THE IMPACT OF POPULATION UNDERCOUNTS ON GENERAL REVENUE SHARING ALLOCATIONS IN NEW JERSEY AND VIRGINIA

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ABSTRACT

Population undercounts of nonwhites in the 1970 Census are known to have occurred. The paper provides a technique of using known aggregate undercount rates to estimate corrected population and income for units of general government and applies the new population and income data to the intrastate allocation formula of the State and Local Fiscal Assistance Act of 1972. Analysis of New Jersey and Virginia's resulting revenue sharing allocations reveals that the number of losers are more than the number of gainers. However, the losses are rather small and uniformly spread while the gains were concentrated in a few core cities.

I. *Introduction*

A unique aspect of the State and Local Fiscal Assistance Act of 1972 (PL 92-512), better known as general revenue sharing, is the direct, formula transfer of funds from the Federal Government to more than 38,000 general purpose governments.[1] Three variables determine the intrastate allocation of funds: population, tax effort, and inverse per capita income. Clearly, errors in measurement of these variables will affect a jurisdiction's allocation. The 1972 legislation anticipated that corrections as well as updates to this intrastate data might be required to ensure for equitable allocations:

> Where the Secretary determines that the data referred to in subparagraphs (A) are not current enough or are not comprehensive enough to provide for equitable allocations, he may use such additional data (including data based on estimates) as may be provided in regulations. (Section 109 (a)(B), Public Law 92-512).

Because of the size of the program and its closed formula, the potential impact of data corrections on allocations should be of some interest.

While measurement error no doubt exists for all three intra-state variables, independent estimates of errors are only available for population undercounts. Accordingly, we shall examine in this paper the allocation effects of correcting known errors in the population data. To this end, we first develop corrected population data based on current Census Bureau estimates of the population undercounts by race, sex, and age groups, and then utilize the corrected data (including income imputations for the undercounted) with the intrastate allocation formula.

The plan of the paper is as follows: Section II develops the methodology for correcting population and imputing income; Section III discusses the implications of changing values of population and income for localities as these two variables relate to the formula; Section IV summarizes the results of correcting the data and attending effects on revenue sharing allocations in New Jersey and Virginia. Section V concludes.

II. *Methodology for Correcting Population and Income Data*

In April, 1973, the Census Bureau made public its evaluation of the 1970 Census

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[1]This contrasts with Australian, Canadian, and West German practices of Federal sharing only to the states or provinces. For discussions of Australian and Canadian experience, see Maxwell (1971); for a discussion of West German experience, see Strauss (1972).

and indicated on the basis of its "preferred" technique that 5.3 million persons were not counted in the Census.[2] The highest rate of undercounts, as was the case in 1960, was for nonwhites. Manipulation of the Census results allows us to construct undercount rates by sex, race, and age for the U.S.

These rates are contained in Table 1 and suggest, for example, that for every 1,000 white males under 5 years of age reported in the 1970 Census, there were in fact 1,024. The largest error occurred for nonwhite males, age 35-39; for every 1,000 reported there were actually 1,217. Several age groups experienced overcounts; that is, on the basis of independent information, e.g., Medicare and Medicaid rolls, Census has concluded that certain groups were less numerous in 1970 than reported.

It should be noted that these are national undercount rates; case studies of particular urban areas in 1960 indicated more severe undercounting in central city areas. However, since Table 1 is the most geographically disaggregated data currently available, it is our point of departure.

Accordingly, we obtain corrected population for the m'th jurisdiction, P^*_m, as:

$$P^*_m = \sum_{i=1}^{2} \sum_{j=1}^{2} \sum_{k=1}^{16} R_{ijk} P_{ijkm} \quad (1)$$

where R is the undercount rate from Table 1
P is the final, official, 1970 population
i'th sex group $i = 1,2$
j'th race group $j = 1,2$
k'th age group $k = 1,16$

To account for the likely underestimation of total money income per locale which results from undercounts of persons, we presume those undercounted had incomes similar to those reported by age, race, and sex. Unfortunately, readily available local income data is only by sex and race. The absence of the age dimension in the income correction implies that the imputation will be on the *high* side since the undercount was heaviest for younger members of the population who are generally thought to have lower incomes.

