(9)\quad GP_{is} = (GP^*_{in}) \frac{LPI^*_{is}}{LPI^*_{in}} .$$

This simplification is particularly useful if one is concerned with reducing the data required in the gross product calculation and is willing to forego an estimate of some of the individual components as expressed in equation (6).

In comparing the Kendrick-Jaycox method to his proposed more simplified approach, Weber concludes "... the simplicity of the latter method seems to offset the appeal of any slight improvement in accuracy to be achieved by the former" (Weber, 1979, p. 222). On the contrary, it appears that the simple approach is both simpler and more accurate. The Kendrick-Jaycox method, as represented by equation (8), excludes the other nonfactor charges (OC) component of gross product. Thus, it is the original Kendrick-Jaycox approach which imposes the "off-setting assumption" suggested by Weber with regard to BTP, LS, and SD. A perusal of the recent magnitudes of these variables for the entire nation reveals their sum to be consistently positive, thus the Kendrick-Jaycox procedure would be biased toward an underestimate of the gross state product. Indeed, it is the more simplified method expressed in equation (9), which may be appropriately expanded to

$$(10)\quad GP_{is} = (IO^*_{in} + IBT^*_{in} + OC^*_{in} + CCA^*_{in}) \frac{LPI^*_{is}}{LPI^*_{in}} ,$$

that would offer the "slight movement in accuracy." L'Esperance *et al.* (1979) introduce an expression similar to equation (10) in which a term for "other adjustments" appears analogous to OC.

Equation (10) may be expanded further if estimates of individual components of the income approach to the gross state product derivation are desired. It should be noted, however, that in the published national product and income accounts the statistical discrepancy is not measured for individual industries. A correction for statistical discrepancies may be made either by distributing the statistical discrepancy equally over each industry or by adjusting the sum of the individual industry estimates with the statistical discrepancy.

The assumption of "similarity" or of "offsetting differences" between the structure of the industries of the state and the nation which underlies the Kendrick-Jaycox procedure, of course, requires that knowledge of a particular state economy accompany any interpretation of the estimates derived in using this technique. The least rigorous and broadest interpretation usually given this assumption is that the factor proportion or factor share of income of each industry is the same for the state as for the nation. It is reasonable to infer that this assumption is imposed as a necessary expedient for making the best possible use of the regional and national income and product data available. Except for manufacturing and mining, no alternative procedures have been proposed for estimating the gross product of the private nonfarm industries of a state economy. In Section III, an extension of the Kendrick-Jaycox procedure that may be applied to the private nonfarm sectors will be introduced. This proposed extension will reduce a potential bias that may result from the Kendrick-Jaycox method just outlined and thereby improve the validity of the estimate.

Census Value Added as a Measure of Gross State Product

Several modifications of and alternatives to the Kendrick-Jaycox method have been proposed for estimating the gross product of a state's manufacturing and mining sectors. The common thread in these methods is that they utilize the regional value added data published by the Bureau of the Census (hereafter Census) in the *Annual Survey of Manufacturers*, the *Census of Manufacturers*, and the *Census of Mineral Industries*. To appreciate the implications of these variations of the Kendrick-Jaycox method, it is important to first understand the major differences between the Census value added series as a measure of production activity and the BEA concept of gross product. Indeed, Census value added data have been selected by some regional economists as a direct measure of the gross product of the manufacturing sector on the assumption that the Census value added and the BEA value added approaches to measuring gross product are conceptually equivalent, which they are not. Kort (1976), for example, uses Census value added to approximate the gross product of manufacturing for the Tennessee economy reasoning, "Where data are available which approximates the desired account, it makes more sense to use the data rather than to fabricate it" (Kort, 1976, p. 61). The implications of this usage of Census value added will become apparent in the following discussion.

Value added, as measured by Census, is "... derived by subtracting the total costs of materials (including materials, supplies, electric energy, cost of resales, and miscellaneous receipts) from the value of shipments (including resales) and other receipts and adjusting the resulting amount by the net change in finished products and work-in-progress inventory between the beginning and end of the year" (*Census of Manufacturers*, 1972, V. III, p. XXVIII). There are two major differences between this measure of manufacturing activity and the gross product-value added-gross income concept used by BEA. The most obvious of these differences is that, in the Census valuation, "intermediate costs of production" are measured only in terms of material costs. Excluded from this measure of intermediate costs are the costs of business services, such as expenditures of maintenance and repair, engineering, consulting, research, and advertising. This results in some part of the gross product which BEA would ascribe to the nonmanufacturing sector being attributed to the manufacturing sector by Census. A less obvious difference results from Census preparing individual industry measurements based on establishment data whereas BEA prepares a measurement based on company data. Census attributes no value added to establishments which do not generate receipts from the shipment of manufacturing products and that only perform the administrative and auxiliary functions of a manufacturing enterprise. For example, the activities of an establishment such as the headquarters of a manufacturing firm may not be measured by Census as part of the value added of the manufacturing sector of a state. As a result, part of the state gross product which BEA would attribute to manufacturing is excluded from the Census value added measurement.

