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COVERAGE OF POPULATION IN THE 1970 CENSUS AND SOME IMPLICATIONS FOR PUBLIC PROGRAMS

- National Population Coverage
- Subnational Population Coverage
- Implications for Distribution of Public Funds
- Implications for Political Representation

U. S. DEPARTMENT OF COMMERCE
BUREAU OF THE CENSUS

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COVERAGE OF POPULATION IN THE 1970 CENSUS AND SOME IMPLICATIONS FOR PUBLIC PROGRAMS

by Jacob S. Siegel

PREFACE

The Bureau of the Census has long been concerned about the quality of the data which it produces. More recently it has begun to give attention to the various implications of the errors in the data. This report was prepared largely in pursuance of a request of a group of leaders of the Black Community, which met under Bureau sponsorship, on May 24 and June 19, 1974, to the Bureau to prepare a document reviewing the methodology and the extent of undercoverage of the population in the 1970 census and examining the implications of geographic variations in undercoverage for various public programs, particularly political representation and disbursement of public funds. The present report deals only with selected aspects of this broad topic, giving principal attention to the impact of underenumeration on legislative redistricting and on the apportionment of funds, especially under General Revenue Sharing. Many other political and fiscal consequences of underenumeration, such as the effects on per capita disbursements of funds, are not considered.

This document was first issued informally as a provisional report early this year on the occasion of the first meeting of the newly established Census Advisory Committee on the Black Population for the 1980 Census (Feb. 28). The copies of the provisional report distributed to the members of the Committee were accompanied by the letter of transmittal from the Director of the Census to the Committee members which is reproduced following the preface. The revised report is now being formally issued as a Bureau of the Census report in the P-23 Series so that it may be made more widely available.

This report was designed and written by Jacob S. Siegel, Senior Statistician for Demographic Research and Analysis, Population Division. Principal professional assistance in the preparation of the report was rendered by Mark D. Herrenbruck and Donald S. Akers, demographic statisticians on the Population Analysis Staff, Population Division. They shared the responsibility for designing and supervising the calculations as well as of assisting the author in developing the assumptions and procedures. Rita A. Daly and Gary D. Smith assisted them in carrying out the various calculations. Mark Herrenbruck was responsible for coordination and checking of the text and tables of the report. Jerome Glynn advised on computer applications, particularly with respect to the production of the various population series. Roger A. Herriot provided advice on the procedures used in calculating the General Revenue sharing allocations and, with the assistance of Victor T. Anglin, directed the production by computer of the various series relating to the revenue sharing allocations. He also provided the adjusted estimates of total money income for States which were employed in calculating some of the series of revenue-sharing allocations. The assistance of Mary C. Bland, who typed several drafts of the report, is gratefully acknowledged.

Charles D. Jones and Richard F. Blass of the Statistical Methods Division kindly provided various unpublished tabulations from the 1970 Census—CPS Match Study and made helpful comments on the parts of the draft where this material was used.

The Bureau wishes to thank Professor I. Richard Savage of the Department of Statistics, Yale University, and Mr. William Grindley of Stanford Research Institute for their helpful comments on the provisional version of the report.

The Bureau of the Census also wishes to thank the members of the Census Advisory Committee on the Black Population for the 1980 Census for urging the Bureau to give special attention to the subject treated here and to prepare an appropriate report, and for critically considering the resulting study. The Bureau of the Census profited greatly from the discussion of the report at the first meeting of the Committee, when the provisional version was a principal agenda item. This role of the Committee does not in any sense imply endorsement of the present report. Responsibility for the methods employed, interpretations made, and conclusions drawn belongs wholly to the Bureau of the Census.

LETTER FROM THE DIRECTOR OF THE CENSUS TO THE CENSUS ADVISORY COMMITTEE ON THE BLACK POPULATION FOR THE 1980 CENSUS

UNITED STATES DEPARTMENT OF COMMERCE
Bureau of the Census
Washington, D.C. 20233

OFFICE OF THE DIRECTOR

February 28, 1975

Dear Committee Member:

At the May 24th meeting with the Leaders of the Black Community, the participants requested that the Bureau of the Census prepare a special report on the undercoverage in the 1970 census and its implications for the black community. The consensus was that the report describe the methodology used in developing its national estimates of the undercount, explore various methodologies which could be used to produce adequate estimates of the underenumeration of the population, by race, at the State and local levels, and analyze the impact of the undercount on congressional apportionment, congressional, State, and local districting, and the General Revenue Sharing Program. The attached report contains our findings.

