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A COMPARISON OF ESTIMATES OF GROSS STATE PRODUCT*

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Introduction

Since the middle of the 1960s there has been a growing interest among the states in the concept and estimation of gross state product (GSP). In the early 1970s many states estimated their GSP, and a few of them have started to estimate and report GSP on a regular basis. See Appendix 1 for a list of states which have estimated and reported their GSP.

A major impetus to this activity was the seminar article by Kendrick and Jaycox [5] which outlined an appealing and feasible procedure for estimating GSP using federally collected and reported data. In the last ten years the Kendrick-Jaycox (K-J) procedure has been subjected to some modification and review, L'Esperance, et al [11], L'Esperance and Fromm [13], and Niemi [16]. For a discussion of state economic accounts and procedures for estimating gross state product, see L'Esperance [8] and Romans [19].

Other approaches to the concept and estimation of GSP besides K-J have been outlined by Romans [19] and Polenske, et al [18]. Estimates and projections for all states are given by each of these investigators for selected years. L'Esperance and Nestel [10], using the original version of the K-J procedure, estimated GSP for all states for the years 1955-1964. This effort was updated by the authors of this paper in 1977 who estimated GSP for all the states for the years 1949-1972, L'Esperance, Baird and Shumay [14].

The purpose of this paper is to compare K-J estimates[1] of GSP prepared by the authors to estimates made by Polenske, et al [18], and Romans [19].

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[1]In this paper the original version of the K-J procedure is considered. Subsequent modifications have been made by L'Esperance, et al [11] involving the contribution of the federal government to a state economy; and by Niemi [17] in weighting the "blow-up" ratio used in this procedure. The same weighting procedure, attributable to a suggestion made by J. W. Kendrick, is used by L'Esperance and Taylor [12]. A full discussion of all known modifications of. the K-J procedure is given in L'Esperance [8].

Description of Methods

    A.   Kendrick-Jaycox

        The K-J method is largely based on the determination of value added by industry, defined as the difference between sales and cost of materials. Since value added data are not available for all economic sectors by state, data on national income originating in each of the private nonfarm industries are used to estimate the contribution of these industries to GSP.

        A very important assumption[2] of the K-J method is that the U.S. factor proportion for the ith private nonfarm industry is the same for all states.

        Let the following be national time series variables:

$(YO)_N^i$ = National income originating in the ith industry

$(YR)_N^i$ = National civilian income received by persons in the ith industry

$(CCA)_N^i$ = National capital consumption allowances in the ith industry

$(IBT)_N^i$ = National indirect business taxes in the ith industry

$(OA)_N^i$ = National other adjustments in the ith industry

$(GNP)_N^i$ = Gross national product originating in the ith industry

When N is replaced by S, these variables refer to state time series.

At the national level:

$$(GNP)_N^i = (YO)_N^i + (CCA)_N^i + (IBT)_N^i + (OA)_N^i$$

        At the state level, each of the terms on the right hand side of the above equation is estimated as follows:

$$(YO)_S^i = (YR)_S^i \left[(YO)_N^i / (YR)_N^i \right]$$

$$(CCA)_S^i = (YO)_S^i \left[(CCA)_N^i / (YO)_N^i \right]$$

$$(IBT)_S^i = (YO)_S^i \left[(IBT)_N^i / (YO)_N^i \right]$$

$$(OA)_S^i = (YO)_S^i \left[(OA)_N^i / (YO)_N^i \right]$$

        The estimate of gross state product in the ith industry is the sum of these terms:

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[2]The validity of this assumption is discussed by L'Esperance and Fromm [13], and Niemi [17].

$$(2) \quad (GSP)^i_S = (YO)^i_S + (CCA)^i_S + (IBT)^i_S + (OA)^i_S$$

Total gross state product is the sum of the gross state products in each of the following sectors: mining, contract construction, manufacturing, wholesale and retail trade; finance, insurance and real estate; transportation, communication and utilities; services and other; agriculture; Federal government; and state and local government.

B. Romans

Romans [19] estimated gross state expenditures, or gross domestic spending plus net exports.

Using the identity

GSY = GSE

or

C + S + Tn = C + I + G + X

or X = S + Tn-(I + G)

where C = Personal consumption expenditures

I = Gross private domestic investment

X = Net exports on current accounts

G = Government purchases

S = Gross savings (sum of personal and business savings)

Tn = Taxes net of government transfer payments to persons and net of any interest paid by government

GSY = Gross state income

GSE = Gross state expenditures

Romans compiled state estimates of S, Tn, I and G. Consumption (C) was estimated residually by subtracting personal savings (S) from estimates of personal disposable income prepared by the U. S. Department of Commerce.

DPI - S = C

where DPI is disposable personal income.

Saving is defined as:

Currency and bank deposits
Savings and loan shares
Government savings bonds
All other securities
Private insurance and pension reserves

Construction, nonfarm homes
Construction and equipment, noncorporate enterprises
Construction and equipment, nonprofit institutions
Construction and equipment, agricultural enterprises

Less

Consumer debt
Security loans
Nonfarm home mortgages
Non real estate farm debt
Bank debt, N.E.C.
Depreciation on nonfarm homes
Depreciation on farm enterprises
Depreciation on nonprofit institutions

Net taxes are defined as

Total federal receipts

Income taxes
Estate and gift taxes
Corporate profits tax
Excise taxes
Customs taxes
Contributions for social insurance

Total state and local receipts
Current surplus on state and local government enterprises

Less

Federal transfer payments
Total federal net interest paid to individuals and businesses
Federal subsidies minus current surplus on federal govern-
ment enterprises (agriculture and other payments)
State and local transfer payments
State and local net interest paid to individuals and businesses

C. Polenske, et al

Polenske, et al [18] constructed an entire multiregional set of
accounts leading up to state estimates of gross national product for
the years 1947, 1958 and 1963. Curiously, nowhere in their book are
the words "gross state product" mentioned. Maintaining as much
comparability as possible with U. S. national income accounts they
compiled these state estimates for use in the multiregional input-
output model (MRIO) that had been formulated at the Harvard Economic
Research Project for the Economic Development Administration, U. S.
Department of Commerce.

Specifically, state final demands were estimated by Polenske, et
al for 80 industries in an input-output framework. The industry final
demands were calculated for personal consumption expenditures, gross

private capital formation, net inventory change, net exports by state of production, net exports by state of exit, net purchases by state and local governments, and net purchases by Federal government.