The resulting effects of the differences between the two measures of manufacturing activity on the national level are evident in Columns 1-6 of Table 5. The Census value added is consistently greater than the BEA gross national product measure. This is expected, since the differences that would arise on the state level from preparing estimates based on establishment versus company data largely will cancel on the national level. The difference arising from the two measures of cost, therefore, prevails. The ratio between the two measures is given in Column 5. The ratios presented in Column 5 indicate that the relative difference between the two measures has increased measurably over time. Since the labor and proprietor income series is the only component of gross product available on the state

Table 5. Comparison of Manufacturing Value Added, Gross Product, and Labor and Proprietor Income, U.S. and Oregon (selected years)

Year	Value Added of Manufacturing, U.S. (million $)	Gross Product of Manufacturing, U.S. (million $)	Labor & Proprietor Income, Manufacturing, U.S. (million $)	Col. 3 ÷ Col. 2	Col. 4 ÷ Col. 2	Value added of Manufacturing, OR (million $)	Labor & Proprietor Income, Manufacturing, OR (million $)	Col. 8 : Col. 7
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1961	164,032	143,768	97,827	.876	.596	1,367	829	.606
1965	226,975	196,308	126,017	.865	.555	1,833	1,022	.557
1969	304,441	254,575	172,766	.836	.567	2,613	1,518	.581
1973	405,255	321,782	219,562	.794	.539	4,284	2,164	.505
1977	580,641	456,049	306,582	.784	.527	6,256[a/]	3,387	.541

a/ Preliminary data.

Sources: U.S. Department of Commerce, Bureau of the Census, *Annual Survey of Manufacturers;*

U.S. Department of Commerce, Bureau of Economic Analysis, *Gross Product Originating in Current and Constant (1972) Dollars* and *Detailed Components of Annual Personal Income, U.S. and Oregon.*

level, it is revealing to examine ratios of this series to value added for the United States and for the State of Oregon (Columns 6 and 9). Given the dissimilarity in the composition of the Oregon manufacturing sector as compared to the U.S., it is surprising that the difference between the two ratios is not greater.

Specifically, there are two major consequences of using Census value added data as a direct measure of manufacturing gross product when estimating total gross state product. First, the gross product of the state would tend to be overestimated, as the value added by nonmanufacturing business services supplied to manufacturing would be attributed to both sectors. The relative importance of manufacturing, therefore, is overstated as well. As noted by Weber (1979), services provided from out-of-state also are attributed to the manufacturing activity within a state by the value added measure. The extent of interstate exchange of services varies widely among states. This double accounting of nonmanufacturing business services generally outweighs the administrative and auxiliary activities associated with manufacturing enterprises that may go unmeasured. The second consequence of using Census value added as an estimate of manufacturing gross product is less obvious. To the extent that the administrative and auxiliary functions associated with manufacturing firms remain unmeasured by Census value, the relative share of national output of states which tend to specialize in these activities is understated. A similar distortion may arise in the measurement of secular trends in the structure of a state economy. For example, in recent years major lumber and wood product firms have begun to shift the location of their corporate headquarters from the Pacific Northwest to the Southeast.

The relative decline of the Pacific Northwest lumber and wood products industry tends to be understated by the Census value added data series.

Despite the apparent attraction of using Census value added as a direct estimate for manufacturing gross product, the conceptual and measurement differences in this data series relative to the BEA gross product measure weigh against its use. This conclusion is particularly appropriate if gross product estimates of the other sectors of the state economy are constructed to conform to the BEA approach. Equally important, however, is the constraint imposed by the inconsistent industry and time-series coverage of these data for many states, as well as the time-lag in its release. For example, of the 20 two-digit (SIC) industries identified under manufacturing, value added is consistently reported for only seven industries in Oregon over the 20-year 1958-77 period. Preliminary 1977 estimates of value added were not available for Oregon until late 1979. A two-year time-lag is typical for the release of these data. (By comparison, BEA state-level data are available with a nine-month lag.) All these particulars present very practical limitations on the use of the value added data series as a measure of gross product for developing state econometric forecasting models which rely on consistent and contemporary time-series data.

The Weighted Value Added Approach

To estimate the gross product of the manufacturing and mining sectors, Suits (1965) proposed allocating to each state a share of gross national product according to share of value added as measured by the Bureau of Census. This method is represented by

$$(11) \quad GP_{is} = \frac{VA_{is}}{VA_{in}} (GP^*_{in}) .$$

Implied in this procedure is the assumption that the ratio of gross product to value added is the same for the state as for the nation. An interpretation of the validity of this assumption must be made in light of the differences between the Census value added and the BEA gross product measures of production activity described in above. First, to the extent a state may specialize in the administrative and auxiliary functions involved in manufacturing enterprises that are unmeasured in the value added series, the manufacturing gross product of the state, as well as its relative contribution to the national gross product, will be understated. The opposite will hold for those states whose major manufacturing industries specialize in the physical production and shipment of goods associated with production. Second, the greater the relative contribution of nonmanufacturing business service inputs to the state's manufacturing sector, the greater the overstatement of the state's gross product and its national share. Should the opposite of this condition hold, the state's gross product will be understated using this procedure. Finally, the lack of contemporary and consistent time-series value added data imposes a critical practical constraint on the application of this procedure.