[2]See Siegel (1973).

TABLE 1

NATIONAL MULTIPLIER MATRIX OF UNDERCOUNT RATES BY SEX, RACE, AND AGE FOR 1970

Age Group	Male		Female	
	White	Non-white	White	Non-white
Under 5	1.024	1.115	1.020	1.107
5-9	1.025	1.081	1.022	1.071
10-14	1.011	1.036	1.009	1.028
15-19	1.013	1.032	1.005	1.021
20-24	1.026	1.095	1.011	1.035
25-29	1.049	1.185	1.029	1.071
30-34	1.042	1.168	1.020	1.038
35-39	1.043	1.217	1.008	1.048
40-44	1.033	1.195	1.001	1.036
45-49	1.036	1.153	1.005	1.053
50-54	1.018	1.112	.997	1.040
55-59	1.021	1.119	1.013	1.080
60-64	1.024	1.079	1.028	1.059
65-69	.998	.937	.989	.895
70-74	.999	.993	1.004	1.062
75+	1.037	1.003	1.063	1.198

Source: Derived from Siegel (1973), Tables 1-8.

Corrected total community income, Y^*_m, is then obtained as:

$$Y^*_m = Y_m + \sum_{i=1}^{2} \sum_{j=1}^{2} [(P^*_{ijm} - P_{ijm})\, PCY_{ijm}] \quad (2)$$

where PCY is per capita income
Y is total money income

III. *Intrastate Formula Considerations*

The intrastate allocation formula has been subject to little discussion to date. This is due in part to its complexity and the relative absence of publicly available information on the actual computational algorithm. For the purpose at hand, we ignore the provision of funds to Indian Tribes and Alaskan Native Villages. The allocation to a county area is statutorily defined as:

$$\$_q = \frac{\frac{P_q T_q}{Y_q}\frac{PCY}{PCY_q}}{\sum_q \left\{\frac{P_q T_q}{Y_q}\frac{PCY}{PCY_q}\right\}} \$_L \quad (3)$$

where $\$_L$ is the total, intrastate, local allocation
T is county area adjusted taxes
q'th county area

subject to:

$$.2\frac{\$_L}{P} \leqslant \frac{\$_q}{P_q} \leqslant \$1.45\frac{\$_L}{P} \quad (4)$$

It has been periodically asserted that population is unimportant in (3). For example, Graham Watt, Director of the Office of Revenue Sharing, has suggested:

> . . . that population tends to be less significant as an element of data in the computation of the entitlement for a jurisdiction than adjusted taxes which weighs more heavily in the formula.[3]

Some simple rearranging suggests to the contrary. First, note that PCY cancels in (3). Second, since per capita income is a derived figure, defined as Y_q/P_q, we may rewrite (3) as:[4]

$$\$_q = \frac{\frac{P_q^2}{Y_q^2} T_q}{\sum_q \left\{\frac{P_q^2}{Y_q^2} T_q\right\}} \$_L \quad (5)$$

It is apparent that population is *more* important than taxes rather than less. Clearly: $\partial\$_q/\partial P_q > \partial\$_q/\partial T_q$.

Of course, if one merely updates T_q (the current Office of Revenue Sharing practice), then relative changes in allocations must follow relative changes in taxes. However, whether an increase in a county area's population or taxes by some arbitrary percentage will increase its allocation is unambiguous: the effect of the population increment will be greater than for taxes.

It should be noted that there is a significant difference between (3) and (5). If one merely corrects population (and not income), then (5) is exponentially larger in effect than (3). Since our goal is to examine the full impact of a population data correction, we shall use (5) as the basis for our computations.

With (5) as our point of departure, there are several ways to simulate with P* and Y*. One can use P*, and then P* and Y**. Also one could use just Y**; however, this ignores the population undercount per se. Accordingly, we shall examine the effects of P*, and P* and Y*.

IV. *Summary of Empirical Results for New Jersey and Virginia*

We perform three simulations:[5] first, we calculate revenue sharing allocations with the original Treasury data. Second, we correct the population data for the undercounts as discussed before and calculate a "population" set of revenue sharing allocations. Third, we correct both population and aggregate income and perform a "population and income" set of revenue sharing allocations.