In accounting for the foreign sector contributions of states their method allocates to the states U. S. net exports and does not take account of net exports among the states. In a conceptual sense, however, gross state product includes both net foreign exports of the U. S. allocated to the states and net exports of the states to other states.

The components of their state estimates were determined as follows:

    1. Personal consumption expenditures:

        These are available nationally for 126 categories of the consumer expenditure surveys taken by the Bureau of Labor Statistics which were converted to the 80 input-output industries. Total expenditures for each commodity within a state equal the product of average consumption expenditures of each income group in a region on the commodity times the number of consumer units in a state. The expenditures were then adjusted from purchaser to producer prices. Any discrepancy between the estimated national consumption and the actual national figure was distributed to the states by adjusting the estimated producer price by a uniform percent, on the assumption that the figures had been under- or overestimated equally in all states.

    2. Net change in inventories:

        Net change in inventories is a small percentage of final demand. It was therefore estimated very roughly because precision was too costly relative to the result. Actual agricultural net inventory changes were available and used. For all other industries national net change in inventories for each industry was allocated by the percentage of gross output of the industry in a state.

    3. Gross private capital formation:

        The ideal data for this component would be types of capital purchased by each industry in each state. Since these data are not always available, three methods were used to estimate them:

        a. When types of capital purchased by groups of industries in a state were available, they were allocated by an

industry-by-state gross output matrix. For the years
in question, this applies to livestock and livestock
products and other agricultural products.

b. When total capital expenditures by industry in a state
are known, they are allocated to type of expenditure by
control totals for each state, total national equipment
expenditures by industry, and percent of gross output.
(In some states only one firm comprises the industry which
results in gaps in the data because of the illegality of
disclosing a firm's books.) This method was used for
mining and manufacturing in 1958 and 1963.

c. Where there are no capital expenditure data, national
capital expenditures are allocated by state gross industry
output.

d. There were other procedures for transportation, communi-
cation and utilities. Data for total private construction
were available.

4. Foreign exports by place of production:

These data appear in a Bureau of the Census Survey
of Manufactures in almost perfect form for this purpose.
However, they were compared to actual export figures reported
by SIC industries in order to check their accuracy. The
following two methods were used for allocation to the states
depending on the agreement between the two sets of data.

a. If the survey results were less than two-thirds of the
published value of SIC export groups in a state, and if
the survey group included more than one I-O industry,
the SIC data were allocated by payroll.

b. In the other case, survey data were used. For states
where data were not reported for the reasons mentioned
above, an estimation was based on the range given in
the survey. In 1963 these ranges were then allocated
by payroll. In 1958, the undisclosed industries were
not labeled, so the 1963 allocations were assumed to
apply.

5. Foreign exports by state of exit` (1963 only):

United States Department of Commerce Schedule B com-
modity groupings were converted to the 80 I-O classes,
and the customs regions were converted to states. Since
these figures were available at the earliest in 1967, it
was necessary to adjust the 1967 figures to 1963 by
national ratios. If in converting regions to states the

53

allocation to a state was clearly unrealistic, exports by state of production were used instead.

6. Net purchases by state and local government:

   Purchases were broken down into several functions such as highways and parks. Data were available on state purchases by function, and they were used to weight the national industrial coefficients for each function. The results were then aggregated by industry for each state. The composition of purchases for a function is assumed to be the same for each state, but the functional mix varies. Therefore the resulting data vary.

7. Net purchases by Federal government:

   National I-O data were allocated to the states as follows: Nonmanufacturing: by number of Federal employees in a state, or by the size of the Federal payroll in a state. Manufacturing: for the years in question, 1963 military purchases were known; their distribution was also used for 1958. Nonmilitary expenditures were allocated by civilian employment.

Comparison of Estimates

How should the validity of a GSP estimate be decided? What criteria should be used to affirm or deny the reliability and accuracy of such an estimate? An accurate estimate of GSP can be made if there are ample and reliable data for measuring the detailed components of GSP, no matter what approach, income, expenditure, or value added, is used. If at least two of these approaches can be employed and their end results satisfy the equality of the summary measures of GSP, GSE, and GSY, so much the better. Moreover, if the use of ad hoc methods is minimal, and if there is little or no need to make simplifying assumptions in order to estimate a component of GSP, then the credibility of the summary estimate is further enhanced. Against such a "ground-up" approach ad hoc methods can be compared and appraised. The nearest investigators have come to perfecting such a "ground-up" approach are found in the estimates prepared for selected states and single years. Examples are Kentucky, 1969, Charlesworth and Herzel [1]; Illinois, 1963, Goldberg [4], and California, 1958, Moody [15]. None of these investigations is entirely free of the use of ad hoc methods. However, each of these investigators made extensive use of data resources in their states, and presumably came up with a reliable estimate of GSP. With the exception of Charlesworth and Herzel [1], ad hoc methods are used sparingly compared to Kendrick-Jaycox [5] and the expenditure approach of Polenske, et al [18].

Unless one has detailed reliable data to measure accurately the components of GSP using any of the three approaches, a precise indication of the error of estimate is difficult to make. Reasonableness of the estimates can be ascertained by other kinds of data and yardsticks of economic performance. The implications of the various assumptions used in estimating GSP can be drawn out, and if they are consistent with the observed behavior of a state economy, so much the better. It may be that one method is better for a particular kind of state economy and

another for a different state economy. Data resources vary from state to state, often depending on the existence and pervasiveness of a state income tax. For many states which have an income tax, ancillary data on business incomes are often collected and available for estimating gross state income in the business sector. The more extensive data resources in a state are, the greater the likelihood of having a richer and more detailed approach to estimating GSP.

Judging from the list of states shown in Appendix I most states use an unmodified version of the K-J method; a few (e.g., Ohio, Georgia),a modified version of the K-J method, and a few (e.g., California, Hawaii, Kentucky), a "ground-up" approach taking advantage of the state's unique data resources. Which of these approaches results in the "best" set of estimates? The answer is that at the present time there is no "actual" set of data against which comparisons can be made of these approaches. However, comparisons can be made among the three general approaches (K-J, Polenske, et al and Romans) for estimating the GSP's of all states for selected years.