The Niemi Modified Kendrick-Jaycox Approach

Reportedly on the advice of Kendrick, Niemi (1972) introduced a modification to the original Kendrick-Jaycox procedure in estimating the gross product of the New England states. Also suggested by L'Esperance and Taylor (1972), this modification is intended to correct for structural differences in the factor proportions between the state and nation. Using Census value added and labor payroll data, an estimate of the output-labor ratio may be estimated for the nation and the state. This adjustment for a dissimilarity in the factor proportions between the state and nation is expressed as $\frac{(VA_{is}/LP_{is})}{(VA_{in}/LP_{in})}$. If this expression is greater than one, then it is presumed that the state's labor productivity is higher than the total U.S. figure (L'Esperance and Taylor, 1972, p. 1). By applying this expression to the Kendrick-Jaycox procedure, an adjustment is introduced to the gross state product estimate to account for differences in factor proportions between state and nation, that is,

$$(12) \quad GP_{is} = \left[\frac{VA_{is}/LP_{is}}{VA_{in}/LP_{in}}\right] \left[GP^*_{in} \frac{LPI^*_{is}}{LPI^*_{in}}\right]$$

According to Niemi, "Value added is conceptually equivalent to gross product originating and labor payroll is conceptually equivalent to income received. On the basis of these figures, it is possible to construct annual estimates of an output-labor ratio in manufacturing for each state during the postwar period" (Niemi, 1972, p. 24). Unfortunately, the modification he proposes is founded upon these very tenuous assertions. Indeed, as has already been noted it is quite obvious from Table 5 that value added is not conceptually equivalent to gross product originating. However, for argument, if it may be accepted that labor payroll and income received are nevertheless equivalent, that is,

$$LP_{is} = LPI^*_{is} \text{ and } LP_{in} = LPI^*_{in}, \text{ or } \frac{LP_{is}}{LP_{in}} = \frac{LPI^*_{is}}{LPI^*_{in}},$$

this implies

$$(13) \quad \frac{LP^*_{is}/LP_{is}}{LP^*_{in}/LP_{in}} = 1 ,$$

and, thus, there is not an apparent difference in the modification proposed by Niemi and the approach suggested by Suits. Rearranging the terms of equation (12) yields:

$$(14) \quad GP_{is} = \left[\frac{LPI^*_{is}/LP_{is}}{LPI^*_{in}/LP_{in}}\right] \left[GP^*_{in} \frac{VA_{is}}{VA_{in}}\right] ,$$

which under the conditions expressed in equation (13) may be simplified to an expression of the Suits procedure,

$$(15) \quad GP_{is} = GP^*_{in} \left[\frac{VA_{is}}{VA_{in}}\right] .$$

Indeed, it may be argued that the two approaches will differ significantly only if there is a major conceptual and/or measurement difference between the labor payroll and income received (i.e., the condition represented by equation (13) does not hold), and not necessarily because of a relevant difference in the factor shares of the state relative to the nation.

An examination of the Census labor payroll and BEA income received measurements reveals they are also conceptually different. The major difference is that income received includes proprietor income while labor payroll does not. Subtracting proprietor income from income received yields labor income. Therefore, it may be appropriate to conclude that the BEA labor income measure is roughly equivalent to the Census labor payroll measure.

This conclusion is supported by a comparison made by Census, "It should be noted that the labor costs included in national income are reasonably close despite the fact that they are computed on a slightly different basis" (*Census of Manufacturing*, 1972, Vol. III, Part I, p. XXX). It would seem appropriate, therefore, to further modify the Niemi modification by substituting labor income for labor and proprietor income in equation (14), that is,

$$(16)\quad GP_{is} = \frac{VA_{is}/LP_{is}}{VA_{in}/LP_{in}} \quad GP^{*}_{in}\,\frac{LI^{*}_{is}}{LI^{*}_{in}} \quad .$$

This will nevertheless simplify to the procedure used by Suits if it is accepted that LP = LI.

In his review and comparison of the alternative methods for estimating gross state product, Weber concludes, "... a method which applied a correction for productivity differences between state and nation such as that suggested by L'Esperance and Taylor and by Niemi seems preferable" (1979, p. 222). Weber rejects, however, the procedure proposed by Suits, "Using the GNP weight amounts to making the assumption that the proportion of double counting in the state is the same as that for the nation. It is doubtful that this is a good assumption for most states" (1979, p. 221). The difference between the two methods is more illusory than real and would seem to depend more upon differences in the relative contribution of proprietors' income to total labor and proprietors' income between the state and nation, rather than differences in the factor shares. The major difference which may arise in the results of either of the two approaches as compared to the Kendrick-Jaycox method occurs largely as a consequence of the significant conceptual and measurement differences between the Census concept of value added and the BEA measure of gross product. This difference is not a reasonable basis for inferring that either method should be preferred to the original Kendrick-Jaycox procedures, with the limiting assumptions of the latter being very explicit.

III. AN EXTENSION OF THE KENDRICK-JAYCOX METHOD

The objectives of this section are: (i) to identify and demonstrate a potential bias which may be introduced by the Kendrick-Jaycox procedure for estimating the industry gross product of a state; (ii) to suggest an extension of this procedure which will correct for this bias and provide a slight improvement in the accuracy of the estimate; and (iii) to compare the results obtained from using this extension to those from using the Kendrick-Jaycox procedure when applied to the State of Oregon. This extension proposes to estimate state gross product by using available state income data in greater detail, unlike the original Kendrick-Jaycox procedure which uses national gross product data in greater detail. The notation developed in Table 4 is used extensively in the following discussion.