In each instance, we use published state area entitlement amounts for the first six months of the revenue sharing law and use the originally published data.[6] The control allocation figures differ from the Treasury Department's because of initial errors in their computer algorithm for small places.

[3]Watt (1974), p. 18.

[4]It has been argued that (3) may be reduced to: $\frac{T_q/PCY_q^2}{\Sigma(T_q/PCY)_q^2}\$_L$ in which case population "disappears" from the formula. However, if we insert the components of PCY_q into this expression, we obtain (5). Population clearly can not "disappear" since it is related to per capita income by an identity.

[5]Computational implementation of the intrastate allocation formula follows Office of Revenue Sharing's post enactment interpretation of the floor. For a discussion of the implications of this, see Strauss (1973).

[6]See U.S. Treasury Department (1973); P_{ijkm} and YP_{ijm} were derived from the relevant tables of the 1970 Fourth Count Summary Tape for New Jersey and Virginia. See U.S. Department of Commerce, Bureau of the Census (1972).

Also, errors in the original data were subsequently corrected. However, since the data was readily available and not materially changed subsequently, it was used as a point of departure.

Table 2 summarizes the effects of the three simulations. Gainers and losers are defined as those who received more or less as a consequence of the update when compared to the control allocations. Of the 588 county, city and township governments in New Jersey, the vast bulk lose as a consequence of correcting for population or population and income. Of the 323 county or city governments in Virginia (recall that independent cities are treated as counties) the situation is more balanced. In both states the "number the same" is due to there being insufficient publicly available information to update the population or/and income data (i.e., places under 2,500 population).

The underlying population and income shifts for the two states are summarized in Tables 3 and 4. In both states, population increased rather modestly with only a few experiencing increases greater than 5%. The change in income was more varied, although small in absolute terms. Focusing on the resultant effects on per capita income (Y^*/P^*), we see that both increases and decreases in per capita income occurred, although in both cases the change was rarely more than three quarters of one per cent.

TABLE 2

NUMBER OF LOCALITIES IN NEW JERSEY AND VIRGINIA THAT GAIN, REMAIN THE SAME OR LOSE FROM DATA CORRECTIONS

		Data Correction		
Change	State	P*	P* and Y*	Both[1]
Gain	N.J.	141	150	128
	Va.	76	58	58
Same	N.J.	3	3	3
	Va.	142	157	139
Lose	N.J.	444	435	422
	Va.	105	108	105

[1]Number of units that gain, remain same, or lose from both corrections.

Finally, Tables 5 and 6 display the relative changes in allocations for New Jersey and Virginia. The bulk of the gainers and losers are concentrated in a $\pm 5\%$ band. Space does not permit the complete jurisdiction by jurisdiction display of allocation changes.[7] We provide the results for Essex County, New Jersey by way of illustration in Table 7. Thus, in Essex County, 3.7% greater population results from the correction of the undercount. Of interest is the intra-county variation in population increases. East Orange and Newark, both heavily nonwhite, experience population corrections in excess of 5% while the other cities and townships experienced increases in the 2-3% range. The increases in revenue sharing allocations that result from the population correction are found in the column labeled "New P" with the percentage change in allocation in the next column. Newark thus would receive a 5.13% increase in allocation and East Orange a 3.97% increase. Clearly, Newark's being at the 1.45% ceiling and East Orange's position below the ceiling explains why East Orange did not move up the full 5.18% that its population did. Finally, the effect of increasing both population and income is contained in the last two columns. Again Newark's allocation would rise 5.13%. Note that East Orange's allocation increases by slightly less now, 3.38%, as a consequence of its relative income position not falling faster than other jurisdictions *in the state*. One may safely conclude from this that the effect of correcting for the undercount, as a consequence of the iterative nature of the floor and ceiling, can only be properly analyzed by examining an entire state.

V. *Conclusions and Policy Perspectives*

The goal of the research has been to develop a viable methodology to correct for known errors in the 1970 Census and ascertain the effects of the corrections for revenue sharing allocations. The analysis of New Jersey and Virginia suggests that virtually all of the population changes re-

[7]Complete tabulations are available from the authors.

