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Appraisal of Alternative Methods of Estimating Local Area Incomes

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Estimating income for small areas may be done in several ways. The "long methods" aggregate each component so far as data will permit and allocate the remaining income on the basis of relationships observed for large areas, usually states. A description of detailed methods and procedures is summarized by Lewis C. Copeland.[1] Estimates arrived at by the use of such methods provide a standard for assessing estimates developed by shorter and simpler procedures.

In estimating income for small areas, it is particularly important to take care of the "situs" problem. Income for an area should represent, so far as possible, the income of the residents as distinguished from total wages, salaries, and other income of business firms located in the area. A second problem arises from the fact that agricultural income, proprietors' income, and property income are not ordinarily available from existing sources in local areas.

The present paper gives an analysis of our experience in Virginia in testing the applicability of alternative methods of estimating the income of local areas.

Problems of Estimation

The development of income estimates involves two procedures: (1) the accumulation of wage and salary data from all sources reporting such information, and (2) the estimation of all other kinds of income (e.g. proprietors' income; dividends, rents, and royalties; pensions, annuity, and insurance premiums; and the like). The smaller the area for which the measure of income is prepared, the more it is influenced by the situs factor. Since by definition income estimates for a local area include only the money received by the residents, it is often necessary to group several small areas together into a larger region. The regional income is then distributed among

NOTE: This paper draws heavily upon work done by my colleagues in the Bureau of Population and Economic Research of the University of Virginia. I would like to make special acknowledgment to John L. Lancaster, Anne Fisher, and Mary Duley.

[1] Lewis C. Copeland, *Methods of Estimating Income Payments in Counties*, Bureau of Population and Economic Research, University of Virginia, 1952.

the individual areas according to resident employment. The complexities of the situs adjustment are not too difficult at the census bench-mark year. The further one moves away from the decennial census, the more complex this adjustment becomes, and the less sure one is of success.

Making income estimates from year to year beyond the census bench-mark year would be comparatively simple if the economic patterns of each area moved in the same direction and at the same rate. If this occurred, the correlations of estimates would be unity. The economic activities producing income in any large area, however, are dynamic and change not only at different rates but frequently in opposite directions. Growth and development depend on the interaction and movement of many factors in the total economy. Thus, the economic system is conceived of as a complex organism undergoing constant change. The change in people's tastes will stimulate the development and growth of one industry while another is passing out of existence. The analogy of the economic system with a biological organism emphasizes the difficulty of predicting behavior and events.

Successful estimates of income for small areas can be made when the net change among the individual components is of the same relative magnitude from one year to another. When this balance among the components is uneven among the areas being measured, the accuracy of the estimates drops. When the interaction of component factors for local areas parallels the pattern of the state or nation from one year to another, the task of estimating income is relatively simple. However, when the internal balance of an area is altered by the economic expansion or decline of such activities as manufacturing, farming, mining, or government installations, the task is complex. Uneven rates of change among the areas of a state restrict the utility of a standard formula for estimating their income. Improvement is possible as the dynamic factors can be identified, described, and measured, but only if they are reported regularly. For example, in areas where about 75 per cent or more of the total income is derived from measurable wages and salaries, the task of estimating income is less difficult than in areas where less than three-fourths of the income is derived from such sources.

Up to now, allocators have been used to develop income estimates for small areas for such components as proprietors' income, income from dividends, rents, royalties, insurance and annuity payments, and, to a large extent, agricultural income. Short methods of estimating the total income depend on how nearly the sum of a series of individual allocators equals the amount to be assigned by a general

allocator. To simplify the problem, if income for each area were divided into two components—wages and salaries, and all other—can an allocator of all other income be as satisfactory as the sum of individual components comprising all other income if allocated separately and then summed? The latter method has been largely followed in the preparation of income estimates for cities and counties among the southeastern states. This procedure, however, is involved, time consuming, and fairly expensive. Simpler methods will be helpful if accuracy is not unduly sacrificed.

The accuracy of income estimates, however prepared, is a matter of considerable concern not only to those who prepare them but to those who use them. Some measure of their accuracy is given by correlating income estimates for local areas for different years. The coefficients of rank correlation between estimated income of Virginia counties and cities for periods ranging from seven to seventeen years were from 0.86 to 0.93.[2]

Considerable work needs to be done to determine the degree of accuracy required of income estimates. For example, if income is to be used as a factor in distributing funds from the federal government to the states or from states to localities, the estimates must be as free from error as circumstances will permit. Measurements of incomes are not entirely free of error or bias even when the utmost care has been exercised in their compilation and preparation, because it is difficult to tie down an estimate to a particular locality for a definite period of time. The dynamic factors referred to earlier make precision impossible. All measures in the social sciences, such as employment, income, sales, and the like, are relative when applied to areas. Only if the population of an area were self-contained and were prevented from moving, could errors of measurement be reduced to a minimum. Because we are dealing constantly with open-end systems, such measures improve the longer they can be accumulated. The behavior of the measures over a period of time provide patterns of consistency or variability. These patterns suggest appropriate ways of handling the data in preparing the estimates.

1940 Income Estimates for States

In 1943 my colleague John L. Lancaster attempted to develop an index that would afford a relative measurement of the adequacy of a regional economy (large or small) to support its population. He correlated each factor selected for inclusion with per capita in-

[2] Lorin A. Thompson, "The Comparison of Selected Measures of Ability to Bear Tax Burdens," *Journal of American Statistical Association*, June 1952, pp. 263–267.

come estimates for the states for 1940.[3] A large number of factors drawn from the decennial census of 1940 were tested in this manner, including the percentage of the population in each community class, the percentage of the population in each major racial division, and the percentage of total employment (other than public emergency employment) in each major industrial classification.

Since the correlation of the adequacy ratio with the per capita income estimates for the states was quite high (0.954), and because there was a growing demand for some measure of county income level, Lancaster decided to use the regression equation of income level on the adequacy ratio to estimate the 1940 income level for Virginia counties and cities. These estimates for 1940 yield a coefficient of 0.981 when correlated with estimates for 1939 made by quite detailed methods.[4]

The basic factors used in computing the adequacy ratio (AR) were:[5] (1) the total population, (2) the number of persons employed (except on public emergency work), (3) to (15) the number of employed in each major industry group (the number in agriculture, forestry, and fishing was increased by the number employed in logging, and manufacturing decreased by the same amount), (16) the percentage of the population which was Negro, (17) the percentage of the population which was rural farm, and (18) the gross value of goods or services produced by each industry in the nation. The adequacy ratio (AR) was

$$(1) \qquad AR = \frac{P \times IW}{LR} \times 1000$$

where P (population) = smaller of remainders (1.000 – proportion Negro, rounded to nearest 0.1 per cent, or 1.000 – proportion rural farm)

LR (labor ratio) = average number of persons supported by each worker, to nearest 0.01

= (population — employed workers) / employed workers

[3] *Survey of Current Business*, Dept. of Commerce, June 1942.