With this in mind we turn to the comparison of estimates of GSP using the L'Esperance, Baird, Shumay [14] K-J estimates, symbolized as L, as a basis of comparison. Comparisons are made with the estimates of Polenske, et al and Romans for four selected years: 1953, 1957, 1958, and 1963. The estimates of these three investigations in the form of current dollar gross state product are shown in Table 1. Polenske, et al (PA) refers to gross state expenditures including net foreign exports by state of production, while Polenske, et al (PB) refers to gross state expenditures including net foreign exports by state of exit, instead of by state of production. Polenske, et al (PB) was used for only 1963. The symbols after the years are L, L'Esperance, Baird and Shumay [14]; R, Romans [19]; PA, Polenske, et al [18] method A, and PB, Polenske, et al [18] method B.

The 1953 estimates prepared by Romans, compiled from Appendix Table X, Romans [19, pp. 216-220] are found by subtracting net income on investments (line 10 of Table 10) from gross state income (line 4 of Table 10) to obtain an estimate of gross domestic product which is conceptually akin to the "domestic" estimate of gross state product using the Kendrick-Jaycox procedure. No such estimates were prepared by Romans for 1957.

It is recognized that expenditure estimates of Polenske and the 1957 estimates of Romans are akin to the concept of gross state product received and the L estimates based on the Kendrick-Jaycox method which measures gross state product produced. However, as can be observed for many states in Table 1, the expenditures estimates exceed the L estimates. Rather than attempt to explain these differences state-by-state, the absolute percentage difference was calculated for each state. They are given in Tables 2 to 6 which show the percent differences between Romans, and L'Esperance, Baird and Shumay, and also between Polenske and L'Esperance, Baird and Shumay. If a percent is negative, then the L estimate is the larger of the two estimates.

Differences between L and R are exhibited in Tables 2 and 3. Specifically Table 2 shows the percent differences for each state between L and R for 1953, the year for which the R estimates can be adjusted, as mentioned earlier, so that they are conceptually closer to K-J. Table 3 shows the percent differences for each state between L and R for 1957.

TABLE 1: Comparisons Between Several Authors' Estimates of GSP

No.	State Name	1953R	1953L	1957R	1957L	1958P	1958L	1963PA	1963PB	1963L
1	Alabama	4272.	4240.	4884.	5333.	6486.	5126.	8315.	8263.	7129.
2	Alaska	0.	0.	0.	0.	0.	0.	1341.	1307.	866.
3	Arizona	1745.	1834.	2454.	2557.	3444.	2631.	5002.	4965.	4259.
4	Arkansas	2258.	2140.	2413.	2435.	3164.	2424.	4179.	3961.	3729.
5	California	32056.	32573.	45307.	43499.	49760.	42153.	73595.	73908.	65919.
6	Colorado	3050.	3067.	4220.	4124.	5041.	4069.	6712.	6553.	6009.
7	Connecticut	6371.	6482.	8747.	8098.	7965.	7581.	10832.	10453.	10954.
8	Delaware	1099.	979.	2033.	1221.	1286.	1183.	1736.	1690.	1659.
9	Florida	6054.	5764.	10556.	8851.	11661.	8853.	17298.	17530.	13780.
10	Georgia	5645.	5558.	6647.	6839.	8494.	6647.	11286.	11106.	9901.
11	Hawaii	0.	0.	0.	0.	0.	0.	3395.	3391.	1995.
12	Idaho	1114.	1157.	1406.	1365.	1805.	1357.	2097.	2034.	1767.
13	Illinois	25438.	25984.	30012.	31441.	27051.	29832.	34790.	33240.	39699.
14	Indiana	10336.	10406.	10922.	12039.	11193.	11321.	13937.	13241.	15579.
15	Iowa	5255.	5260.	6257.	6268.	6679.	6049.	8138.	7706.	7855.
16	Kansas	4152.	4290.	4646.	4932.	6105.	5146.	7197.	6870.	6452.
17	Kentucky	4519.	4554.	5145.	5391.	5999.	5191.	7863.	7562.	7093.
18	Louisiana	4861.	4705.	6025.	6387.	7804.	6082.	9707.	11458.	8041.
19	Maine	1633.	1540.	2062.	1848.	2230.	1758.	2676.	2662.	2311.
20	Maryland	6083.	6177.	7921.	7857.	8066.	7662.	11411.	11828.	11425.
21	Massachusetts	11419.	11390.	14600.	13713.	14036.	13132.	18327.	17869.	18436.
22	Michigan	18963.	19111.	20950.	21579.	18584.	19562.	25467.	26035.	27259.
23	Minnesota	6503.	6637.	7829.	8004.	8000.	7958.	10645.	10557.	10788.
24	Mississippi	2384.	2245.	2505.	2580.	3685.	2570.	4782.	4717.	3905.
25	Missouri	8720.	8644.	10194.	10053.	11003.	9769.	13631.	13258.	13279.
26	Montana	1341.	1427.	1567.	1658.	1831.	1610.	2192.	2190.	1975.
27	Nebraska	2712.	2721.	3239.	3174.	3748.	3120.	4176.	4011.	4081.
28	Nevada	557.	585.	843.	804.	999.	711.	1920.	1906.	1550.
29	New Hampshire	1075.	1076.	1431.	1338.	1632.	1277.	2056.	2005.	1775.