The Kendrick-Jaycox Bias

Before addressing the details, the general argument regarding the bias introduced by the Kendrick-Jaycox method will be outlined. The assumption underlying the Kendrick-Jaycox method is that the structure within each industry of the state is similar to that of the nation, or that the differences are offsetting. One important structural difference that may exist is the relative importance of proprietor income to the total labor and proprietor income. This difference can be easily determined on the one-digit SIC level from available secondary data. The Kendrick-Jaycox method uses the state's share of national labor and proprietor income to estimate the state's share of the components of gross product that are unknown at the state level. Should the state's share of proprietor income be different than its share of labor income, this structural difference would be incorporated into deriving the state's share of gross product. As will be demonstrated, an examination of the unknown components of gross state product reveals that there is no valid reason to assume that the state's share of proprietor income should be pertinent to the estimation of these components. Therefore, the Kendrick-Jaycox method may be inconsistent with the assumption upon which it is based. If, for example, a state's share of national proprietor income is greater than its share of national labor income, this structural difference will agument the magnitude of the gross product estimate. There is no reason to suppose that there exist offsetting influences.

The term bias, as used here, characterizes an estimate derived from the Kendrick-Jaycox method if it overstates, or understates, an alternative estimate which is consistent with the assumption that there is no structural difference between the state and nation, except that relating to proprietor income.

To address the details of this argument, it is expedient to demonstrate the potential bias which may be introduced by the Kendrick-Jaycox procedure by beginning with the simplified expression of this approach as proposed by Weber identified earlier as equation (9) and, again, as

$$(17)\quad GP_{is} = GP^*_{in} \frac{LPI^*_{is}}{LPI^*_{in}} \quad ,$$

where the asterisk superscript represents a known value as measured by BEA. Although unpublished, data for the individual components of labor and proprietors' income are available upon request from the Regional Economic Measurement Division of BEA on the one-digit SIC, industry level. Recalling that LPI* can be decomposed, i.e.,

$$(18)\quad LPI^* = LI^* + PI^* \quad ,$$

equation (17), therefore, may be expanded to

$$(19)\quad GP_{is} = GP^*_{in} \frac{(LI^*_{is} + PI^*_{is})}{(LI^*_{in} + PI^*_{in})} \quad .$$

For convenience, let all the components of gross product unknown at the state level except for employers contribution to social insurance (ES) be represented as

$$(20)\quad U_{is} = RI_{is} + CP_{is} + NI_{is} + IBT_{is} + OC_{is} + CCA_{is} \quad .$$

State and national industry gross product may be respectively expressed as

$$(21)\quad GP_{is} = LI^*_{is} + PI^*_{is} + ES_{is} + U_{is}$$

and

$$(22)\quad GP_{in} = LI^*_{in} + PI^*_{in} + ES^*_{in} + U^*_{in} \quad .$$

It is evident from equations (21) and (22) that the unknown portion of industry gross product to be estimated consists of employer contributions to social insurance (ES_{is}), nonproprietor profit type income ($RI_{is} + CP_{is} + NI_{is}$), and the nonfactor charges and adjustments against gross product (IBT_{is} + $BTP_{is} + LS_{is} + CCA_{is}$). Substituting equations (21) and (22) into (19), the Kendrick-Jaycox method may be expressed as:

$$(23)\quad LI^*_{is} + PI^*_{is} + ES_{is} + U_{is} =$$

$$(LI^*_{in} + PI^*_{in} + ES^*_{in} + U^*_{in}) \frac{(LI^*_{is} + PI^*_{is})}{(LI^*_{in} + PI^*_{in})} \quad .$$

Solving for the unknowns of equation (23) yields

$$(24)\quad ES_{is} + U_{is} = (ES^*_{in} + U^*_{in}) \frac{(LI^*_{is} + PI^*_{is})}{(LI^*_{in} + PI^*_{in})} \quad .$$

Assume, for argument, that state and national industries are structurally similar in the sense that the proportion of labor income to total labor and proprietor income is the same for the state as for the nation, that is,

$$(25)\quad \frac{LI^*_{is}}{LI^*_{is} + PI^*_{is}} = \frac{LI^*_{in}}{LI^*_{in} + PI^*_{in}} \quad ,$$

or

$$(26)\quad \frac{LI^*_{is}}{LI^*_{in}} = \frac{LI^*_{is} + PI^*_{is}}{LI^*_{in} + PI^*_{in}}$$

Substituting the left term of equation (26) into (24) yields

$$(27)\quad ES_{is} + U_{is} = (ES^*_{in} + U^*_{in}) \frac{(LI^*_{is})}{(LI^*_{in})} \quad ,$$

or

$$(28)\quad ES_{is} + U_{is} = ES^*_{in} \frac{(LI^*_{is})}{(LI^*_{in})} + U^*_{in} \frac{(LI^*_{is})}{(LI^*_{in})} \quad .$$

Equation (28) is an intuitively attractive expression in keeping with the assumption of structural similarity underlying the Kendrick-Jaycox method. This expression suggests that each of the unknown components of industry state gross state product may be estimated by weighting its national counterpart with the ratio of state to national labor incomes. Given no additional information it seems reasonable, for example, that a state's share of employer contribution to social insurance may be assessed on the basis of its relative share of total labor income.