[4] John L. Lancaster, "Per Capita Income of Virginia Counties for 1940," *University of Virginia News Letter*, October 1, 1945.

[5] Sources of data: *Census of Population, 1940*, Bureau of the Census, Characteristics of Population, Vol. II, United States Summary. (1) Table 21; (2) Table 46; (3) to (15) Table 46; (16) Table 24; (17) Table 21. (18) Special industry reports of the census of 1940.

IW (industrial weights) = summation of weighted percentage of employment by major industry

$$= \tfrac{1}{4}\ [a + 5b + e + 3d + 4(e + f + g + h + j + k + l + m)]^{6}$$

The weights used were small whole numbers roughly proportional to the per worker value of total production in the industry.

Table 1 shows the several factors for the forty-eight states and the District of Columbia. The product moment correlation between per capita income (PCI) and the AR factor is 0.954 and the regression equation is $PCI = 1.73AR + 93$. Income estimates for each of the cities and counties were then prepared on the basis of the preceding regression equation for 1940. The per capita income for Virginia, using the above formula, was $461 as compared to the $447 estimated by the National Income Division.

1950 Income Estimates for States

A similar procedure was followed in preparing estimates of income for 1950. The adequacy ratio (AR) was

$$(2) \qquad AR = \frac{P \times IW}{LR} \div 100$$

where P = percentage of total population urban and rural nonfarm or white population, according to 1950 census,

[6] Symbols and weights of industrial employment in 1940:

Industry	*Percentage of Total Employment (rounded to nearest whole per cent)*	*Weight*	*Product*
Agriculture, forestry, and fishing, + logging	*a*	1	*a*
Mining	*b*	5	*5b*
Construction	*c*	1	*c*
Manufacturing — logging	*d*	3	*3d*
Transportation	*e*	4	*4e*
Trade	*f*	4	*4f*
Finance, insurance, and real estate	*g*	4	*4g*
Business and repair services	*h*	4	*4h*
Personal services	*i*	0	0
Amusements and recreation	*j*	4	*4j*
Professional and related services	*k*	4	*4k*
Government	*l*	4	*4l*
Industry not reported	*m*	4	*4m*

Source: John L. Lancaster, "Per Capita Income of Virginia Counties for 1940," *University of Virginia News Letter*, October 1, 1945.

TABLE 1

Adequacy Ratios, Population Factors, Labor Ratios, Industry Weights, and Per Capita Incomes, by States, 1940

(ratios, except for per capita income)

	AR	*P*	*LR*	*IW*	*PCI*
Alabama	124	0.527	2.17	0.51	$ 266
Arizona	233	0.772	2.32	0.70	473
Arkansas	88	0.430	2.34	0.48	257
California	391	0.908	1.74	0.75	808
Colorado	246	0.776	2.21	0.70	530
Connecticut	469	0.944	1.51	0.75	839
Delaware	358	0.829	1.60	0.69	923
District of Columbia	492	0.716	1.15	0.79	1057
Florida	245	0.728	1.78	0.60	472
Georgia	164	0.563	1.82	0.53	317
Idaho	166	0.619	2.31	0.62	442
Illinois	376	0.877	1.75	0.75	727
Indiana	270	0.763	1.98	0.70	537
Iowa	208	0.639	1.94	0.63	488
Kansas	204	0.664	2.08	0.64	421
Kentucky	147	0.558	2.36	0.62	313
Louisiana	178	0.640	2.07	0.57	365
Maine	264	0.805	2.04	0.67	503
Maryland	366	0.834	1.64	0.72	707
Massachusetts	421	0.978	1.81	0.78	769
Michigan	320	0.836	1.88	0.72	652
Minnesota	216	0.676	2.00	0.64	514
Mississippi	75	0.359	2.00	0.42	205
Missouri	242	0.704	1.92	0.66	508
Montana	229	0.686	2.01	0.67	584
Nebraska	183	0.623	2.04	0.60	431
Nevada	398	0.858	1.66	0.77	843
New Hampshire	342	0.875	1.79	0.70	560
New Jersey	441	0.945	1.65	0.77	894
New Mexico	151	0.667	2.79	0.63	359
New York	415	0.947	1.71	0.75	848
North Carolina	143	0.536	1.95	0.52	320
North Dakota	120	0.490	2.20	0.54	368
Ohio	308	0.845	1.95	0.71	647
Oklahoma	149	0.603	2.55	0.63	360
Oregon	293	0.765	1.80	0.69	579
Pennsylvania	344	0.909	2.06	0.78	635
Rhode Island	449	0.985	1.69	0.77	715
South Carolina	139	0.519	1.87	0.50	289
South Dakota	134	0.523	2.14	0.55	378
Tennessee	150	0.564	2.10	0.56	319

(continued on next page)

TABLE 1 (continued)

(ratios, except for per capita income)

	AR	*P*	*LR*	*IW*	*PCI* [a]
Texas	206	0.665	2.00	0.62	419
Utah	227	0.829	2.70	0.74	489
Vermont	234	0.706	1.87	0.62	513
Virginia	213	0.633	1.87	0.63	447
Washington	304	0.807	1.86	0.70	644
West Virginia	214	0.721	2.66	0.79	409
Wisconsin	234	0.722	1.96	0.64	519
Wyoming	250	0.710	1.90	0.67	599

[a] *Survey of Current Business*, Dept. of Commerce, June 1942.

Source: J. L. Lancaster, "Per Capita Incomes of Virginia Counties for 1940," *University of Virginia Newsletter*, October 1, 1945.

whichever is smaller (product-moment correlation coefficient of *P* with 1950 state per capita incomes [7] = +0.68)

LR = relationship between total population including military and total civilian employment plus military, i.e. average number of persons supported by each worker (product-moment correlation coefficient of *LR* with 1950 state per capita incomes = −0.79)

IW = summation of weighted percentage of employment by thirteen industries [8] (product-moment correlation of *IW* with 1950 state per capita incomes = +0.62)

The adequacy ratio has a product-moment correlation coefficient of +0.86 with the state per capita incomes. *P*, *LR*, and *IW* were expressed in a multiple correlation coefficient and provided an *R* of +0.88. This was considered too small to be of any real value, so the estimating equation was not applied to local data.

A final attempt to arrive at a short method provided rather satisfactory results. Equation 2 was used, and *LR* remained the same, but *P* and *IW* were revised so that:

P = percentage of total population white urban and white rural nonfarm, according to 1950 census (product-moment cor-

[7] *National Income Supplement, 1951, Survey of Current Business*, Dept. of Commerce.