The results of the Bureau's analyses indicate that, in general, the impact on political representation, apportionment of funds, and general revenue sharing allocation of potential adjustments for underenumeration would be considerably less than might be suggested by intuition from the underenumeration rates themselves. Nevertheless, it is possible to find specific examples where it appears that substantial inequity may occur. The principal problem is how to deal with these specific instances since there seems to be no currently available method that is uniformly acceptable for correcting for the effects of underenumeration at the State and local levels.

The National Academy of Sciences recommended in its report, America's Uncounted People, that increased support should be given to analytic studies with the objective of devising methods for adjusting small-area census counts. The Bureau is giving serious attention to these problems and is planning further research efforts with the hope of developing theoretical models, capable of being tested, that may lead to improved and adequate procedures for correcting census counts of State and local areas. Even if such methods can be developed, two problems must be faced. One is that there is serious question as to whether such methods would be operationally feasible. Secondly, there can be no guarantee that the adjustments made will treat everyone equitably. In fact, some allocations may be more inequitable following the adjustment than they were before.

Apportionment and revenue sharing are not the only programs that depend upon accurate census information at the State and local level; decisions regarding other public programs at all levels are also made on the basis of such data. Therefore, a more promising approach would be to take a

better census initially than try to correct for the undercoverage below the national level. Attention at the Bureau is being directed toward a systematic consideration of innovative procedures for improving census coverage and toward a program of assessing such procedures. With the help of the various advisory committees, we hope to make a substantial improvement in coverage of minorities in the 1980 census.

Sincerely,

VINCENT P. BARABBA
Director
Bureau of the Census

CONTENTS

	Page
Introduction and summary	1
National population coverage	2
Scope of available coverage estimates	2
Summary of national error rates	2
Summary of methodology used in deriving the estimates	3
Sources of error and alternative estimates	3
Subnational population coverage	5
General problems relating to data and methodology	5
States	5
Prior studies relating to regional variations in coverage	5
Synthetic method	6
Symptomatic data on coverage	8
Variants of the synthetic method	10
Demographic analysis	11
Areas within States	12
Problems in application of synthetic method	12
Alternative methods	13
Implications for political representation and distributions of public funds	13
Political representation	13
Congressional apportionment	13
Congressional, State, and local districting	14
Implications for one-man one-vote rule	15
Distributions of public funds	16
Some issues involved in adjusting official data	16
Effect of adjustment for population only	17
Effect of adjustment for population and other factors (income)	19

Text Tables

Table		
A.	Number of States with specified rates of net underenumeration according to the population corrected by the basic synthetic method, by regions: 1970	7
B.	Number of States with specified rates of net underenumeration according to the population corrected by the basic synthetic method and by various modified synthetic methods: 1970	10
C.	Number of States with specified rates of net underenumeration according to the population corrected by a modified synthetic method, by regions: 1970	11
D.	Minimal model values for the number of contiguous legislative districts and the total contiguous population required to establish an additional district, according to the underenumeration rate by race, the population distribution by race, and the average population per district	15
E.	Number of States with specified shifts in apportioned funds according to the 1970 census population corrected by the basic synthetic method	17
F.	Number of States with specified shifts in apportioned funds according to the 1970 census population corrected by various modified synthetic methods	19
G.	Number of States gaining or losing General Revenue Sharing funds as a result of the adjustment of the population factor (basic synthetic method), the income factor, or both factors, by regions	20
H.	Number of States with specified percentage shifts in population and in funds apportioned under General Revenue Sharing, according to factor adjusted: population adjustment by the basic synthetic method	21
I.	Number of States gaining or losing General Revenue Sharing funds as a result of the adjustment of the population factor (modified synthetic method based on median family income), the income factor, or both factors, by regions	22
J	Number of States with specified percentage shifts in population and in funds apportioned under General Revenue Sharing, according to factor adjusted: population adjustment by modified synthetic method (median family income)	23