TABLE 1 — Continued

No.	State Name	1953R	1953 L	1957R	1957L	1958P	1958L	1963PA	1963PB	1963L
30	New Jersey	14761.	15264.	17956.	18884.	17617.	17933.	23182.	22155.	25560.
31	New Mexico	1316.	1322.	1713.	1846.	2926.	1906.	3136.	3089.	2589.
32	New York	44098.	43686.	55501.	53234.	50065.	50471.	61701.	67708.	68836.
33	North Carolina	6220.	6006.	7426.	7214.	8586.	7054.	11894.	11268.	10650.
34	North Dakota	1053.	992.	1179.	1129.	1882.	1214.	1744.	1954.	1501.
35	Ohio	22209.	22478.	25794.	26795.	25158.	24463.	32374.	30967.	32618.
36	Oklahoma	3900.	4018.	4476.	4799.	5959.	4764.	7500.	7294.	6192.
37	Oregon	3545.	3794.	4080.	4289.	4830.	4125.	6253.	6437.	5762.
38	Pennsylvania	25143.	25862.	30069.	29939.	28514.	27908.	34986.	33853.	35834.
39	Rhode Island	1842.	1806.	2158.	1978.	2102.	1880.	2650.	2577.	2624.
40	South Carolina	3200.	3032.	3348.	3337.	4532.	3155.	5439.	5362.	4792.
41	South Dakota	1185.	1096.	1333.	1276.	1511.	1241.	1851.	1797.	1592.
42	Tennessee	5066.	5088.	5879.	6094.	6941.	5770.	9248.	8946.	8494.
43	Texas	16584.	16631.	20206.	21256.	22997.	20626.	29762.	30822.	27559.
44	Utah	1441.	1571.	1756.	1996.	2372.	1979.	3223.	3140.	2895.
45	Vermont	672.	639.	848.	749.	1419.	702.	1676.	1761.	978.
46	Virginia	6567.	6154.	7959.	7633.	10395.	7457.	12955.	13375.	10960.
47	Washington	5936.	5965.	7075.	7145.	8767.	6949.	11291.	11645.	9682.
48	West Virginia	3342.	3506.	3578.	4292.	4160.	3823.	5073.	4719.	4450.
49	Wisconsin	7950.	8030.	9500.	9534.	8633.	9102.	11446.	10976.	12514.
50	Wyoming	739.	714.	805.	821.	1340.	828.	1237.	1224.	1055.
51	Total U.S. GSP	358382.	358200.	440075.	437628.	458458.	418124.	603323.	603341.	586607.
52	Calculated TGSP	356384.	358200.	437454.	437628.	458457.	418124.	603324.	603345.	586607.

Notes: All estimates are in millions of current dollars.
R—Romans, L—L'Esperance, Baird, and Shumay, PA & PB—Polenske.

57

TABLE 2:   States Ranked by Absolute Percent
           Differences Between GSP Estimates
           by Romans--1953 and L'Esperance-
           Baird-Shumay

Rank		State and Number	
1	8	Delaware	12.3
2	44	Utah*	8.3
3	41	South Dakota	8.1
4	46	Virginia	6.7
5	37	Oregon*	6.6
6	24	Mississippi	6.2
7	34	North Dakota	6.1
8	19	Maine	6.0
9	26	Montana*	6.0
10	40	South Carolina	5.5
11	4	Arkansas	5.5
12	45	Vermont	5.2
13	9	Florida	5.0
14	3	Arizona*	4.9
15	28	Nevada*	4.8
16	48	West Virginia*	4.7
17	12	Idaho*	3.7
18	33	North Carolina	3.6
19	50	Wyoming	3.5
20	18	Louisiana	3.3
21	30	New Jersey*	3.3
22	16	Kansas*	3.2
23	36	Oklahoma*	2.9
24	38	Pennsylvania*	2.8
25	13	Illinois*	2.1
26	23	Minnesota*	2.0
27	39	Rhode Island	2.0
28	7	Connecticut*	1.7
29	5	California*	1.6
30	10	Georgia	1.6
31	20	Maryland*	1.5
32	35	Ohio*	1.2
33	49	Wisconsin*	1.0
34	32	New York	0.9
35	25	Missouri	0.9

TABLE 2 — Continued

Rank		State and Number	
36	22	Michigan*	0.8
37	17	Kentucky*	0.8
38	1	Alabama	0.8
39	14	Indiana*	0.7
40	6	Colorado*	0.6
41	52	Calculated TGSP*	0.5
42	47	Washington*	0.5
43	31	New Mexico*	0.5
44	42	Tennessee*	0.4
45	27	Nebraska*	0.3
46	43	Texas*	0.3
47	21	Massachusetts	0.3
48	15	Iowa*	0.1
49	29	New Hampshire*	0.1
50	51	Total U.S. GSP	0.1

*Negative.

TABLE 3: States Ranked by Absolute Percent Differences Between GSP Estimates by Romans--1957 and L'Esperance-Baird-Shumay

Rank		State and Number	
1	8	Delaware	66.5
2	9	Florida	19.3
3	48	West Virginia*	16.6
4	45	Vermont	13.2
5	44	Utah*	12.0
6	19	Maine	11.6
7	14	Indiana*	9.3
8	39	Rhode Island	9.1
9	1	Alabama*	8.4
10	7	Connecticut	8.0
11	31	New Mexico*	7.2
12	29	New Hampshire	7.0
13	36	Oklahoma*	6.7
14	21	Massachusetts	6.5
15	16	Kansas*	5.8
16	18	Louisiana*	5.7
17	26	Montana*	5.5
18	43	Texas*	4.9
19	30	New Jersey*	4.9
20	37	Oregon*	4.9
21	28	Nevada	4.9
22	17	Kentucky*	4.6
23	13	Illinois*	4.5
24	41	South Dakota	4.5
25	34	North Dakota	4.4
26	46	Virginia	4.3
27	32	New York	4.3
28	5	California	4.2
29	3	Arizona*	4.0
30	35	Ohio*	3.7
31	42	Tennessee*	3.5
32	12	Idaho	3.0
33	33	North Carolina	2.9
34	22	Michigan*	2.9
35	24	Mississippi*	2.9

TABLE 3 — Continued

Rank		State and Number	
36	10	Georgia*	2.8
37	6	Colorado	2.3
38	23	Minnesota*	2.2
39	27	Nebraska	2.0
40	50	Wyoming*	1.9
41	25	Missouri	1.4
42	47	Washington*	1.0
43	4	Arkansas*	0.9
44	20	Maryland	0.8
45	51	Total U.S. GSP	0.6
46	38	Pennsylvania	0.4
47	49	Wisconsin*	0.4
48	40	South Carolina	0.3
49	15	Iowa*	0.2
50	52	Calculated TGSP	0.0

*Negative.

Differences between L and Polenske, et al are shown in Tables 4, 5 and 6. In particular, Table 4 shows the percent differences for each state between L and PA for 1963, and Table 6 reveals the percent differences between L and PB for 1963.

A cursory review of Tables 2 to 6 reveals that the R (1953) estimates are much closer to the L estimates than any of the three sets of the estimates by Polenske, et al. How much "closer" is shown in Table 7 whereby the percent differences of Tables 2 to 6 are rearranged as a classification of ranges of absolute percent difference. There are 22 states for which the absolute percentage difference between R and L is less than or equal to 2 percent, and 16 states have a difference of 1 percent or less. On the other hand, if the most disparate estimates are considered to be those states with an absolute difference greater than 5.0 percent, then there are 13 of these, of which only one shows an absolute difference greater than 10 percent. Roman's estimate for Delaware is 12.3 percent greater than L's estimate.