[8] Using the wage and salaries, supplements to wages and salaries, income of unincorporated enterprises, and the net corporate dividend payments shown by industry in Tables 14, 15, 16, and 20 of *ibid.*, Lancaster summed these for each of the thirteen employment classifications and divided them by the 1950 census employment figures, including the military. The resulting average payments for each type of employment, e.g. manufacturing, construction, trade, and personal service, were related and each expressed in terms of weight, e.g. 3 or 4.

relation coefficient of P with 1950 state per capita incomes $= +0.73$)

IW = summation of weighted percentage of employment by sixteen industries [9] (product-moment correlation coefficient of IW with 1950 state per capita incomes $= +0.72$)

IW was further refined by the application of a factor reflecting the sex and median income of employment. This factor was obtained by weighting the percentage of men in the experienced labor force by the male median income and the percentage of women by the female median income. The median incomes were expressed in multiples of 1.00, using the lowest median income as 1.00. The products were summed to be used as a sex factor (the sex factors had a rank correlation of $+0.90$ with the state per capita incomes). They were next multiplied by the IW shown above to give a final IW (the IW thus obtained has a product-moment correlation coefficient with 1950 state per capita income of $+0.89$).

When the revised P and IW and the same LR were used in equation 2, they provided an AR that has a product-moment correlation coefficient of $+0.93$ with the state per capita incomes. The three factors (P, LR, and IW) were correlated with the state per capita incomes and provide a multiple correlation coefficient of $+0.954$. The multiple regression equation is $PCI = 0.3698P + 2.4871IW - 605.3281LR + 1538.6691$. This estimating equation was applied to the state factors and the resulting per capita incomes have a coefficient of $+0.954$ with the Department of Commerce per capita income estimates (see Table 2 for the values of the factors and the estimates by state). The standard error of estimate is 93.5551.

[9] Two of the thirteen employment classifications used in the first attempt were broken down further. Manufacturing was split into three categories (based on the level of average wages) and trade was divided into wholesale and retail. The weights used were based on the average annual earnings per full-time worker shown in Table 26 of the *National Income Supplement, 1951, Survey of Current Business*, Dept. of Commerce. The average wages for each type of employment were related and expressed as weights, e.g. 7.25 or 8.50, and applied to the percentages.

TABLE 2

Adequacy Ratios, Population Factors, Labor Ratios, Industry Weights, Estimated Per Capita Incomes, and Per Capita Incomes Reported by the Department of Commerce for States, 1950

	AR	*P*	*LR*	*IW*	PCI	
					Estimated	*Commerce*
United States	172	78.4	1.63	357	$1469	$1440
Northeast:						
Maine	132	86.4	1.90	291	1144	1151
New Hampshire	175	91.0	1.62	311	1365	1308
Vermont	122	78.4	1.74	271	1188	1159
Massachusetts	243	96.6	1.54	387	1605	1603
Rhode Island	230	96.8	1.47	350	1555	1542
Connecticut	279	94.2	1.41	418	1760	1782
Middle Atlantic:						
New York	258	89.7	1.48	425	1733	1875
New Jersey	283	91.3	1.42	440	1807	1710
Pennsylvania	204	87.2	1.66	389	1534	1537
East North Central:						
Ohio	219	82.8	1.59	420	1651	1581
Indiana	194	78.6	1.59	393	1583	1458
Illinois	258	83.6	1.43	441	1801	1760
Michigan	231	82.1	1.65	465	1727	1594
Wisconsin	185	77.7	1.53	365	1549	1440
West North Central:						
Minnesota	158	74.3	1.60	340	1443	1333
Iowa	141	69.3	1.61	327	1403	1413
Missouri	141	71.1	1.59	315	1386	1406
North Dakota	86	57.8	1.77	264	1145	1269
South Dakota	95	58.7	1.66	269	1225	1275
Nebraska	130	68.8	1.57	297	1352	1478
Kansas	142	72.8	1.64	319	1366	1340
South Atlantic:						
Delaware	191	76.7	1.50	373	1587	1956
Maryland	189	76.9	1.52	374	1577	1559
District of Columbia	257	64.5	1.06	423	1973	1991
Virginia	105	61.1	1.64	283	1272	1144
West Virginia	117	73.9	2.19	347	1103	1053
North Carolina	62	50.4	1.70	208	1046	947
South Carolina	48	45.5	1.74	185	962	833
Georgia	59	50.8	1.66	193	1033	969
Florida	113	71.8	1.64	259	1217	1211
East South Central:						
Kentucky	74	60.9	2.01	243	949	909
Tennessee	69	56.8	1.85	224	997	969
Alabama	49	47.0	1.94	201	882	844
Mississippi	19	31.5	1.98	118	645	702

(continued on next page)

TABLE 2 (continued)

	AR	P	LR	IW	PCI	
					Estimated	*Commerce*
West South Central:						
Arkansas	36	45.9	2.09	163	696	823
Louisiana	66	54.6	2.03	245	939	1052
Oklahoma	104	68.6	1.91	290	1129	1076
Texas	128	72.9	1.70	299	1280	1272
Mountain:						
Montana	156	74.8	1.68	351	1422	1568
Idaho	123	71.3	1.85	319	1239	1260
Wyoming	201	78.9	1.53	389	1609	1509
Colorado	172	83.1	1.69	350	1417	1380
New Mexico	112	75.9	2.12	313	1062	1133
Arizona	128	80.3	2.05	326	1138	1235
Utah	171	86.9	1.99	392	1341	1274
Nevada	254	86.4	1.41	414	1747	1894
Pacific:						
Washington	223	86.1	1.65	427	1634	1630
Oregon	198	83.6	1.63	387	1545	1515
California	241	88.7	1.60	435	1685	1755

1950 and 1953 Income Estimates for Virginia Areas

The county and city factors had to be built up in a slightly different way from that described for the state factors before they could be used in the equation.

P = percentage of total white urban and white rural nonfarm, according to 1950 census (the same)

LR = relationship between total population including military and total civilian employment plus military, i.e. average number of persons supported by each worker (the same, except that the institutional population was removed from the total population before the relationship was made)

IW = summation of weighted percentage of employment by sixteen industries (the sex factor had to be obtained in a different way) [10]

[10] The 1950 census does not provide median incomes for men and women in the experienced labor force on a county and city basis. It does provide the breakdown into male and female employment, however. Instead of the median incomes, the Virginia Unemployment Compensation Commission average wage for each county and city was used as the male median income and this was multiplied by 0.64 to get a female median income (the basis for this procedure was the ratio of female to male median income for Virginia according to the census—$1,372 to 2,139). Again, the lowest UCC average wage was used as 1.00 and all others were expressed as multiples of 1.00. Whereas the lowest median income used for the

The local per capita incomes estimated from the application of equation 2 to the local data have a product-moment correlation of +0.92 with Anne Fisher's estimates for 1950 prepared by the method used in "County Income Estimates for Seven Southeastern States." [11]