CONTENTS—Continued

Detailed Tables

Table | Page

1. Rates of net underenumeration according to the population corrected by the basic synthetic method and by various modified synthetic methods, for States, divisions, and regions: 1970 25
2. Distribution of one billion dollars by States, divisions, and regions according to the 1970 census population count and the 1970 census population corrected by the basic synthetic method and by various modified synthetic methods 26
3. Amounts of General Revenue Sharing money based on 1970 census reported data and 1970 census data corrected by the basic synthetic method for States, divisions, and regions 27
4. Amounts of General Revenue Sharing money based on 1970 census reported data and 1970 census data corrected by a modified synthetic method for States, divisions, and regions 28

COVERAGE OF POPULATION IN THE 1970 CENSUS AND SOME IMPLICATIONS FOR PUBLIC PROGRAMS

INTRODUCTION AND SUMMARY

The Bureau of the Census first publicly presented its findings regarding the completeness of coverage of the United States population in the 1970 census at a press conference in April 1973 and at the annual meeting of the Population Association of America held in the same month. Subsequently, the results were published in **Demography**[1] and in the Bureau of the Census report, Evaluation and Research Program PHC(E)-4.[2] Publication of these documents and the present one reflect the Bureau's continuing effort to inform users of data from the decennial population censuses regarding the quality of the data and the implications of errors in them.

The reports cited present estimates of net underenumeration only for the population of the United States as a whole. Even before presentation of these results, many groups inquired about the possibility of analyzing census coverage in 1970 for areas within the United States, such as States, counties, and major cities. The considerable interest in such figures arises not only because of the desire to employ improved data in the planning and evaluation of various public and private programs, but also because of the fact that considerable sums of money are distributed to governmental units on the basis of population or population and other factors and population is the key factor in determining political representation in legislative bodies.

This report presents first a summary of the Census Bureau's work on the coverage of the national population in 1970. Next, it discusses the problems and possible procedures involved in the preparation of estimates of population coverage for States and major political units within States for 1970. The implications of census underenumeration of the population of such areas with respect to political representation and financial allocations are then considered. Since adequate estimates of census coverage of the population of States and smaller political units are not available, population adjustments for States (but not for counties and cities) were developed for the present purpose using partly arbitrary criteria. The calculations are, therefore, not definitive; they are only illustrative of the possible levels of underenumeration and of the general character of the changes that would result from adjusting the population data used in carrying out various public programs.

Underenumeration in the United States in 1970 has been estimated at the relatively low level of about 2.5 percent. Although corresponding estimates for areas within the United States are not available, variations from area to area are suggested by differences in national figures for the principal races and by limited data from various special studies. In the absence of a tested formula for deriving reliable estimates of undercoverage for State and local areas, several alternative series of corrected figures have been prepared for States designed to illustrate some possible coverage levels and as a basis for evaluating illustratively the effect of coverage errors on political representation and the disbursement of funds. In the basic synthetic method, national coverage rates by race, or age, sex, and race, are applied to the population of each State, and in the several modified synthetic methods the national rates by race are varied according to low-income status, median family income, or educational level for States. An experimental project using more complex methods of demographic analysis to measure coverage of State population is now under way at the Census Bureau.

Some of the principal findings of this study may be noted here, but it is to be emphasized that the particular numerical results depend on the adequacy of the adjustments for underenumeration and that the adjustments employed in this report are subject to substantial error. The rates of underenumeration for States according to the various assumptions reflect largely the racial distribution of the population in each State. According to the various synthetic methods, 15 to 21 States show undercount rates under 2 percent, 40 to 43 States show undercount rates under 3 percent, and 44 to 50 States show undercount rates under 4 percent. Adjustment for undercount rates derived by these methods would either not affect Congressional apportionment or would cause a shift of only one Congressman between a pair of States. The size and variation of the percentage shifts in funds allocated to States under a simple apportionment formula based on population only, resulting from a correction of census counts for States, would be far less than the population undercount rates. Nearly all (46 to 50) States would receive less than 2 percent more or less in funds than they would receive on the basis of the census counts, and 40 to 46 States would receive less than 1 percent more or less.