It is also observed that the R (1957) estimates are not quite as close to the L estimates as are the R (1953) estimates, although they are still closer than any of the P estimates. There are 31 states for which the absolute difference is less than or equal to 5.0 percent. Table 7 also shows that only about one-fifth of the states showed differences less than 10.0 percent between the P and L estimates.

Tables 8 and 9 refer to L and R. Most regions of the country are represented in both the best and the worst categories for R (1953) and L (Table 8). Southern states dominate the "greatest differences" (six out of 13), yet there are nearly as many southern states with "smallest differences" (five). There are more eastern states for which differences are smallest than for which differences are greatest. Great Lakes and southwestern states are not among the "greatest differences," although they appear in "smallest differences." That is as far as any regional patterns can be detected, and it leaves the impression that estimates are closer for Great Lakes and eastern states than for others. Although this pattern is not overly strong, it is consistent with observations made later about the Polenske estimates. The pattern observed among the southern states is quite different from the pattern of Polenske-L comparisons in the south, however.

As mentioned previously, both R (1953) and R (1957) are much closer to L than are the estimates of Polenske. Within a smaller range of differences, however, there is quite a difference between R (1953) and R (1957). In Tables 8 and 9, it can be seen that there are many closer estimates in R (1953) than in R (1957). This is consistent with the data shown in Table 8, where the greatest number of R (1953) estimates is in the "$\delta \leq 5\%$" category. The reason for the general agreement of L and R for 1953 is that R's estimate for 1953 was found by subtracting net income on investments. This resulted in an estimate which is conceptually closer to the domestic estimate of gross state product using the K-J procedure. This subtraction was not performed for 1957.

In both years there are about the same number of states for which differences are greater than 5 percent, but those differences are greater for R (1957).

TABLE 4: States Ranked by Absolute Percent Differences Between GSP Estimates by Polenske--A--1958 and L'Esperance-Baird-Shumay

Rank		State and Number	
1	45	Vermont	102.1
2	50	Wyoming	61.8
3	34	North Dakota	55.0
4	31	New Mexico	53.5
5	40	South Carolina	43.6
6	24	Mississippi	43.4
7	28	Nevada	40.5
8	46	Virginia	39.4
9	12	Idaho	33.0
10	9	Florida	31.7
11	3	Arizona	30.9
12	4	Arkansas	30.5
13	18	Louisiana	28.3
14	29	New Hampshire	27.8
15	10	Georgia	27.8
16	19	Maine	26.8
17	1	Alabama	26.5
18	47	Washington	26.2
19	36	Oklahoma	25.1
20	6	Colorado	23.9
21	41	South Dakota	21.8
22	33	North Carolina	21.7
23	42	Tennessee	20.3
24	27	Nebraska	20.1
25	44	Utah	19.9
26	16	Kansas	18.6
27	5	California	18.0
28	37	Oregon	17.1
29	17	Kentucky	15.6
30	26	Montana	13.7
31	25	Missouri	12.6
32	39	Rhode Island	11.8
33	43	Texas	11.5
34	15	Iowa	10.4
35	51	Total U.S. GSP	9.6

TABLE 4 - Continued

Rank		State and Number	
36	52	Calculated TGSP	9.6
37	13	Illinois*	9.3
38	48	West Virginia	8.8
39	8	Delaware	8.7
40	21	Massachusetts	6.9
41	20	Maryland	5.3
42	49	Wisconsin*	5.2
43	7	Connecticut	5.1
44	22	Michigan*	5.0
45	35	Ohio	2.8
46	38	Pennsylvania	2.2
47	30	New Jersey*	1.8
48	14	Indiana*	1.1
49	32	New York*	0.8
50	23	Minnesota	0.5

*Negative.

TABLE 5:   States Ranked by Absolute Percent
           Differences Between GSP Estimates
           by Polenske—A—1963 and L'Esperance–
           Baird–Shumay

Rank		State and Number	
1	45	Vermont	71.4
2	11	Hawaii	70.2
3	2	Alaska	54.8
4	9	Florida	25.5
5	28	Nevada	23.9
6	24	Mississippi	22.5
7	31	New Mexico	21.1
8	36	Oklahoma	21.1
9	18	Louisiana	20.7
10	12	Idaho	18.7
11	46	Virginia	18.2
12	3	Arizona	17.4
13	50	Wyoming	17.3
14	1	Alabama	16.6
15	47	Washington	16.6
16	41	South Dakota	16.3
17	34	North Dakota	16.2
18	29	New Hampshire	15.8
19	19	Maine	15.8
20	48	West Virginia	14.0
21	10	Georgia	14.0
22	40	South Carolina	13.5
23	13	Illinois	12.4
24	4	Arkansas	12.1
25	6	Colorado	11.7
26	33	North Carolina	11.7
27	5	California	11.6
28	16	Kansas	11.5
29	44	Utah	11.3
30	26	Montana	11.0
31	17	Kentucky	10.9
32	14	Indiana	10.5
33	32	New York	10.4
34	30	New Jersey	9.3
35	42	Tennessee	8.9

TABLE 5 – Continued

Rank		State and Number	
36	49	Wisconsin	8.5
37	37	Oregon	8.5
38	43	Texas	8.0
39	22	Michigan	6.6
40	8	Delaware	4.6
41	15	Iowa	3.6
42	52	Calculated TGSP	2.8
43	51	Total U.S. GSP	2.8
44	25	Missouri	2.7
45	38	Pennsylvania	2.4
46	27	Nebraska	2.3
47	23	Minnesota	1.3
48	7	Connecticut	1.1
49	39	Rhode Island	1.0
50	35	Ohio	0.7
51	21	Massachusetts	0.6
52	20	Maryland	0.1

TABLE 6:   States Ranked by Absolute Percent
           Differences Between GSP Estimates
           by Polenske--B--1963 and L'Esperance-
           Baird-Shumay