Estimates of income for Virginia cities and counties have been prepared by both the long and short methods for 1950 and 1953.[12] The difference in the estimates obtained by the two methods for 1950 and 1953 are summarized in Table 3. The difference between the long and the short method was less than 5 per cent in 1950 for 29 per cent of the areas and less than 10 per cent for 51 per cent of

TABLE 3

Percentage Differences between per Capita Incomes Estimated by Long Method and by Short Method, Virginia Cities and Counties, 1950 and 1953

Difference in Percentage Points	*Number of Areas*	
	1950	*1953*
0–4	37	32
5–9	38	22
10–14	26	18
15–19	12	12
20–24	6	12
25–29	5	11
30–34	0	4
35–39	0	7
40–44	1	4
45–49	2	1
50–54	0	1
55–59	0	0
60–64	0	0
65–69	0	1
70–74	0	0
75–79	0	0
80–84	0	0
85–89	0	1
Total	127	126

Note: The number of cities and counties changes from time to time from annexations and consolidations. This accounts for the total of 127 in 1950 and 126 in 1953.

states was $693, the lowest used for the counties and cities in Virginia was $921. This procedure was thought defensible, since the UCC wage reflects almost none of the low agricultural wages and only a small percentage of service wages. The sex factor was used to get the complete *IW* factor.

[11] Mary B. Duley, *Developments in Virginia's Income since 1947 with County and City Estimates for 1953*, Bureau of Population and Economic Research, University of Virginia, 1955.

[12] In this discussion, the long method is based on the procedures that aggregate measurable components and allocate the remaining items on the basis of relationships observed for large areas such as states. Short methods include the use of regression formulas or simplified modifications of the long method.

the areas. In 14 of the 127 areas, the differences were larger than 20 per cent. In 1953, the differences were somewhat larger than for 1950, perhaps because:

1. The industrial weights and the labor ratio used for the 1953 short method estimates were the 1950 values.
2. The changes in employment between 1950 and 1953 were not uniform, nor were they always in the same direction.
3. Drought conditions seriously affected agricultural income in some counties during 1953.
4. Employment in coal mining areas declined sharply.
5. A few areas were experiencing small industrial booms.

In the counties where agriculture is a major source of employment, drought conditions disrupted the expected pattern of change. Whenever the areas differ in rate and kind of change from one period to another, the short methods will have larger errors than the long methods, unless the changes offset each other and the rates of change are fairly uniform in amount. However, the interaction of forces may produce cumulative errors. Estimates can be improved only when the changes in the more dominant factors in the product mix can be identified and measured. The use of regression methods for estimating income for census years produced results that were reasonably satisfactory for Virginia, but when applied to county data for the state of Washington were much less so. Perhaps a modification of weights for the dominant factors in Washington's economy might yield more satisfactory results.

The methods described thus far are still rather detailed and time consuming. It seemed appropriate to try another approach in preparing estimates for 1953. This procedure is a hybrid. The large urban areas were separated from the remainder of Virginia. Since wage and salary payments comprise upward of two-thirds of total income in such areas, they were used to estimate total income for the large urban areas. (Moreover, wage and salary data can be more readily assembled for urban areas.) The income from the urban regions was totaled and subtracted from the Department of Commerce estimate of total income for the state. The income of the rural regions was then estimated from the residual income on the basis of their shares of income in a previous bench-mark year when the estimates were prepared by the long method.

There are six urban regions in Virginia where, in each of the years for which we have prepared estimates, wage and salary payments from industries covered by the Virginia Unemployment Compensation Commission, from government, and from railroads have to-

taled more than 65.0 per cent of total income as estimated by the long method of allocating individual income components. Even when income is allocated to these regions by the most detailed method, adjustments must be made within each region for the residence of the worker. These six regions include thirty of the counties or cities of the state. In addition, there are six other separate areas (one county and five cities) where wage and salary payments in these same industrial groups also constitute more than 65.0 per cent of total income.

The income estimated for these thirty-six counties and cities by the long allocation method represented 66.3 per cent of the state's total income in 1951, and 71.0 per cent in 1953. All the counties and cities that have been undergoing rapid population change are in this list. Therefore, income was assigned to these thirty-six areas on the basis of the measurable wage and salary payments from industries covered by UCC, from government, and from railroads, and then the residue of the state total income was distributed to the remaining ninety areas in terms of relatively stable "shares" of income. Tables 4 and 5 show the results of an attempt to develop 1953 county and city income estimates by this method; the first shows the data used in assigning income to the thirty-six urban areas, and the second, the distribution of the residual income to the remaining ninety areas.

When percentages similar to those shown in column 5 of Table 5 are computed from the appropriate columns of Table 4, no percentage of variation exceeds (arithmetically) 5 per cent. The table below shows the range of percentage variation for all 124 areas: [18]

	Less than 5.0%	*5.0%–9.9%*	*10.0%–14.9%*	*15.0%–19.9%*	*20.0% and over*
Number of areas	66	29	19	6	4
Per cent	53.2	23.4	15.3	4.9	3.2
Cumulative per cent	53.2	76.6	91.9	96.8	100.0

If knowledge of local conditions were used to make reasonable adjustments to the estimates shown in Table 5, it seems likely that most of the extreme variation would be removed. The method used in estimating the income for this group of ninety areas assumes that the pattern of income structure in each area remains fairly constant. This assumption is probably never completely trustworthy, but in the particular years involved in this trial it was especially misleading.

[18] The 127 political subdivisions in 1950 and the 126 in 1953 were grouped into 124. This was necessary for comparability due to annexations.

TABLE 4

Projection of Total Income of Urban or Industrial Areas for 1953 on Basis of Measureable Wage and Salary Items, Virginia, 1951–1953

(millions of dollars)