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[1] Jacob S. Siegel, "Estimates of Coverage of the Population by Sex, Race, and Age in the 1970 Census, "**Demography**, Vol. 11, No. 1, February 1974.

[2] U.S. Bureau of the Census, 1970 Census of Population and Housing: Evaluation and Research Program PHC(E)-4, **Estimates of Coverage of Population by Sex, Race, and Age: Demographic Analysis**, U.S. Government Printing Office, Washington, D.C., 1974.

Under the General Revenue Sharing formula the adjustment for population only, at the State level, results in little change in funds apportioned. Only the District of Columbia would show a shift in funds exceeding 2.0 percent with the basic synthetic method of population adjustment, and 5 States would show such a shift with the synthetic method modified according to median family income. The funds apportioned would be altered to a much greater extent, however, if both population and income were fully adjusted for understatement; then, under the two population adjustment procedures 17 States and 15 States, respectively, would show shifts in funds exceeding 2.0 percent. The effect of adjusting the per capita income factor in the formula is much greater than the effect of adjusting the population factor, and the amount and direction of the change on the basis of population give little or no indication of the amount or even the direction of change on the basis of income. Nevertheless, when both the population and per capita income factors are corrected, the shifts in the revenue-sharing funds are generally less than the underenumeration rates for population estimated by synthetic methods.

Any estimates of coverage for areas within States would be speculative since the variation around State levels of coverage could be considerable. A set of model calculations using various assumed correction factors for population suggests that the possibility of an increase in the number of Congressmen, State legislators, or city councilmen for a designated part of a State or city at the expense of a legislator from the other part of the same State or city is extremely small; a relatively high undercount rate would be required over a large number of contiguous legislative districts. Illustrative calculations for areas within States of the effect on revenue-sharing allocations of correcting the population factor only in the formula would give misleading indications of greater equity in the distribution of revenue-sharing funds, inasmuch as adjustments for the omission of the income of missed persons in the per capita income factor and in the "tax effort" factor would tend wholly to offset the population adjustments in the population factor and the per capita income factor, and a further adjustment for the understatement of the income of enumerated persons would produce a substantially different distribution of funds.

NATIONAL POPULATION COVERAGE

Scope of Available Coverage Estimates

Official estimates of the completeness of the coverage of the population in the 1970 census have been prepared by the U.S. Bureau of the Census only for the United States as a whole. Separate estimates of net census errors are available for each age group for males and females, and for whites and blacks. Comparable estimates could not be prepared for the population of Spanish heritage in spite of the frequently expressed interest in such figures. The estimates relate to the resident population of the United States, excluding U.S. Armed Forces and citizens overseas. Several sets of estimates of net underenumeration of the total population and of net census error rates for age, sex, and race classes in 1970 were prepared and the set which utilized the available data most fully and appeared to be most logical demographically was selected as the "preferred" set. A detailed account of the results, and of the methodology and the assumptions used in preparing the estimates, is given in our report, Evaluation and Research Program PHC(E)-4.[3]

Summary of National Error Rates

The preferred estimates of net underenumeration of the U.S. total population in 1970 is 5.3 million persons. This amount corresponds to a rate of 2.5 percent. The comparable figures in 1960 are 5.1 million and 2.7 percent.

The estimates for the sexes and races indicate that about two-thirds of the persons missed in the 1970 census were males and about two-thirds were white. The net omission rate for males (3.3 percent) was nearly twice that for females (1.8 percent) and the net omission rate for blacks (7.7 percent) was about four times as great as for the white population (1.9 percent). Both race groups showed a greater deficit of males than females. Accordingly, undercoverage was greatest for black males (9.9 percent), least for white females (1.4 percent), and intermediate for white males (2.4 percent) and black females (5.5 percent). In sum, the estimated national rates of underenumeration (in percents) are as follows:

Sex	Omission rate (percent)		
	All classes	White	Black
Both sexes...	2.5	1.9	7.7
Male.....	3.3	2.4	9.9
Female.....	1.8	1.4	5.5

According to the preferred set of estimates, net undercount rates for black males were over 10 percent in all 5-year age groups under 65 except in the range 5 to 19 and at ages 60 to 64, exceeding 12 percent in each group from 20 to 49 years of age and reaching 17 to 19 percent at age 25 to 44.