To extend this argument, now consider that it is determined that the state and national industries are structurally dissimilar in the sense that the proportion of labor income to total labor and proprietor income is less for the state than for the nation, that is,

$$(29)\quad \frac{LI^*_{is}}{LI^*_{is} + PI^*_{is}} < \frac{LI^*_{in}}{LI^*_{in} + PI^*_{in}} \quad ,$$

or

$$(30)\quad \frac{LI^*_{is}}{LI^*_{in}} < \frac{LI^*_{is} + PI^*_{is}}{LI^*_{in} + PI^*_{in}} \quad .$$

Aternatively stated, this relation reflects the fact that the proportion of proprietor income to total labor and proprietor income of the state is greater than that of the nation. This may reveal an important structural dissimilarity between the state and nation. The inequality may reflect, for example, a lower level of concentration in the industry of the state relative to the nation. Using the Kendrick-Jaycox method of estimating the unknown components of gross product as expressed in equation (24) under the conditions identified in equation (30) yields the following relation:

$$(31) \quad (ES^*_{in} + U^*_{in}) \frac{(LI^*_{is} + PI^*_{is})}{(LI^*_{in} + PI^*_{in})} > (ES^*_{in} + U^*_{in}) \frac{(LI^*_{is})}{(LI^*_{in})} ,$$

which may be expressed as

$$(32) \quad ES_{is} + U_{is} > ES^*_{in} \frac{LI^*_{is}}{LI^*_{in}} + U^*_{in} \frac{LI^*_{is}}{LI^*_{in}}$$

The question to be addressed at this juncture is whether this relation is a credible *a priori* assumption on which to base the estimation of industry gross state product, supposing there are no structural dissimilarities except where they have been identified by equation (29).

The employer contribution to the social security payroll tax is based upon a flat percentage rate leveled on wages and salaries of employees up to a ceiling amount. In order that the following condition may hold,

$$(33) \quad ES_{is} > ES^*_{in} \frac{(LI^*_{is})}{(LI^*_{in})} ,$$

either (1) the proportion of occupations covered under the social security system is greater for the industry of the state than for the nation, or

(2) the proportion of wages and salaries above the ceiling is lower for the industry of the state than for the industry of the entire nation. While these conditions may be plausible, it is difficult to conclude they will arise merely because the proportion of proprietor income to total labor and proprietor income is higher for the state than for the nation. Both proprietor and corporate enterprises are subject to the same tax to be paid on employee wages and salaries. Based upon income generated from self-employment, proprietors may make payments to social security in the category of personal contributions. However, only the employer contributions, not the personal contributions to social security made either by proprietors or employees, are included in the measure of gross product. Therefore, since no other structural dissimilarities are identified, it is not unreasonable to assume the relation depicted by equation (31) will hold. Indeed, given no further information, it would seem more valid to infer from the principle underlying the Kendrick-Jaycox method, that the state's share of contributions to social insurance should be estimated on the basis of its relative share of labor income, that is,

$$(34) \quad ES_{is} = ES^{*}_{in} \frac{(LI^{*}_{is})}{(LI^{*}_{in})} .$$

If one accepts that equation (34) is the more credible assumption, then, for the inequality expressed in (32) to remain valid, the remaining unknown portion of gross product to be estimated must constitute a larger share of its national counterpart than does labor income, that is,

$$(35)\quad U_{is} > U^*_{in} \frac{(LI^*_{is})}{(LI^*_{in})}\text{, or } \frac{U_{is}}{U^*_{in}} > \frac{LI^*_{is}}{LI^*_{in}}$$

where

$$(36)\quad U_{is} = RI_{is} + CP_{is} + NI_{is} + IBT_{is} + BTP_{is} + LS_{is} + CCA_{is} .$$

Certainly this includes the most important unknown components of gross regional product. Again, however, there is no apparent basis for considering this to be a reasonable assumption merely because proprietor income is determined to be a larger proportion of labor and proprietor income for the industry of the state than for the nation. Indeed, given the greater importance of proprietor income to the state, one would expect that a larger proportion of labor income would originate from proprietor establishments in the state as compared to the nation. Therefore, with all other things equal, one may expect the ratio of corporate profit (CP) to labor income (LI) to be smaller for the state than for the nation, rather than larger. The most tenable approach would seem to lie with distributing to the state the unknown portion of industry gross product according to the state relative share of labor income, that is

$$(37)\quad U_{is} = U^*_{in} \frac{(LI^*_{is})}{(LI^*_{in})} .$$

Therefore, given the determination that proprietor income is a larger proportion of labor and proprietor income for the state than for the nation, the particular method of gross product construction proposed originally by Kendrick-Jaycox will violate the principle of structural simiilarity underlying their approach. In this instance an upward bias is introduced in the estimate.