AREA: COUNTY OR CITY	1951					1953						TOTAL INCOME, 1951	TOTAL INCOME, 1953	
	UCC Covered Wages	*Wages and Salaries in Government*	*Railroad Wages and Salaries*	*Total Wages and Salaries Measured*	*Total Adjusted for Situs*	*UCC Covered Wages*	*Wages and Salaries in Government*	*Railroad Wages and Salaries*	*Total Wages and Salaries Measured*	*Total Adjusted for Situs*	(10) ÷ (5)	*Long Method Estimate*	*Short-Cut Estimate* (12) × (11)	*Long Method Estimate by Bureau*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
State	1,526.6	1,044.3	107.6	2,678.5	2,678.5	1,778.1	1,164.9	129.9	3,072.9	3,072.9		4,382.2	4,828.9	4,828.9
Region 1.A:	105.9	372.2	6.5	484.7	477.9	145.3	510.5	7.9	663.6	645.4		668.5	903.8	902.3
Arlington	65.1	219.5	1.3	285.9	257.2	82.7	288.6	1.6	372.9	335.3	1.30	351.4	458.2	456.4
Alexandria	30.5	59.2	4.1	93.8	95.4	47.1	89.3	5.0	141.4	130.6	1.37	135.5	185.5	185.4
Fairfax and Falls Church	10.4	93.5	1.1	105.0	125.3	15.5	132.6	1.3	149.4	179.6	1.43	181.6	260.2	260.5
Region 1.B:	351.3	111.8	21.4	484.4	472.3	404.1	83.4	25.8	513.3	500.5		708.3	749.3	748.6
Chesterfield & Colonial Heights	23.3	10.7	1.0	35.0	49.8	27.8	7.3	1.2	36.4	50.8	1.02	70.8	72.3	72.2
Dinwiddie	0.5	2.9	0.3	3.7	7.9	0.7	2.3	0.4	3.3	7.8	1.00	14.4	14.4	14.3
Petersburg	27.1	8.0	1.0	36.0	34.6	31.2	7.7	1.1	40.0	40.8	1.18	49.1	57.9	57.9
Henrico	4 3	15.8	3.5	23.7	59.7	5.9	10.5	4.3	20.7	68.2	1.14	89.0	101.7	101.6
Richmond	277.6	54.8	15.4	347.8	287.3	314.7	40.2	18.6	373.5	297.7	1.04	440.3	456.2	455.8
Prince George	0.1	16.7	0.1	16.9	20.3	0.2	13.7	0.1	14.1	21.0	1.03	27.0	27.9	27.9
Hopewell	18.3	2.9	0.1	21.3	12.8	23.6	1.6	0.1	25 2	13.7	1.07	17.7	19.0	19.0
Region 1.C—North:	87.4	68.5	3.8	159.7	157.3	129.1	71.6	4.6	205.3	196.5		195.9	244.3	246.0
Hampton	10.8	34.8	0.9	46.5	61.0	13.6	37.9	1.1	52.5	75.2	1.23	75.9	93.7	94.4
Newport News	74.3	12.4	2.2	88.9	52.9	109.7	9.8	2.6	122.2	62.3	1.18	67.6	79.5	80.2
Warwick	2.3	21.3	0.8	24.3	43.4	5.7	23.9	0.9	30.6	58.9	1.36	52.4	71.1	71.4
Region 1.C—South:	190.4	255.6	15.3	461.3	458.9	228.6	320.3	18.5	567.4	565.8		669.9	826.0	826.7
Norfolk	7.0	44.4	2.7	54.1	91.1	9.6	48.0	3.2	60.8	109.1	1.20	125.6	150.4	149.7
Norfolk	150.9	142.6	6.6	300.1	240.9	178.0	176.1	8.0	362.1	293.1	1.21	360.4	438.5	439.2
Portsmouth	23.4	42.5	5.0	70.9	82.3	28.7	65.5	6.0	100.3	105.6	1.28	114.3	146.6	147.3
South Norfolk	4.1	3.3	0.5	7.9	10.5	5.5	3.7	0.7	9.8	13.6	1.29	14.6	18.9	19.2
Princess Anne	5.0	22.9	0.5	28.3	34.1	6.8	27.0	0.6	34.4	44.4	1.30	55.0	71.5	71.3

(continued on next page)

TABLE 4 (continued) (*millions of dollars*)

AREA: COUNTY OR CITY	1951 UCC Covered Wages	1951 Wages and Salaries in Government	1951 Railroad Wages and Salaries	1951 Total Wages and Salaries Measured	1951 Total Adjusted for Situs	1953 UCC Covered Wages	1953 Wages and Salaries in Government	1953 Railroad Wages and Salaries	1953 Total Wages and Salaries Measured	1953 Total Adjusted for Situs	(10) ÷ (5)	TOTAL INCOME, 1951 Long Method Estimate	TOTAL INCOME, 1953 Short-Cut Estimate (12) × (11)	TOTAL INCOME, 1953 Long Method Estimate by Bureau
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Region 2.2:	101.3	13.3	1.5	116.2	116.2	109.0	7.7	1.9	118.6	118.6		175.9	179.6	178.4
Henry	23.4	1.9	0.2	25.6	28.4	27.3	1.2	0.2	28.7	27.7	0.98	37.9	36.9	36.9
Martinsville	18.5	1.9	0.1	20.6	18.2	24.9	1.0	0.1	26.1	20.2	1.11	25.6	28.4	28.3
Pittsylvania	2.8	3.8	0.5	7.1	30.3	3.6	2.7	0.6	6.8	31.1	1.02	55.9	57.3	56.2
Danville	56.6	5.7	0.7	62.9	39.2	53.2	2.8	0.9	56.9	39.5	1.01	56.5	57.0	57.0
Region 4.3	154.0	31.7	25.5	211.2	211.2	182.4	26.8	30.8	239.9	239.9		292.0	331.8	334.5
Giles	13.3	1.7	0.8	15.8	15.6	12.3	1.2	1.0	14.5	17.7	1.14	21.2	24.1	23.8
Montgomery	18.1	6.7	1.0	25.8	18.5	43.1	5.3	1.2	49.5	20.8	1.12	29.5	33.1	32.9
Radford	13.6	1.4	0.6	15.5	8.4	8.0	0.9	0.7	9.6	9.8	1.16	11.5	13.3	13.5
Pulaski	12.7	2.8	0.7	16.3	21.5	11.9	2.2	0.9	15.0	26.8	1.25	30.1	37.7	36.7
Roanoke	21.3	4.5	4.5	30.4	37.7	23.2	5.3	5.5	33.9	43.2	1.14	52.9	60.6	60.5
Roanoke	75.0	14.6	17.9	107.4	109.5	83.9	11.9	21.5	117.4	121.7	1.11	146.8	163.1	167.1
Other areas:														
Warren	13.1	1.6	0.1	14.9	13.4	14.5	1.0	0.1	15.6	13.3	0.99	19.9	19.7	19.7
Bristol	17.4	1.7	0.5	19.5	17.6	18.4	1.2	0.5	20.2	17.1	0.98	21.1	20.6	20.3
Charlottesville	16.7	9.0	1.3	27.0	24.3	18.2	6.7	1.6	26.5	23.8	0.98	39.7	38.9	38.9
Fredericksburg	8.5	3.8	0.3	12.6	11.4	10.3	2.6	0.4	13.3	11.9	1.05	18.6	19.5	20.0
Lynchburg	50.7	5.8	1.6	58.2	53.8	56.8	3.5	2.0	62.3	52.9	0.98	73.5	72.2	72.5
Winchester	15.3	1.6	0.1	16.9	15.2	16.6	0.9	0.9	17.6	15.8	1.04	21.2	22.0	22.1
Total specified areas	1,112.0	876.6	77.9	2,066.6	2,029.5	1,333.3	1,036.2	95.0	2,463.5	2,401.6		2,904.5	3,427.8	3,430.0
Remainder of state	414.6	167.7	29.7	611.9	649.0	444.8	128.8	34.9	609.4	671.3		1,477.7	1,401.1	1,398.9

Column	*Source*
1, 6	Virginia Unemployment Compensation Commission.
2, 7	Assembled by Bureau of Population and Economic Research.
3, 8	Railroad Retirement Board.
4	Cols. 1 + 2 + 3.
5, 10	The adjustment made within the areas for situs. In Virginia this adjustment is necessary, no matter what method of estimation is used, unless the estimation is made from a regression based on residence of workers.
9	Cols. 6 + 7 + 8.
11	Col. 10 ÷ col. 5.
13	Col. 12 × col. 11.
14	Mary B. Duley, *Developments in Virginia's Income since 1947 with County and City Estimates for 1953*, University of Virginia, 1955.