TABLE 3

EXTENT OF POPULATION CHANGE IN NEW JERSEY AND VIRGINIA BY TYPE OF GOVERNMENT

		Per Cent Change							
Type	State	0	.1 to 1.0	1.1 to 2.0	2.1 to 3.0	3.1 to 4.0	4.1 to 5.0	5.1 to 6.0	6.0+
Counties	N.J.	0	0	1	19	1	0	0	0
	Va.[1]	0	0	11	62	30	28	2	1
Cities	N.J.	2	0	160	139	21	8	4	1
	Va.	166	0	3	27	3	2	0	0
Townships	N.J.	0	0	71	146	12	3	0	0
	Va.	—	—	—	—	—	—	—	—

[1]Includes independent cities.

TABLE 4

EXTENT OF PER CAPITA INCOME CHANGE IN NEW JERSEY AND VIRGINIA BY TYPE OF GOVERNMENT

		Per Cent Change							
Type	State	−.99 to −.75	−.74 to −.50	−.49 to −.25	−.24 to 0.0	.1 to .25	.26 to .50	.51 to .75	.75+
Counties	N.J.	0	0	0	3	10	8	0	0
	Va.	0	12	24	37	41	20	0	0
Cities	N.J.	0	0	3	29	82	214	6	1
	Va.	1	10	30	111	30	19	0	0
Townships	N.J.	1	0	5	14	41	166	4	1
	Va.	—	—	—	—	—	—	—	—

TABLE 5

EXTENT OF REVENUE SHARING ALLOCATION CHANGE IN NEW JERSEY BY TYPE OF DATA CORRECTION AND GOVERNMENT

		Per Cent Change					
Type of Government	Type of Data Correction	−7.9 to −5.0	−4.9 to −1.0	−.9 to 0.0	.1 to 1.0	1.1 to 5.0	5.1 to 8.0
Counties	P*	0	16	1	0	4	0
	P* and Y*	0	16	1	0	4	0
Cities	P*	1	231	21	8	73	1
	P* and Y*	1	233	5	0	95	1
Townships	P*	0	154	23	4	51	0
	P* and Y*	0	176	12	2	48	0

TABLE 6

EXTENT OF REVENUE SHARING ALLOCATION CHANGE IN VIRGINIA BY TYPE OF DATA CORRECTION AND GOVERNMENT

Type of Government	Type of Data Correction	Per Cent Change						
		−9.9 to −8.0	−7.9 to −5.0	−4.9 to −1.0	−.9 to 0.0	.1 to 1.0	1.1 to 5.0	5.1 to 8.0
Counties and Independent Cities	P*	0	3	66	14	11	39	1
	P* and Y*	0	0	96	2	0	35	1
Other Cities	P*	1	16	37	110	3	21	1
	P* and Y*	0	0	58	109	0	21	1

sulting for the update by age, race, and sex were in the 1-5% range. The places that experienced the largest population increases were, not surprisingly, the most nonwhite. Changes in income that resulted from imputing income levels to those missed in the 1970 Census were more modest in percentage terms than the changes in population. Of interest is that actual declines in per capita incomes occurred in both New Jersey and Virginia; again, this result is not surprising in view of both the concentration of nonwhites and their attending lower than average per capita incomes.

The allocation of revenue sharing funds that occurred with the population and income updates was different than the initial allocation. Again, the differences that occurred were almost entirely within a 5% band of gains and losses. As expected, those which gained more typically were most heavily nonwhite.

While it is difficult to judge the superiority of updating just population or population and income, it is apparent that greater equity would be achieved using either method than currently exists as a result of using the original 1970 Census population and income data. As the revenue sharing formula rewards localities on the basis of population, it would add to the overall equity of the program to properly measure the populations in the localities. As a matter of public policy it makes good sense to account for the size of that clientele; failure to correct for the undercount is then to underestimate the task each city faces in providing the necessary public services.

To be sure, the methodology developed is quite simple and not the only one available to update local population and income data.[8] It does represent a straightforward technique that is readily understood and can be implemented nationally with a minimum of difficulty. As additional information on undercount rates by state and urban/rural residence become available, they should no doubt be used in place of the more simple age, race, sex undercount rates employed in this research. However, to the extent that these more refined estimates will be available in the more distant future, it would seem sensible at this juncture to update the 1970 Census as suggested above and use more detailed information as it becomes available.