Similarly, should it be determined that the ratio of proprietor income to total labor and proprietor income is smaller for the state than for the nation, then the Kendrick-Jaycox method using labor and proprietor income ratios will introduce a bias by understating the industry gross product of the state. It should also be noted that Kendrick-Jaycox qualified their assumption of structural similarity by assuming that any divergences are offsetting. As is evident in equation (31) this would not be the case in the example given.

An Unbiased Extension of the Kendrick-Jaycox Procedure

If it may be concluded that equations (34) and (37) provide unbiased estimates of the unknown components of industry state gross product consistent with the principle of similar or offsetting structural differences, independent of differences in the relative share of proprietor to labor income, then the original Kendrick-Jaycox method as expressed by equation (17) may be modified appropriately by the following:

$$(38) \quad GP_{is} = (GP^*_{in} - PI^*_{in}) \frac{(LI^*_{is})}{(LI^*_{in})} + PI^*_{is} \quad .$$

Expanding this expression and solving for the unknown components ES_{is} and U_{is} will yield:

$$(39) \quad ES_{is} + U_{is} = ES^*_{in} \frac{(LI^*_{is})}{(LI^*_{in})} + U^*_{in} \frac{(LI^*_{is})}{(LI^*_{in})} \quad .$$

This expression is the sum of equations (34) and (37) and is independent of the relative importance of proprietor income to the state as compared to the nation.

The estimates resulting from this proposed extension are consistent as the term is used by L'Esperance and Fromm. They ascribe the property of consistency to methods of gross state product construction for which "... the sum of the 50 GSP's will algebraically sum to gross national product (GNP)" (L'Esperance and Fromm, 1974, p. 46). Except for methods using Census value added as a direct measure of gross product, all the methods outlined possess this property.

A Comparison of Results With Application to Oregon

Presented in Table 6 is a comparison of the results of the proposed extension and the Kendrick-Jaycox procedure when applied to estimating the 1978 private nonfarm gross product of Oregon. Columns 2 and 3 identify the ratios of proprietor income to total labor and proprietor income for Oregon and the United States with respect to the industries identified in Column 1. By dividing Column 2 by Column 3, a proprietor income location quotient is derived in Column 4. This location quotient can be used to evaluate the relative importance of proprietor income in the Oregon economy as compared to the United States by industry. According to the earlier argument, if the values of this expression are greater (less) than one, the Kendrick-Jaycox procedure will introduce a bias that overstates (understates) the state gross product estimate if it is assumed that there are no other structural dissimilarities between the industry of the state and the nation. Of course, the extent of this bias also depends upon the absolute importance of proprietor income for both the nation and the state. The values of this location quotient in this table reveal proprietor income is generally of greater significance in the industries of the Oregon economy than for the U.S.

Table 6. A Comparison of Oregon Private Nonfarm Gross Product, Estimates by Industry, 1978[a/]

Industry	PI^*_o/LPI^*_o	PI^*_n/LPI^*_n	Col. 2 ÷ Col. 3	$ES_o + U_o$ K-J Method	$ES_o + U_o$ Extension	Col. 5 ÷ Col. 6	$LPI^*_o + ES_o + U_o$ K-J Method	$LPI^*_o + ES_o + U_o$ Extension	Col. 8 ÷ Col. 9
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)[b]	(9)[b]	(10)
(1) Ag. Services, Forestry & Fisheries	.335	.275	1.290	36,296	32,300	1.124	152,021	148,025	1.027
(2) Mining	.029	.064	.455	74,537	77,293	.964	118,987	121,743	.977
(3) Construction	.236	.163	1.451	212,839	194,183	1.096	1,329,824	1,311,168	1.014
(4) Manufacturing	.017	.008	2.123	1,860,117	1,842,763	1.009	5,811,452	5,794,098	1.003
(5) Transportation, Communications & Public Utilities	.046	.033	1.365	1,062,032	1,048,662	1.013	2,250,053	2,236,683	1.006
(6) Wholesale Trade	.064	.067	.948	871,587	874,780	.996	2,004,727	2,007,920	.998
(7) Retail Trade	.126	.097	1.304	1,030,339	996,744	1.034	2,825,414	2,791,819	1.012
(8) Finance, Insurance, & Real Estate	.203	.119	1.712	2,569,334	2,322,945	1.106	3,451,055	3,204,666	1.077
(9) Business Services	.226	.142	1.597	226,179	203,881	1.109	997,598	975,300	1.023
(10) Professional, Social & Related Services	.252	.203	1.245	255,245	239,382	1.066	1,877,655	1,861,792	1.009
(11) TOTAL - Private Nonfarm	.117	.083	1.409	8,198,505	7,832,931	1.047	20,818,786	20,453,212	1.018

a/ Subscripts o and n refer to Oregon and the U.S., respectively.

b/ 1,000s of current $'s.

The constructed estimates of the unknown components of gross state product using the Kendrick-Jaycox procedure according to equation (24) are presented in Column 5 of Table 6. The constructed estimates of these unknown components using the proposed extension as represented by equation (39) are depicted in Column 6. A comparison between these estimates may be made from Column 7 which expresses the ratio of the two. Since proprietor income is a larger proportion of labor and proprietor income for Oregon than for the nation, the Kendrick-Jaycox method introduces a bias (refer to line 11, Column 7) toward overstating unknown gross product components of Oregon's total private nonfarm sector by about 4.7 percent. For three of the industries listed in Table 6, this bias is more than 10 percent, as may be observed by referring to Column 7, Lines 1, 8, and 9.