TABLE 5

Distribution of Income to "Rest of State" Area by Short Method and by Long Method, Virginia, 1953

(*dollars in thousands*)

Area	*Income Long Method 1951*	*Percentage of Area Total*	*1953 Income Residual*	*1953 Income Long Method*	*Percentage Variation*
	(1)	(2)	(3)	(4)	(5)
Rest of state	$1,477,806	100.00	$1,401,000	$1,398,935	+ 0.1
Accomack	36,974	2.50	35,052	32,256	+ 8.7
Albemarle	33,383	2.26	31,648	30,670	+ 3.2
Alleghany	31,327	2.12	29,698	25,314	+17.3
Amelia	6,441	0.44	6,105	5,025	+21.5
Amherst	15,717	1.06	14,901	17,110	−12.9
Appomattox	7,761	0.53	7,357	5,946	+23.7
Augusta	43,774	2.96	41,499	39,337	+ 5.4
Bath	6,723	0.46	6,375	5,494	+16.0
Bedford	29,014	1.96	27,506	27,345	+ 0.6
Bland	4,657	0.32	4,415	4,463	− 1.1
Botetourt	15,536	1.05	14,729	13,041	+12.9
Brunswick	16,026	1.08	15,192	13,384	+13.5
Buchanan	23,659	1.60	22,430	20,989	+ 6.9
Buckingham	8,638	0.58	8,189	7,712	+ 6.2
Campbell	36,092	2.44	34,217	31,248	+ 9.5
Caroline	10,954	0.74	10,384	11,474	− 9.5
Carroll	20,464	1.38	19,401	20,624	− 5.9
Charles City	4,178	0.28	3,961	4,646	−14.7
Charlotte	11,444	0.77	10,849	11,113	− 2.4
Clarke	9,164	0.62	8,688	9,846	−11.8
Craig	2,774	0.19	2,630	2,634	− 0.2
Culpeper	15,114	1.02	14,328	14,391	− 0.4
Cumberland	4,844	0.33	4,592	4,069	+12.9
Dickenson	15,656	1.06	14,842	13,747	+ 8.0
Essex	5,644	0.38	5,350	5,547	− 3.6
Fauquier	31,624	2.14	29,981	33,964	−11.7
Floyd	7,599	0.51	7,204	7,838	− 8.1
Fluvanna	5,732	0.39	5,434	5,081	+ 6.9
Franklin	21,265	1.44	20,159	19,459	+ 3.6
Frederick	19,913	1.35	18,879	18,468	+ 2.2
Gloucester	9,815	0.66	9,304	9,801	− 5.1
Goochland	6,687	0.45	6,340	5,850	+ 8.4
Grayson	19,367	1.31	18,362	18,991	− 3.3
Greene	2,955	0.20	2,801	2,878	− 2.7
Greensville	14,499	0.98	13,745	14,544	− 5.5
Halifax	33,020	2.23	31,304	29,025	+ 7.9
Hanover	21,935	1.48	20,795	25,076	−17.3
Highland	3,429	0.23	3,252	2,968	+ 9.6
Isle of Wight	18,973	1.28	17,986	18,336	− 1.9

(continued on next page)

TABLE 5 (continued)

(dollars in thousands)

Area	*Income Long Method 1951*	*Percentage of Area Total*	*1953 Income Residual*	*1953 Income Long Method*	*Percentage Variation*
	(1)	(2)	(3)	(4)	(5)
James City	5,385	0.36	5,105	6,306	−19.0
King & Queen	4,420	0.30	4,190	5,131	−18.3
King George	7,490	0.51	7,100	6,627	+ 7.1
King William	9,812	0.66	9,303	9,877	− 5.8
Lancaster	8,121	0.55	7,698	8,013	− 3.9
Lee	22,311	1.51	21,152	19,485	+ 8.6
Loudoun	31,192	2.11	29,571	33,976	−13.0
Louisa	9,812	0.66	9,301	9,047	+ 2.8
Lunenburg	11,423	0.77	10,830	9,911	+ 9.3
Madison	7,137	0.48	6,765	6,745	+ 0.3
Mathews	6,155	0.42	5,835	6,372	− 8.4
Mecklenburg	30,744	2.08	29,146	25,553	+14.1
Middlesex	4,913	0.33	4,658	5,396	−13.7
Nansemond	23,207	1.57	22,000	24,889	−11.4
Nelson	12,003	0.81	11,379	12,101	− 6.0
New Kent	3,466	0.23	3,287	3,878	−15.2
Northampton	18,523	1.25	17,560	17,237	+ 1.9
Northumberland	9,355	0.63	8,868	9,319	− 4.8
Nottoway	24,013	1.62	22,765	15,505	+46.8
Orange	17,347	1.17	16,446	17,546	− 6.3
Page	14,620	0.99	13,860	14,259	− 2.8
Patrick	11,232	0.76	10,648	12,508	−14.9
Powhatan	4,447	0.30	4,216	3,683	+14.5
Prince Edward	14,696	0.99	13,933	13,501	+ 3.2
Prince William	29,968	2.03	28,411	35,817	−10.0
Rappahannock	4,606	0.31	4,366	4,305	+ 1.4
Richmond	5,033	0.34	4,772	5,017	− 4.9
Rockbridge	26,687	1.81	25,301	22,125	+14.4
Rockingham	44,110	2.98	41,817	40,591	+ 3.0
Russell	22,127	1.50	20,977	16,508	+27.1
Scott	17,504	1.18	16,593	17,475	− 5.0
Shenandoah	20,878	1.41	19,793	22,358	−11.5
Smyth	27,288	1.85	25,869	26,999	− 4.2
Southampton	26,647	1.80	25,263	27,625	− 8.6
Spotsylvania	14,336	0.97	13,591	14,248	− 4.6
Stafford	15,411	1.04	14,610	14,503	+ 0.7
Surry	6,319	0.43	5,991	5,880	+ 1.9
Sussex	12,388	0.84	11,745	11,416	+ 2.9
Tazewell	42,280	2.86	40,083	35,206	+13.9
Washington	33,012	2.23	31,296	30,332	+ 3.2
Westmoreland	9,160	0.62	8,683	9,440	− 8.0
Wise	45,048	3.05	42,707	39,943	+ 6.9
Wythe	21,495	1.45	20,379	21,290	− 4.3