[3] U.S. Bureau of the Census, PHC(E)-4, **op. cit.**

Summary of Methodology Used in Deriving the Estimates

The principal method used to estimate the coverage of the national population is termed "demographic analysis." The method involves the compilation, combination, and manipulation of various types of demographic data that are largely independent of the 1970 census and aggregated data from administrative records, to derive an expected "true" population for comparison with the census results. The principal types of demographic data and administrative record data that were used in the present instance are data from previous censuses, birth statistics, death statistics, life tables, immigration data, and Medicare enrollments. The accuracy of estimates derived by demographic analysis is, of course, affected by the quality of the basic data and the adequacy of the assumptions employed in preparing the estimates.

In brief, the method of deriving the preferred set of estimates of coverage error is as follows. The estimates of the corrected population under 35 years of age were based directly on birth statistics for the years 1935 onward (adjusted for underregistration), which were carried forward to 1970 by statistics of deaths and statistics of net immigration (adjusted to include certain omitted categories). The estimates for white females aged 35 to 64 years of age represent extensions to 1970 of estimates for native white females aged 15 to 44 years of age in 1950 prepared by Coale and Zelnik.[4] In general, the Coale-Zelnik method involved estimating the "true" number of births for each year from the census counts for the population in single ages in several successive censuses corresponding to each birth cohort, and then aging these births forward to census dates to derive the corrected population.

The estimates for black females aged 35 to 64 represent extensions to 1970 of estimates for these cohorts in 1960 prepared by Coale and Rives.[5] The Coale-Rives estimates started with the assumption that the "true" population in 1880 could be determined on the basis of "model" tables of population distributions. This corrected age distribution was carried forward to 1970 on the basis of mortality rates taken from a combination of model life tables and official life tables. Estimates of births were derived on the assumption that the proportion of the population under 20 years of age for females in the preliminary projections and the proportion in the census were the same, combined with use of assumed sex ratios of births. The corrected black as well as white male populations 35 to 64 years of age were derived by applying expected "true" sex ratios (males per 100 females) to the corresponding corrected female populations.

Corrected estimates of persons 65 and over in 1970 were derived from Social Security Administration figures on persons enrolled for hospital and/or medical insurance under the Medicare system. The Medicare data were adjusted for persons not enrolled in Medicare and further adjusted to be consistent with expected "true" sex ratios for the elderly population.

Sources of Error and Alternative Estimates

The alternative sets of estimates of net underenumeration reflect our uncertainty in the results. Still other sets of estimates could reasonably have been developed, considering the possible errors in the data and in the assumptions. The figures presented were recognized as estimates subject to revision and, in fact, research on their accuracy was initiated as part of the estimation process and has been continuing.

The component of the estimation process to which the greatest uncertainty is attached is net immigration. Recent research suggests that the estimates of net immigration for 1960 to 1970 employed in calculating the published estimates of coverage could be in error by as much as 1 million—either through understatement of immigration, both of aliens and citizens, or through understatement of emigration, both of aliens and citizens, particularly of foreign-born residents. Other important sources of possible error include the completeness of the Medicare enrollment data, a primary basis of estimating net census errors for the population 65 and over; the accuracy of the expected sex ratios, the measure employed in calculating the coverage estimates either for males or females from coverage estimates for the other sex derived directly; the allowances for the underregistration of births, the essential basis of estimating the expected population under 35 years of age; and the use of official death statistics and life tables without adjustment for possible underregistration and age misreporting of deaths. In addition, a number of assumptions subject to error are involved in the complex demographic procedures used to calculate the expected female population 35 to 64 years of age.

Various alternative estimates of the total net underenumeration in the 1970 census were prepared corresponding to various estimates of net underenumeration in the 1960 census and to various estimates of the amount of change in population between 1960 and 1970. Alternative estimates of coverage for 1960 were based either on demographic analysis, reinterview surveys, or a composite of these procedures. Because we

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[4] Ansley J. Coale and Melvin Zelnik, **New Estimates of Fertility and Population in the United States**, Princeton, N.J., Princeton University Press, 1963, Chapter 2.