As a practical matter, one can visualize a variety of options to correct the revenue sharing allocations as a result of the new data. To some extent there already is experience with using new data in the revenue sharing program since the between state allocation uses post-1970 Census population statistics as well as annually renewed data on state and local taxes. To date the policy employed has been to make only prospective changes in the sizes of revenue sharing checks; this is a policy that has been followed in other grant-in-aid programs in the past and on balance would seem advisable in terms of the within-state allocations. With close to half of the $30 billion now allocated, requiring retroactive corrections to the within-state allocations might be physically impossible if not administratively

[8]For a more naive methodology, see Savage and Windham (1973).

TABLE 7

EFFECT OF UNDERCOUNT ON ESSEX COUNTY, N.J. REVENUE SHARING ALLOCATIONS

	P	NEW P	% CHG	PCY	NEW PCY	% CHG	$	$ NEW P	% CHG	$ NEW P	% CHG
Essex County	932526.	967040.	3.70	3739.	3730.	—0.24	3631002.	3739436.	2.99	3734825.	2.86
Belleville Town	37629.	38429.	2.13	3617.	3625.	0.22	130240.	127655.	—1.98	133493.	2.50
Bloomfield Town	52029.	53096.	2.05	3957.	3967.	0.25	154887.	151590.	—2.13	158657.	2.43
Caldwell Borough	8677.	8854.	2.04	4751.	4763.	0.25	18264.	17872.	—2.15	18709.	2.44
East Orange City	75471.	79382.	5.18	3877.	3869.	—0.21	360923.	375249.	3.97	373116.	3.38
Essex Fells Borough	2541.	2589.	1.89	8817.	8841.	0.27	3898.	3972.	1.90	3972.	1.90
Glen Ridge Borough	8518.	8680.	1.90	5666.	5683.	0.30	16068.	15680.	—2.41	16443.	2.33
Irvington Town	59743.	61021.	2.14	3618.	3623.	0.14	230579.	226062.	—1.96	236732.	2.67
Montclair Town	44043.	45543.	3.41	5450.	5436.	—0.26	88639.	89071.	0.49	91727.	3.48
Newark City	381930.	401539.	5.13	2492.	2493.	0.04	4248199.	4466310.	5.13	4466310.	5.13
North Caldwell Borough	6733.	6905.	2.55	6157.	6156.	—0.02	10330.	10594.	2.56	10594.	2.56
Nutley Town	31913.	32555.	2.01	4004.	4018.	0.35	84360.	82501.	—2.20	86247.	2.24
Orange City	32566.	33870.	4.00	3393.	3389.	—0.12	174727.	177617.	1.65	180310.	3.20
Roseland Borough	4453.	4539.	1.93	4267.	4283.	0.37	7620.	7441.	—2.35	7787.	2.19
South Orange Village	16971.	17308.	1.99	6938.	6955.	0.25	28697.	28051.	—2.25	29400.	2.45
Verona Borough	15067.	15372.	2.02	5148.	5164.	0.31	23116.	23584.	2.02	23584.	2.02
West Caldwell Borough	11913.	12147.	1.96	4825.	4843.	0.37	25342.	24761.	—2.29	25897.	2.19
West Orange Town	43715.	44586.	1.99	4867.	4881.	0.29	123450.	120684.	—2.24	126367.	2.36
Fairfield Borough	6884.	7023.	2.02	3599.	3616.	0.47	23576.	23060.	—2.19	24044.	1.99
Cedar Grove Township	15582.	15943.	2.32	3623.	3625.	0.06	136694.	141523.	3.53	141206.	3.30
Livingston Township	30127.	30699.	1.90	5263.	5287.	0.46	117052.	120199.	2.69	119953.	2.48
Maplewood Township	24932.	25437.	2.03	5348.	5363.	0.28	213425.	219708.	2.94	219480.	2.84
Millburn Township	21089.	21474.	1.83	9216.	9248.	0.35	69367.	71130.	2.54	71241.	2.70

difficult in terms of calculating how much each locality in fact gained and lost over past Entitlement Periods.

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