(continued on next page)

TABLE 5 (continued)

(dollars in thousands)

Area	*Income Long Method 1951*	*Percentage of Area Total*	*1953 Income Residual*	*1953 Income Long Method*	*Percentage Variation*
	(1)	(2)	(3)	(4)	(5)
York	12,196	0.83	11,561	13,177	−12.3
Buena Vista	6,713	0.45	6,365	6,324	+ 0.6
Clifton Forge	7,355	0.50	6,973	6.714	+ 3.9
Harrisonburg	14,584	0.99	13,826	14,635	− 5.5
Staunton	24,252	1.64	22,990	25,005	− 8.1
Suffolk	17,949	1.21	17,017	19,716	−13.7
Waynesboro	18,594	1.26	17,627	18,940	− 6.9
Williamsburg	7,271	0.49	6,894	6,777	+ 1.7

Column	Source
2	Col. 1 expressed as a fraction of the total ($1,477,806) for the ninety areas.
3	Col. 2 1953 income residual ($1,401,000) for the ninety areas.
4	Mary B. Duley, *Developments of Virginia's Income Since 1947 with County and City Estimates for 1953*, Bureau of Population and Economic Research, University of Virginia, 1955.
5	Col. 3–col. 4 as percentage of col. 4.

Although the state's total income increased by 10.2 per cent, the income of this group of ninety counties and cities declined by 5.3 per cent. These ninety areas receive 71.0 per cent of the state's farm income. As a result of severe drought, the state's income from agriculture declined by $109.1 million between 1951 and 1953. In some of the counties, there was an almost total crop failure; in others, crops were estimated as high as 80.0 per cent of normal.

A realistic adjustment of these estimates to show the decline of farm income between 1951 and 1953 would remove most of the overestimation, and a distribution of these overestimated amounts to the more industrial areas of the group would adjust most of the badly underestimated areas.

Summary

The short method of estimating income for local areas is somewhat limited in its application. Our experience with it indicates that, for urban areas not too far removed from a census benchmark year, reasonably useful estimates can be prepared from wage information available from the unemployment compensation commissions, the Railroad Retirement Board, and governmental sources. The distribution of nonwage and salary income, e.g. proprietors' income, dividends, rents and royalties, is less satisfactory. If only a total income figure for the area is needed, the short method can be used within limits.

Among the rural areas, however, the fluctuations in income can be affected by droughts, construction of new plants, and industrialization. Estimates of income for these areas must be made on the basis of knowledge of local conditions and the extent to which events may have influenced the fortunes of a community during any particular year. Such knowledge cannot be reduced to a mechanical formula. The formula is useful as a point of departure, and by comparing the income data and other data, e.g. retail sales, with the income estimates, some indication of the reasonableness of the formula estimate can be obtained. If the divergence is large, a satisfactory estimate can then only be made on the basis of localized knowledge of conditions affecting the area. Even this knowledge can miscarry if records of changes are inadequate.

In conclusion, short methods of estimating income for local areas are useful if the margin of error permitted is as large as 10 per cent. If more precise estimates are needed, the user should be reminded of the limitations.

COMMENT

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Anyone who has attempted to estimate income for small areas has searched diligently for short-cut methods of one sort or another. There are at least three possibilities. One is to devise a formula, using certain relevant data, that will give the desired answer. Another is to apportion the various segments of total income among the small areas on the basis of more complete data that are available in certain bench-mark years and then to apply the proportionate distribution in the bench-mark year to the particular year or area under consideration. A third is to use all important local data available on a yearly basis and to apportion the remainder either by formula or by reference to the bench-mark year, that is to say, to use some combination of methods one or two along with the available year data.

Lorin A. Thompson presents a formula that he and his colleagues have devised for estimating income in small areas. It is $AR = (P \times IW)/LR$, where AR is the independent variable in a linear equation giving per capita income. I should like to consider for a moment the assumption involved in this AR formula. P, in the numerator, is urban and rural nonfarm white population. It implies, if I interpret it correctly, that the higher the urban and rural nonfarm white

percentage of the population, the higher the per capita income. This may be true in many states, but the relationship does not hold in the state of Washington. Among the highest 25 per cent of the counties of Washington, ranked in order of the size of per capita income, all but two counties have a relatively high percentage of rural farm population. The highest per capita income is found in the wealthy agricultural counties of eastern Washington. Adams and Lincoln counties, for example, had per capita incomes in 1950 and 1952 almost double the state average. On the other hand, some other farm counties, such as Stevens and Wahkiakum, with a relatively high percentage of farm population have a low per capita income. I computed the coefficient of correlation between estimated per capita income and percentage of rural farm population in 1950 and got an r^2 of 0.003, which shows that in our state there is absolutely no correlation between the percentage of farm or nonfarm population and per capita income. The nonwhite population in Washington is, of course, negligible, being only 2.6 per cent of the total.

I also question the general applicability of the *IW* (industrial worker) factor of the formula. As I interpret this item, it says that the per capita income depends on the percentage distribution of the labor force in various employment categories. Counties or areas with a certain distribution by classes of their industrial workers will have a higher per capita income than others. An examination of data for the state of Washington indicated that this is not necessarily true. Counties of widely differing sizes often had very similar patterns of industrial classification of workers and also very different per capita incomes. For example, King County, the county in which Seattle is located, had a very similar employment classification to Whatcom County, but the per capita income of King was much higher than that of Whatcom. Also, many counties with very different *IW* classifications have similar per capita incomes. Thus, while I did not have time to test this formula for the whole state of Washington, I would be willing to guess that it would not give good results, even though it did in Virginia.

The situs problem is also difficult to handle by means of a formula of this sort. This troublesome problem always crops up when the income-paid concept is used and the data pertain only to income produced. Invariably, there are some areas where income produced and income paid are not the same. The situs problem can only be solved, I believe, by first-hand and detailed knowledge of the area concerned.

The second short-cut method of estimating income in small areas,

that of apportioning the various segments of income on the basis of their distribution in some bench-mark year, may not be considered a short-cut method, since by implication a computation by the long method was made in the bench-mark year. However, when once the income by small areas for bench-mark years has been obtained, one can make a reasonably good estimate for succeeding years provided —and this proviso is very important—there have not been substantial changes in the relative sizes of the incomes of the smaller areas. As Thompson points out, "Making income estimates from year to year beyond the census bench-mark year would be comparatively simple, if the economic patterns of each area moved in the same direction and at the same rate." But, of course, this generally does not happen. A new industrial plant in a small county, or a drought, or a substantial change in farm prices may materially alter the relative share of the state income received by a particular county or group of counties.