The industry gross product estimates derived by using the Kendrick-Jaycox procedure and the proposed extension are presented respectively in Columns 8 and 9 of Table 6. These estimates may be computed either by using equations (17) and (38) or simply by adding the estimates of the unknown components of Columns 5 and 6 to the known measure for labor and proprietor income. The difference between the two gross product estimates results only from the difference in the constructed estimates of the unknown components. Column 10 is a ratio of the estimates of total private nonfarm gross state product using the two methods of estimation. While the overall difference between the two estimates is less than 2 percent, there is some variation among sectors in the estimates. It will be noted that the greater reduction in bias resulting from the proposed extension is obtained for certain of the nonmanufacturing sectors (especially finance, insurance and real estate) where proprietor income is of much greater significance. It is for these very sectors that no viable alternative to the Kendrick-Jaycox method has been previously proposed.

Table 7 provides a time-series comparison of the two methods of gross state product construction over the 1958-79 period. The column headings of this table are the same as for Table 6. During the last several decades, there has occurred a decline in the proportion of proprietor income to labor and proprietor income for both Oregon and the nation. This trend is evident in Columns 2 and 3 of Table 7. Interestingly, there is no discernible trend in the values for the location quotient expressed in Column 4. The ratio of the two estimates of the unknown components in Column 7 would suggest, with some qualification, that there exists also a secular trend in the bias introduced by the Kendrick-Jaycox method. With three exceptions, there is a general decline in this bias until 1976. Therefore, for the 1958-75 period, the Kendrick-Jaycox procedure understates the relative growth in the unknown components it estimates as compared to the proposed extension.

Examining the performance of the ratio of the two estimates for the 1973-78 period would suggest there also may be a cyclical pattern inherent in the bias introduced by the Kendrick-Jaycox method when applied to Oregon. The marked decline in the ratio of the two estimates between 1973-75 suggests that this method overstates the slowdown which occurred during this period; the increase of the ratio between 1975-78 indicates this method overstates the expansion of this second period. From this partial analysis of the evidence, however, it is certainly not conclusive that there exists a cyclical pattern in the bias introduced by the Kendrick-Jaycox method.

Table 7. A Comparison of Total Oregon Private Nonfarm Gross Product Estimates, 1958-1979[a/]

Year	PI^*_o/LPI^*_o	PI^*_n/LPI^*_n	Col. 2 : Col. 3	$E_o + U_o$ K-J Method	$E_o + U_o$ Extension	Col. 5 ÷ Col. 6	$LPI^*_o + ES_o + U_o$ K-J Method	$LPI^*_o + ES_o + U_o$ Extension	Col. 8 : Col. 9
	(2)	(3)	(4)	(5)[b/]	(6)[b/]	(7)	(8)[b/]	(9)[b/]	(10)
1958	.199	.145	1.379	1,269,704	1,178,310	1.078	3,532,254	3,440,860	1.027
1959	.193	.142	1.354	1,452,501	1,356,126	1.071	3,950,476	3,854,101	1.025
1960	.180	.133	1.346	1,512,337	1,418,380	1.066	4,070,973	3,977,016	1.024
1961	.180	.134	1.341	1,552,126	1,460,659	1.063	4,141,431	4,049,964	1.023
1962	.175	.131	1.341	1,624,280	1,539,136	1.055	4,372,500	4,287,356	1.020
1963	.170	.128	1.324	1,857,035	1,758,424	1.056	4,775,967	4,677,356	1.021
1964	.172	.129	1.333	2,039,237	1,932,927	1.055	5,231,839	5,125,528	1.021
1965	.171	.126	1.352	2,241,695	2,171,955	1.032	5,656,159	5,586,419	1.012
1966	.165	.122	1.349	2,461,970	2,348,125	1.048	6,247,607	6,133,762	1.019
1967	.162	.120	1.351	2,526,856	2,415,284	1.046	6,455,543	6,343,971	1.018
1968	.153	.116	1.327	2,758,728	2,646,034	1.043	7,042,258	6,929,564	1.016
1969	.144	.108	1.333	2,920,144	2,815,497	1.037	7,585,431	7,480,784	1.014
1970	.137	.101	1.361	2,956,955	2,867,865	1.031	7,796,619	7,707,529	1.012
1971	.134	.099	1.353	3,245,876	3,136,259	1.035	8,488,889	8,379,272	1.013
1972	.131	.099	1.326	3,784,654	3,659,498	1.034	9,749,319	9,624,163	1.013
1973	.122	.093	1.313	4,225,868	4,100,535	1.031	10,910,300	10,784,967	1.012
1974	.119	.086	1.389	4,481,288	4,381,166	1.023	11,878,173	11,778,051	1.009
1975	.114	.085	1.343	5,080,974	4,994,288	1.017	12,933,542	12,846,856	1.007
1976	.111	.085	1.317	5,968,007	5,808,597	1.027	15,020,465	14,861,055	1.011
1977	.117	.085	1.364	7,116,202	6,815,779	1.044	17,828,301	17,527,878	1.017
1978	.117	.083	1.409	8,198,505	7,832,931	1.047	20,818,786	20,453,212	1.018
1979	.112	.082	1.366	8,944,204	8,613,272	1.038	23,374,770	23,043,838	1.014

a/ Subscripts o and n refer to Oregon and the U.S., respectively.

b/ 1,000s of current $'s.