Rank		State and Number	
1	45	Vermont	80.1
2	11	Hawaii	70.0
3	2	Alaska	50.9
4	18	Louisiana	42.5
5	34	North Dakota	30.2
6	9	Florida	27.2
7	28	Nevada	23.0
8	46	Virginia	22.0
9	24	Mississippi	20.8
10	47	Washington	20.3
11	31	New Mexico	19.3
12	36	Oklahoma	17.8
13	3	Arizona	16.6
14	13	Illinois*	16.3
15	50	Wyoming	16.0
16	1	Alabama	15.9
17	19	Maine	15.2
18	12	Idaho	15.1
19	14	Indiana*	15.0
20	30	New Jersey*	13.3
21	29	New Hampshire	13.0
22	41	South Dakota	12.9
23	49	Wisconsin	12.3
24	10	Georgia	12.2
25	5	California	12.1
26	40	South Carolina	11.9
27	43	Texas	11.8
28	37	Oregon	11.7
29	26	Montana	10.9
30	6	Colorado	9.1
31	44	Utah	8.5
32	17	Kentucky	6.6
33	16	Kansas	6.5
34	4	Arkansas	6.2
35	48	West Virginia	6.0

TABLE 6 - Continued

Rank		State and Number	
36	33	North Carolina	5.8
37	38	Pennsylvania*	5.5
38	42	Tennessee	5.3
39	35	Ohio*	5.1
40	7	Connecticut*	4.6
41	22	Michigan*	4.5
42	20	Maryland	3.5
43	21	Massachusetts*	3.1
44	52	Calculated TGSP	2.9
45	51	Total U.S. GSP	2.9
46	23	Minnesota*	2.1
47	15	Iowa*	1.9
48	8	Delaware	1.9
49	39	Rhode Island*	1.8
50	27	Nebraska*	1.7
51	32	New York*	1.6
52	25	Missouri*	0.2

*Negative.

TABLE 7: Number of States Classified by Range of Absolute Percentage Differences Shown in Tables 2-6

Range of Absolute Percentage Difference	Romans/L		Polenske(PA)/L		Polenske(PB)/L
	1953	1957	1958	1963	1963
$\delta \leq 1\%$	16	7	2	4	1
$1\% < \delta \leq 2\%$	6	2	2	2	5
$2\% < \delta \leq 5\%$	13	22	3	5	5
$5\% < \delta \leq 10\%$	12	11	7	6	10
$10\% < \delta \leq 20\%$	1	5	10	24	19
$\delta > 20\%$	0	1	24	9	10
Total	48	48	48	50	50

Source: Table 2

69

TABLE 8: Classification of Absolute Percentage Differences
          by Size: R (1953) & L

Smallest differences (< 2.0% absolute difference)

Alabama	Missouri
California	Nebraska
Colorado	New Hampshire
Connecticut	New Mexico
Georgia	New York
Indiana	Ohio
Iowa	Rhode Island
Kentucky	Tennessee
Maryland	Texas
Massachusetts	Washington
Michigan	Wisconsin (22)

Greatest differences (> 5.0% absolute difference)

Arkansas	Oregon
Delaware	South Carolina
Florida	South Dakota
Maine	Utah
Mississippi	Vermont
Montana	Virginia (13)
North Dakota	

TABLE 9: Classification of Absolute Percentage Difference
          by Size: R (1957) & L

Smallest differences (< 2.0% absolute difference)

Arkansas   South Carolina

Iowa   Washington

Maryland   Wisconsin

Missouri   Wyoming   (9)

Pennsylvania

Greatest differences (> 5.0% absolute difference)

Alabama   Montana

Connecticut   New Hampshire

Delaware   New Mexico

Florida   Oklahoma

Indiana   Rhode Island

Kansas   Utah

Louisiana   Vermont

Maine   West Virginia   (17)

Massachusetts

Delaware is worst in both cases, being 12.3 percent greater than L (1953) and 66.5 percent greater than L (1957).

In 1957, most regions are again represented among the best and the worst (Table 9). Regional patterns are not the same for 1953, however. There is no particular pattern among the "smallest differences," probably because there are not many states in it. In "greatest differences," southern and eastern states dominate. The presence of the eastern states is contradictory to the tendencies observed in 1953 and in the Polenske estimates. The presence of southern states is consistent with patterns previously observed.

. Tables 10 and 11 refer to the estimates of Polenske, et al and L. The states for which L and Polenske, et al are closest are the Great Lakes and eastern states (Table 10). Several of them are manufacturing states. Those states for which L and Polenske, et al are close in two out of three years support this observation, with the addition of three agricultural states and two southeastern states. In other words, L and Polenske, et al agree most in the upper eastern states of the northeast.

The worst disagreement between L and Polenske, et al occurs consistently among four southern states and other assorted states. It might be permissible to discount Alaska and Hawaii since they were in early statehood in 1963 and may not have produced reliable data. As noted above, the disagreement in 1958 is particularly striking, and it covers most regions in the country. In fact, "greater than 20 percent" contains more states than any other category for that year, while most states fall in the 10-20 percent category for PA (1963) and are evenly split between "less than 10 percent" and 10-20 percent for PB (1963).

Table 12 compares the estimates of other investigators to those of L, Polenske, and R. The estimates of GSP are for selected years and states.

For California and Illinois, the disparity between Polenske (PA) and (PB) and the other investigators' estimates is easily observed. On the other hand, the estimates of Polenske (PA) and Suits, et al for Michigan are much closer to each other, and are probably close to the true but unknown GSP for Michigan in 1958 which was a severe recession year in Michigan. Suits, et al used value added in manufacturing to estimate GSP in manufacturing. For Tennessee, Kort used an extensively modified version of the K-J method. His estimates are higher than L's. In 1963 there is closer agreement among Polenske (PA) and (PB) and Kort than between Kort and L.

As mentioned earlier, the K-J method assumes that the national factor proportion in a given private nonfarm industry is the same in each state. Niemi [17] examined this assumption and determined those states for which the national output-labor ratio would result in an absolute error of 5.0 percent or less.