The third method, a variant of the second, gives, I believe, the most satisfactory results. It consists of using all significant and appropriate data available on a small area basis and distributing the remainder of the income segments among the local areas in accordance with their relative importance in the bench-mark year. Changes that have occurred since the bench-mark year can be allowed for by reference to local data that reflect those changes. This latter method is the one that I judge Thompson favors. He suggests that wage information available from the Unemployment Compensation Commission, the Railroad Retirement Board, and governmental sources is most useful in making estimates in urban areas. Nonwage and salary income items, such as interest, dividends, rents, royalties, and transfer items like public assistance and pensions, are somewhat more difficult to use. These may have to be allocated by small areas in proportion to their relative share of state income in bench-mark years. Demand and time deposits, which are available by counties every year and a half or two years, can be used to make adjustments for changes in property and other income factors that have occurred since the bench-mark years. State sales or income tax data can also be used for this purpose.

Proprietors' income and agricultural income are possibly the most difficult to handle satisfactorily. Farm income particularly is subject to considerable change from year to year because of weather variations and price fluctuations. I agree with Thompson that estimates of income in rural areas must be made from a knowledge of local conditions and must be adjusted in accordance with events that have altered the fortunes of a community during any particular

year. These changes will be reflected in such economic data as local bank deposits and retail sales. I agree also that this knowledge cannot be reduced to a mechanical formula.

In conclusion, formulas for estimating income in local areas, particularly if they are designed to be generally applicable, should be viewed with suspicion and used with caution. A formula that may work fairly well for estimating income in one state may not be of much use in another. I agree with Thompson that estimates of income in small urban areas can probably be best made by allocating on the basis of local wage and salary data, since wage data ordinarily account for about two-thirds of the income in urban counties. On the other hand, wage and salary data cannot be used alone to make satisfactory estimates of income in rural areas. Farm income must also be computed. Except in years when the decennial census of agriculture is taken, one must resort to the type of adjustment that Thompson has suggested. The long-run solution to this problem is, of course, to get more frequent and more detailed statistics on farm income in small areas.

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Lorin A. Thompson's conclusion that the short-cut methods of estimating income for local areas that he has tested are useful only if precise estimates are not required was to be expected as far as general formulas are concerned. Income is involved and complicated; it is derived from many sources, each of which is influenced by many factors. A simple formula cannot possibly include all the factors involved; an adequate formula would be so complicated that it would not constitute a short-cut method.

Even though a formula may work well in most cases and may give satisfactory results for some purposes, many of the valuable by-products of income estimation are lost. Since a general formula does not provide breakdowns by source or type of income, it does not provide the tools needed for analysis. It is those counties for which a formula does not work well that are most interesting and informative to the income analyst. The use of short-cut methods would appear to be limited to segments that are relatively stable in distribution from year to year and for which allocators are not available on a current basis. Some limited time saving may be realized by estimating them as a group rather than individually.

For purposes of testing short-cut methods, Thompson uses the

estimates obtained by the longer, detailed allocation method as a standard. Unfortunately, there is no precise mathematical method by which one can test the validity of the assumption that these estimates are correct. It is at least theoretically possible that the results obtained by the short-cut method are closer to the truth. If all the facts were known, what appears to be a less exact method may actually give better results in some cases than a more detailed method would. Judgment on the relative merits of different methods must necessarily be based largely on logic supplemented by tests of reasonableness based on comparisons with other series.

The studies of Thompson and his associates have been of great value to the rest of us who are working on county income estimates. I, for one, feel that the question of short-cut methods has been resolved and that we should turn our attention to the problem of improving our estimates by the allocation method. This requires both improved state estimates and improved county allocators.

Just as Thompson has assumed for the purposes of his studies that the county estimates made by the allocation method are correct, we and most others have assumed that the state estimates as prepared by the National Income Division of the Department of Commerce are correct. We are fully aware of the difficult problem of allocating income payments by states and feel that, with its limited staff, the NID does an excellent job in this respect. Nevertheless, we could perform our job much more satisfactorily if the NID had better allocators available for use in making its state estimates. What may be a relatively small error as far as the distribution of the national total by states is concerned becomes of significant size for some individual counties in the county distribution.

In this respect, I should like to mention particularly agricultural income, which seems to be the most troublesome segment at all levels. In each of the years since we have been making county estimates, the NID estimate of farm proprietors' income in New York State has been revised significantly at least once and sometimes twice. The smallest correction was 9.9 per cent of the original figure, the largest, 23.3 per cent. Since agricultural income is a relatively small percentage of total income payments in New York, these revisions have made little difference in the total state income, but they have resulted in substantial changes in the estimated incomes of individual counties. The very fact that revisions of such a magnitude are made throws a cloud on the reliability of the estimates.

Among the nonagricultural sources, in several cases, we have found evidence that the NID state estimate for a particular category

was too low; in others, that it was too high. Here again, the apparent errors we have discovered are insignificant in relation to the total state income but can be important in individual counties.

The only adjustment for commutation made in the federal estimate for New York State is between New York and New Jersey. While this is the principal situs adjustment that should be made and is the one that has the most effect on the state estimate, estimates for individual counties are affected by the lack of an adjustment for commutation between New York and other states as well as Canada.

Records in the files of federal, state, and local governmental agencies contain a wealth of information that could be used to improve the allocation of income. The problem of getting it into usable form is essentially one of demonstrating the value of income estimates. In New York, we receive excellent cooperation from other state departments and outside organizations in supplying statistical information needed for purposes of allocation; and we are, I believe, fortunate in having more in the way of usable local area statistics than do most other states. There are, however, a number of deficiencies that could be remedied if funds were available. For example, the Department of Taxation and Finance makes a detailed analysis of personal income tax returns based on a sample. For most of their purposes, this sample is adequate. However, it yields usable results only for the state as a whole and for the large metropolitan counties. If we had available for individual counties the detail now available for the state on an annual basis, most of our difficult problems of allocation would be solved. It is questionable, however, whether the additional expenditure of funds that would be necessary to provide statistics for all counties can be justified on the basis of the present use of county estimates.

Thompson mentioned the possibility of using income as a factor in distributing federal and state aid. In New York, interest in county income estimates has been shown by departments and special commissions concerned with state aid. At present, in state-aid formulas, ability to pay is measured by equalized assessed valuation, but, with the increased use of nonproperty taxes by local governments, the adequacy of this measure is being questioned. Before county income estimates can be used for any such purpose, however, they must not only satisfy the statistician but must also be acceptable to administrators, legislators, and the general public. I do not believe that this requirement can be met by improved statistical techniques alone. Better allocation factors than those now available will be needed.