[5] Ansley J. Coale and Norfleet W. Rives, Jr., "A Statistical Reconstruction of the Black Population of the United States, 1880-1970: Estimates of True Numbers by Age and Sex, Birth Rates, and Total Fertility, " **Population Index**, January 1973, Office of Population Research, Princeton University, and Population Association of America, Inc., pp. 3-36.

consider our estimates of births and deaths between 1960 and 1970 as being of a high order of accuracy, but not our estimates of net immigration, the estimates of intercensal change vary solely on the basis of variation in the estimates of net immigration in this period. The various estimates of the amount of net underenumeration in 1970 range from 3.1 million to 5.8 million (or from 1.5 to 2.8 percent). The lower estimates—3.1 million to 4.9 million—are based on the results of reinterview surveys, or a composite of the results of demographic analysis and reinterview surveys, in 1960. The more reasonable possibilities, indicated by demographic analysis, range from 4.8 million to 5.8 million (or from 2.3 to 2.8 percent). These figures vary by one-half million above and below the preferred estimate of 5.3 million (2.5 percent)—that is, by 10 percent of the preferred estimate. Fay's detailed review of the estimates of coverage for 1970 published by the Census Bureau employing the same basic data as the official preferred estimate concludes that underenumeration should be 800,000 greater than the official estimate but that the confidence interval of this higher estimate encompassed the official figure.[6]

A rough measure of national population coverage may also be obtained from the 1970 Census—Current Population Survey (CPS) Match Study, a case-by-case match of a sample of households reported in the Current Population Survey and households reported in the census.[7] The original coverage rate reported by the Match Study, 3.1 percent, needs to be adjusted downward to reflect the inclusion in the census count as published of certain classes of persons who could not be directly enumerated for various reasons ("imputations")[8] and for whom census questionnaires were not available for the Match Study. An adjusted estimate of the underenumeration rate that can be compared with the estimate based on demographic analysis is 2.3 percent. (A further downward adjustment should be made in this figure to allow for the small amount of overenumeration in the census.) Omission rates are also available by sex and race from the Match Study, but the information necessary for adjusting them (downward) is not available:

Sex	Omission rate (percent)		
	All classes	White and other races	Black
Both sexes...	3.1	2.6	7.5
Male.....	3.1	2.6	7.3
Female.....	3.1	2.5	7.6

The Match Study estimates agree with the "demographic" estimates in showing much higher underenumeration rates for blacks (7.5 percent) than for whites (2.6 percent), especially for females. They differ in not showing higher underenumeration rates for males than for females; yet such a relationship is firmly demonstrated by demographic analysis. The differences between the results of the two studies are probably to be explained by the combined effect of the greater understatement of the underenumeration of males than females in the Match Study (correlation bias) and the omission of "imputations" from the census records when the Match Study was carried out. Evaluations based on surveys have typically understated the extent of underenumeration in censuses, especially of groups typically underenumerated in censuses.

The 1970 Census—CPS Match Study provides additional information regarding national census coverage in 1970 in the form of estimates of the coverage of housing units. Estimates of the coverage of occupied units cannot be taken to indicate the level of population coverage directly, because it is necessary also to allow for the difference in average household size between enumerated and missed units and the understatement of average household size of enumerated units. Quite clearly, on the basis of our preferred estimates of population coverage, coverage of population is much less complete than coverage of housing units. About 1.4 percent of the occupied housing units were omitted from the census according to the 1970 Census—CPS Match Study,[9] but 2.5 percent of the population was omitted from the census according to the estimates of coverage based on demographic analysis.[10] Thus, if we assume no difference in the average size of missed and

[6] Robert E. Fay III, **Statistical Considerations in Estimating the Current Population of the United States,** unpublished PhD dissertation, University of Chicago, August 1974.

[7] U.S. Bureau of the Census, 1970 Census of Population and Housing: Evaluation and Research Program, **Estimates of Coverage of Population: Census-CPS Match,** unpublished study. The results of this study are affected by the fact that a portion (under 3 percent) of the cases in the CPS could not be definitely assigned as enumerated or missed, by the correlation bias between the two "surveys," by the fact that the census records were employed prior to adjustment for certain classes of persons who could not be directly interviewed, and by the fact that persons living in special dwelling places and college students were excluded from the comparison.