Niemi does not specify which way the error falls. Referring to Table 1, it is observed that the gross state products of West Virginia, Alabama, Utah, Indiana, and Oklahoma, are estimated to be larger by L'Esperance, Baird and Shumay than the gross state expenditures estimated by Romans. Delaware, Florida,

TABLE 10: Frequency with Which States Appear in "10% and less" Category

3 columns	2 columns	1 column
Minnesota	New York	Indiana
Ohio	New Jersey	Illinois
Pennsylvania		Oregon
Connecticut	West Virginia	Texas
Delaware	Wisconsin	Arkansas
Maryland	Rhode Island	Colorado
Massachusetts	Iowa	Kansas
Michigan	Missouri	Kentucky
	Nebraska	North Carolina
	Tennessee	Utah

TABLE 11:   Frequency with Which States Appear in "greater than 20%" Category

3 columns	2 columns	1 column*
Florida	Alaska	Alabama
Louisiana	Hawaii	Arizona
Mississippi	New Mexico	Arkansas
Nevada	North Dakota	Colorado
Vermont	Oklahoma	Georiga
	Virginia	Idaho
	Washington	Maine
		Nebraska
		New Hampshire
		North Carolina
		South Carolina
		South Dakota
		Tennessee
		Wyoming

*These appear in the 1958 column only

TABLE 12: Comparison of GSP for Selected States and Selected Years (billions of current $)

California

	UCLA Bus. Forecast. [21]	L [14]	Romans [19]	Polenske (B) [18]	Polenske (A) [18]	Polenske (B) [18]
1957	43.3	43.4				
1958	44.8	42.2				
1963	64.2	65.9				
			45.3	33.2	49.8	73.9

Illinois

	Goldberg [14]	L [14]	Polenske (A) [18]
1963	38.5	39.7	34.8

Kentucky

	Charlesworth & Herzel [1]	L [14]
1969	12.1	11.3

Michigan

	Suits et al. [20]	L [14]	Romans [19]	Polenske (A) [18]	Polenske (B) [18]
1957	20.595	21.579		18.584	
1958	18.597	19.562		25.467	
1963	25.592p	27.259			26.034
			20.950		

p = preliminary

Tennessee

	Kort [6]	L [14]	Romans [19]	Polenske (A) [18]	Polenske (B) [18]
1957	6.3	6.1		6.9	
1958	6.5	5.8		9.2	
1963	9.1	8.5			8.9
			5.9		

75

Maine, and Rhode Island gross state products are estimated by L to be smaller than the gross state expenditures estimated by Romans. Therefore, one can hypothesize the direction of the output-labor ratio errors.

Conclusion

What can be deduced from the comparisons in Section 3? Which method results in the most reliable and accurate estimate of GSP. No categorical answer can be given at this time. If a time series is desired, then the K-J method, pure or modified, has the distinct advantage over Romans' and Polenske's expenditure approaches of using existing time series data consistently estimated and reported for all states. The Polenske method uses extensive expenditure series reported intermittently, but is handicapped by the lack of annual time series for constructing year-to-year estimates of GSP. Nonetheless, their estimates can serve as "benchmarks" against which GSP, estimated by other means, can be compared and contrasted. This does not mean that the estimates of Polenske are necessarily the correct ones. It means that, for a state having discrepancies among its differently estimated GSP's careful reconciliations will have to be made among the estimates for the years for which Polenske estimates are available.

The small differences between Romans and K-J reflect the underlying use of federally collected income data (wage and salaries) for building the components of the separate estimates of GSP. In fact it is suggested that for the 36 states where the absolute difference is equal to or less than 5 percent, the expenditure approach of Romans and the value added method of K-J may be used jointly by these states. Both approaches used together would produce estimates of double entry economic accounts leading to an estimate of GSE and GSP produced respectively. To check the validity of the two summary estimates it would be worthwhile to estimate independently the difference between the GSE of Roman's approach and the GSP produced using the K-J method. If the difference is almost zero for a state, it may mean that domestic GSP and GSE are the same. For Ohio in 1957 Roman's estimate is less than L's by 4.3 percent, and Polenske is less than L's by 2.1 percent in 1958. Yet the greater estimate should not be L's for the reason that L's estimates are of GSP produced and those of Romans are more akin to GSP received. The small differences, however, may be insignificant which would mean that GSP received and GSP produced are virtually the same for Ohio.

In addition to the modifications of these methods there are other possibilities for improving the estimates of GSP. It would be more appropriate to recognize the movement of prices across states and use, instead of the national deflators, state deflators based on price movements within a state. Very few, if any, states have estimated a price index unique to the state. One example is the Florida price level index, Florida Department of Administration [3].

Kendrick and Jaycox [5] mentioned that the U. S. Department of Commerce "has allocated its national estimates of interest, rents, and royalties among states on a where-received basis, but does not publish them due to weaknesses in the allocation procedure." They also note the possibility of obtaining direct data on indirect business taxes paid to state and local government from the State and Local Governments Division of the Census Bureau.

76

It is recognized that the major gaps at the state level are corporate profits, depreciation, and "foreign" trade flows abroad and among the states. Three possibilities exist for closing the first two gaps: first, for states having a corporate income tax, reporting of profit data would help, especially from multi-state corporations. There should not be much trouble with intrastate corporations; second, correlating such profit data, where available, with the difference between income originating and income received may result in a reliable method for allocating such differences among all the states so that a proxy variable for profits by state could be constructed. A third method using state wage and salary data is discussed by L'Esperance [7].

Finally, considerable work remains on estimating the components of the difference between GSP produced and GSP received.

Our major conclusion is that there is no single approach available at the present time for estimating GSP annually for all states. Major data gaps still exist, and a number of conceptual issues (e.g., measuring the contributions of government, multi-state corporations and "foreign" trade) across states remain unresolved. Moreover, two independent approaches (e.g., income and expenditure) have still to be devised for estimating GSP, as is the case for GNP. The K-J approach remains an appealing method and is currently being modified several ways by the authors.

A number of individual states using a "ground-up" approach by mining their rich data resources will continue to contribute to our understanding of GSP; however, a general approach will eventually have to be adopted for all states as is now the case for personal income by state.

A list of states for which GSP's have been estimated. These estimates are in addition to the ones prepared for all states by Romans [19], Polenske, et al [18], L'Esperance and Nestel [10], Cohen and Maeshiro [2], and L'Esperance, Baird and Shumay [14].