IV. SUMMARY

This report has attempted to (1) supplement the Weber survey and the other literature relating to the methods of gross state product estimation, by reviewing the concept and methods of measuring gross national product; (2) extend Weber's analysis regarding some of the limitations of these methods; and (3) demonstrate a bias which may result from the Kendrick-Jaycox method and introduce an extension of this method which will reduce this bias and thereby improve the accuracy of the estimate.

Regarding the accuracy of the various methods for estimating gross state product, Weber concludes, "Unfortunately, there are no absolute standards against which to measure them" (Weber, 1979, p. 238). This conclusion is appropriate in the sense that there does not exist a time-series measure for the gross product of any state which is derived from a data base of comparable accuracy and detail as that used by BEA to measure gross product on the national level. Weber's conclusion is not appropriate, however, if it precludes, as one "absolute standard" against which to measure these methods, a careful examination of the validity of the assumptions as they relate to the properties of the data used by each method.

There are very significant differences between the BEA gross product and Census value added measures of production activity. It is not apparent that either the direct or indirect use of the value added series would necessarily contribute to an improvement in a state gross product estimate beyond that provided by the Kendrick-Jaycox method. Given the data available, there is no alternative more reasonable than to rely on the basic assumption of the Kendrick-Jaycox method, i.e., that the structure of the industry of the state is similar to that of the nation, or that divergences are offsetting.

It is not necessary to assume, however, a structural similarity between the state and nation as to the relative importance of proprietor income. The state and national ratios of proprietor to labor income can be identified from available data, at least on the one-digit SIC level. Should these ratios be different, then the Kendrick-Jaycox method will introduce a bias. This bias exists because this particular structural difference should not affect the estimate for the unknown components of gross state product. With the Kendrick-Jaycox method, it does.

The method of state gross product estimation introduced in this report will eliminate the bias which may result for the Kendrick-Jaycox method, if there is a difference in the relative importance of proprietor income between the state and nation. While accounting for this particular difference, the estimates derived from this method are based on the assumption that structure of the state and nation are otherwise similar. This method, in fact, is an extension of the original Kendrick-Jaycox method. For certain nonmanufacturing sectors of the Oregon economy, the difference between the estimates from using the two methods was greater than 10 percent. For these sectors, no viable atlernative to the Kendrick-Jaycox method has been previously proposed for estimating their contribution to gross state product.

References

Bureau of Economic Analysis, U.S. Department of Commerce, Survey of Current Business and Census of Manufacturers, Area Series (selected years).

Bureau of the Census, U.S. Department of Commerce, Annual Survey of Manufacturers and Census of Manufacturers, Area Series (selected years).

Jaszi, G., and C.S. Carson. 1979. "The National Income and Product Accounts of the United States: An Overview," Survey of Current Business 59: 5-34.

Kendrick, J.W. 1972. Economic Accounts and Their Uses. New York: McGraw-Hill Book Company.

Kendrick, J.W. and C.L. Jaycox. 1965. "The Concept and Estimation of Gross State Product," Southern Economic Journal 32: 153-168.

Kort, J.P. 1976. Estimating Gross State Product: An Analysis and an Application to the Tennessee Economy. Center for Business and Economic Research, The University of Tennessee, February.

L'Esperance, W.L., G. Nestel, and D. Fromm. 1969. "Gross State Product and an Econometric Model of a State," Journal of the American Statistical Association 64: 787-807.

L'Esperance, W.L. and D. Fromm. 1974. "A Note on Estimating Gross State Product," Growth and Change 5: 46-47.

L'Esperance, W.L. and D. Schutter. 1969. "Reconciling Gross Farm Income and Product at the State Level," Journal of Regional Science 9: 107-111.

L'Esperance, W.L., C.A. Baird, and A. Shumay. 1979. "A Comparison of Estimates of Gross State Product," Regional Science Perspective 9: 48-83.

L'Esperance, W.L., and D. Taylor. 1972. "Gross Ohio Product (1949-1970) and the Ohio Economy," Bulletin of Business Research 47(5): 1-3.

Niemi, A.W., Jr. 1969. New England: Gross State Product and Productivity 1948-65, unpublished doctoral dissertation, University of Connecticut.

Niemi, A.W., Jr. 1972. "A Re-examination of the Kendrick-Jaycox Method for Estimating Gross State Product," Review of Regional Studies, 123-131.

Ratajczak, P. and R.M. Williams. 1972. "The Case for a Gross State Product Series," Growth and Change 3: 29-31.

Renshaw, V. 1975. "Gross State Product: Comment," Growth and Change 6: 43-46.

Suits, D. 1965. "Econometric Model of Michigan," Research Seminar in Quantitative Economics, University of Michigan, June.

Weber, R.E. 1979. "A Synthesis of Methods Proposed for Estimating Gross State Product," Journal of Regional Science 19: 217-230.