[8] U.S. Bureau of the Census, 1970 Census of Population and Housing: Evaluation and Research Program PHC(E)-6, **Effect of Special Procedures to Improve Coverage in the 1970 Census,** U.S. Government Printing Office, Washington, D.C., 1974, pp. 2-3.

[9] U.S. Bureau of the Census, 1970 Census of Population and Housing: Evaluation and Research Program PHC(E)-5, **The Coverage of Housing in the 1970 Census,** U.S. Government Printing Office, Washington, D.C., 1973, table D, p. 5.

[10] U.S. Bureau of the Census, PHC(E)-4, **op. cit.,** table 3, p. 29.

enumerated households, about 1.4 percent of the population was missed as a result of failure to enumerate all occupied housing units, and 1.1 percent of the population was missed as a result of omission of persons in enumerated units.

SUBNATIONAL POPULATION COVERAGE

General Problems Relating to Data and Methodology

For most uses of census data, incomplete coverage of the national population is not serious, particularly if the rate of underenumeration is small and if all constituent geographic areas are affected more or less uniformly. The national average rate of underenumeration is small (2.5 percent) but geographic uniformity almost certainly does not exist, as is suggested in part by the difference in the national coverage rates of the two principal races. There may, in fact, be large variations in coverage rates from area to area and, if so, they are of serious concern for many uses of census data. Some black leaders and city mayors maintain that incomplete coverage in the census has resulted in inequitable allocations of funds to governmental units or in an improper distribution of representatives in legislative bodies. The Census Bureau has recognized the pressing importance of this matter and has launched a major program to try to measure the coverage of the population of the principal subnational areas. Research on the coverage of the population of States in the 1970 census is now under way.

There has been a presumption on the part of many persons that it should be readily possible to develop a methodology that would produce reliable estimates of coverage for States and areas within States. This is not true. Estimates of the coverage of the population of geographic subdivisions of the United States, similar in reliability and scope to those prepared and published for the United States as a whole, cannot be prepared. It may not even be possible to develop a methodology which would produce adequate estimates for States. The measurement problem for areas within States is even more difficult and could involve very different methods. Any estimates for counties and cities would, on the average, be subject to much greater error than those for States.

Furthermore, given the uncertainties of the data, assumptions, and methods, and hence of the resulting estimates of coverage, proper statistical procedure calls for developing estimates of the range of error in any estimates of coverage. Without such estimates of the "confidence interval," we may be accepting estimates of coverage that have untenably large bands of error or that are for some of the geographic units included, farther from the true population than the uncorrected numbers. The measurement of error bands presents an even more difficult problem than estimating the coverage rates themselves.

States

Prior studies relating to regional variations in coverage. Several prior studies provide limited information regarding regional variations in census coverage in the United States. These studies all involve the "dual systems" approach, that is, a case-by-case match of census data with data from another survey (e.g., post-enumeration survey, Current Population Survey) or a set of records (e.g., birth registration records, Medicare enrollment). None of these studies employ the method of demographic analysis.

The results of these studies cannot be taken as directly indicative of the variations in the coverage of the total population of geographic regions in 1970, since they relate to an earlier census, a demographic variable other than population, only part of the population in 1970, or are subject to serious measurement errors. Where the evaluation is based on a match of the census with a survey, it is probable that the extent of undercoverage in the census is understated because of omission of the same individuals in the survey, and since the understatement may vary from one area to another, the estimated regional pattern of undercoverage may reflect the actual pattern only roughly.

The 1950 Census–Post-Enumeration Survey (PES) Match Study showed the highest rate of omission in the South (1.8 percent) and the lowest rate in the Northeast region (0.8 percent), as compared with a national average of 1.4 percent.[11] While the estimates of coverage error derived from the PES tabulations appear to be seriously low, it is reasonable to suppose that the actual geographic differences are at least as large as those shown by the PES figures and that the PES figures essentially reflect the regional pattern of coverage error.

The 1960 Record Check Study, a match of the 1960 Census with various records covering the "entire" population (1950 census, persons added by the 1950 Census–Post-Enumeration Survey, birth registrations from 1950 to 1960, aliens registered in January 1960), indicated the highest gross omission rate for the South and the lowest gross omission rate for the North Central region in all six series of estimates.[12] One series, for example, shows 5.1 percent for the South, 4.3 percent for the West, 3.7 percent for the Northeast, and 3.4 percent for the North Central region.[13]

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[11] U.S. Bureau of the Census, **The Post-Enumeration Survey: 1950**, Bureau of the Census, Technical Paper No.4, Washington, D.C., 1960, table F, p. 10.