State	Source of GSP Estimate
Alabama	Etheredge, William H. "Alabama Profile: Estimating Gross State Product," Alabama Business, June, 1974
	Niemi, Albert W., Jr. Gross State Product and Productivity in the Southeast, Chapel Hill: The University of North Carolina Press, 1975
Alaska	"Estimated Gross State Product for Alaska," Alaska Review of Business and Economic Conditions, II (April 1974), 1-17
	Kresge, David T. and Monica E. Thomas. "Estimated Gross State Product for Alaska," Alaska Review of Business and Economic Conditions, Vol. XI, No. 1, The Institute of Social Economic and Government Research, The University of Alaska, April, 1974
Arkansas	Anthers, Wm. L. "Gross State Product for Arkansas, 1958 and 1963," Arkansas Business and Economic Review, February, 1969
	Niemi, Albert W., Jr. Gross State Product and Productivity in the Southeast, Chapel Hill: The University of North Carolina Press, 1975
California	UCLA Business Forecast. A Method for Estimating Gross State Product, Graduate School of Management, University of California, Los Angeles, 1972
	Moody, Harold T. Theory and Application of Regional Income and Product Accounts, Ann Arbor: University Microfilms, Inc., 1964
Connecticut	Laube, Melissa. New England's Gross State Product, Federal Reserve Bank of Boston, 1976
District of Columbia	Kendrick, John W. and C. Milton Jaycox. "The Concept and Estimation of Gross State Product," Southern Economic Journal, Vol. 32, (October 1965), 153-168
Florida	Niemi, Albert W., Jr. Gross State Product and Productivity in the Southeast, Chapel Hill: The University of North Carolina Press, 1975

State	Source of GSP Estimate

Georgia   Niemi, Albert W., Jr. "Georgia's Gross State Product, A Measure of Economic Activity," Georgia Business, 30 (1970), 1-9

Niemi, Albert W., Jr. Georgia: Gross State Product and Productivity, 1950-1968, Bureau of Research, College of Business Administration, The University of Georgia, Athens, 1971

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Niemi, Albert W., Jr. Gross State Product and Productivity in the Southeast, Chapel Hill: The University of North Carolina Press, 1975

Hawaii   Oshima, Harry T. and Mitsuo Ono. Hawaii's Income and Expenditure, 1958, 1959 and 1960, 3 volumes, Economic Research Center, University of Hawaii, 1965

Shang, Yung C., William H. Albrecht and Glenn Ifuku. Hawaii's Income and Expenditure Accounts, 1958-1968, Economic Research Center, University of Hawaii, July, 1970

Idaho   Lynch, Gary A. "Estimating Idaho and Regional Gross Product," Idaho Business and Economic Review, 2 (June 1971), 22-27

Illinois   Goldberg, Kalman. A System of Gross Income and Product Accounts for Illinois, 1963, Department of Business and Economic Development, State of Illinois, May, 1967

Green, R. Jeffrey. A Long-Range Econometric Forecasting Model for Illinois, Bureau of Economic and Business Research, University of Illinois, March, 1967

Indiana   Fishkind, Henry. "Indiana's Gross State Product, 1954-72," Indiana Business Review, Vol. XLIX (July-August 1974), 1-6

Iowa   McNiff, Frank. "Gross State Product-Iowa," Iowa Business Digest, March, 1974

Kentucky   Charlesworth, Harold K., and William G. Herzel. The Gross State Product of Kentucky, 1969, Office of Developmental Services and Business Research, College of Business and Economics, University of Kentucky, 1972

Niemi, Albert W., Jr. Gross State Product and Productivity in the Southeast, Chapel Hill: The University of North Carolina Press, 1975

Maine   Laube, Melissa. New England's Gross State Product, Federal Reserve Bank of Boston, 1976

State	Source of GSP Estimate
Maryland	Kendrick, J. W. and C. Milton Jaycox. "The Concept and Estimation of Gross State Product," The Southern Economic Journal, Vol. 32, (October 1965), 153-168
Massachusetts	Laube, Melissa. New England's Gross State Product, Federal Reserve Bank of Boston, 1976
Montana	Winn, Thomas J., Jr. Gross State Product for Montana, manuscript, Research Division, Department of Revenue, State of Montana, Helena, 1975
Nebraska	Turner, Keith and Vernon Renshaw. A New Business Activity Index for Nebraska, Business Research Bulletin No. 73, Bureau of Business Research, University of Nebraska, 1972
New Hampshire	Laube, Melissa. New England's Gross State Product, Federal Reserve Bank of Boston, 1976
New Jersey	White, Norman. Estimates of GSP for New Jersey, 1947-1969, 2nd Annual Report, Economic Policy Council and Office of Economic Policy, Department of the Treasury, State of New Jersey, June, 1969
North Carolina	Niemi, Albert W., Jr. Gross State Product and Productivity in the Southeast, Chapel Hill: The University of North Carolina Press, 1975
North Dakota	Henry, Mark S. North Dakota Gross State Product, 1960-1973, North Dakota Economic Studies No. 12, Bureau of Business and Economic Research, University of North Dakota, November, 1975
Ohio	L'Esperance, Wilford L. "Gross State Product of Ohio, 1949-1968," Bulletin of Business Research No. 45, Center for Business and Economic Research, The Ohio State University, May, 1970
	L'Esperance, Wilford L. and Daniel Taylor. "Gross Ohio Product(1949-1970) and the Ohio Economy," Bulletin of Business Research, Vol. XLVII, No. 5, Center for Business and Economic Research, The Ohio State University, May, 1972
	L'Esperance, Wilford L. "An Overview of the Ohio Economy," Bulletin of Business Research, Vol. LI, No. 1, Center for Business and Economic Research, The Ohio State University, January, 1976
Oklahoma	Liew, Chang K., Ju-Ho Kin, and Han Ki Min. An Estimation of Gross State Product for Oklahoma, University of Oklahoma, Norman, 1973
Rhode Island	Laube, Melissa. New England's Gross State Product, Federal Reserve Bank of Boston, 1976

State	Source of GSP Estimate
South Carolina	Rawson, William S., Teddy T. Su, and James G. Hilton. "South Carolina's Gross State Product and Its Estimation," Business and Economic Review, 16 (February 1970), 2-5
	Niemi, Albert W., Jr. Gross State Product and Productivity in the Southeast, Chapel Hill: The University of North Carolina Press, 1975
South Dakota	Schwarz, D. F. and V. E. Montgomery. "Gross State Product Estimates for South Dakota," South Dakota Business Review, 27 (May 1970), 3-9
Tennessee	Kort, John R. Estimating Gross State Product: An Analysis and An Application to the Tennessee Economy, Center for Business and Economic Research, The University of Tennessee, Knoxville, 1976
	Niemi, Albert W., Jr. Gross State Product and Productivity in the Southeast, Chapel Hill: The University of North Carolina Press, 1975
Texas	Adair, Bryan. The Estimation of a State's Gross Product, A Procedure Applied to Texas, Bureau of Business Research, The University of Texas, 1975

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