[12] U.S. Bureau of the Census, **Evaluation and Research Program of the U.S. Censuses of Population and Housing, 1960: Record Check Studies of Population Coverage**, Series ER60, No. 2, Washington, D.C., 1964, table 4, p. 9.

[13] This series appears to be most consistent with the national estimate of net underenumeration derived by the method of demographic analysis.

A comparison of the missed rates for occupied housing units, as estimated from the 1970 Census–CPS Match Study, shows that the field coverage may have been somewhat better in the North Central region (0.8 percent) and worse in the South (2.6 percent).[14] However, when the results of the Post-Enumeration Post Office Check in the South are taken into account, the estimated missed rate for the South (1.7 percent) approximates the rates for other regions. In 1960 the rate for the South was well above the rates for other regions.

The 1970 Census–Medicare Match Study showed gross omissions of aged persons from the census to be highest in the South (6.8 percent) and lowest in the North Central region (3.7 percent), as compared with a national average of 4.9 percent.[15] The variation between regions is pronounced for white females, the missed rate in the South (6.7 percent) being about double the missed rate in the other three regions. The data also suggest regional variations for the other sex-race groups (although not for Negroes-and-other-races as a whole), but the sample was to small to provide definitive results.

Finally, the 1970 Census–CPS Match Study provides a limited indication of geographic variations in coverage of the total population of regions in the 1970 census. Omission rates for the four regions, as originally compiled and as adjusted downward to reflect the inclusion of "imputations" in the census counts as published, are as follows:[16]

Region	Omission rate (percent)	
	Before adjustment	After adjustment
United States..	3.1	2.3
Northeast.....	3.1	2.5
North Central.....	1.7	1.1
South.....	4.5	3.0
West.....	2.6	1.9

The omission rate is highest in the South and lowest in the North Central region; the rates for the Northeast and the West are intermediate.

On the basis of the various studies using the dual-systems approach, we can make a very simple generalization. The South consistently appears to have the poorest coverage rate and the North Central region generally appears to have the best coverage rate.

An interesting and important question is whether the variation between regions is merely the result of the differences in race composition or whether it is also the result of differences in the coverage rates for each race from region to region. After this report had virtually been completed, omission rates for regions, for blacks and "whites and other races" separately, became available from the 1970 Census–CPS Match Study. These (unadjusted) figures suggest that there is regional variation in the coverage rates for each race. The regional variation in coverage for "blacks" and "whites and other races" resembles each other and that for all classes; for blacks, omission rates in the South, West, and Northeast are consistently well above the rate for the North Central States by a roughly similar amount:

Region	Omission rate (percent)	
	Black	White and other races
United States..	7.5	2.6
Northeast.....	8.3	2.8
North Central.....	4.1	1.5
South.....	8.5	3.6
West.....	7.4	2.4

Synthetic method. A satisfactory methodology which would produce reliable estimates of coverage even for States is not available and has to be developed. A great variety of methods may be considered, from rather simplistic ones to highly complex ones, each having many variants.

The simplest procedure that might be used for estimating the coverage of State populations is the method of reference to standard ratios or the synthetic method.[17] In the present application national estimates

[14] U.S. Bureau of the Census, PHC(E)-5, **op. cit.**, table G, p. 9.

[15] U.S. Bureau of the Census, 1970 Census of Population and Housing: Evaluation and Research Program PHC(E)-7, **The Medicare Record Check: An Evaluation of the Coverage of Persons 65 Years of Age and Over in the 1970 Census**, U.S. Government Printing Office, Washington, D.C., 1973, table 2, p. 12.

[16] U.S. Bureau of the Census, **Census-CPS Match Study**, unpublished **op. cit.**

[17] The method of reference to standard ratios or the synthetic method is widely used by demographers as a device for obtaining estimates, approximations, or adjustments of absolute numbers or general ratios (rates or proportions) for different dates, periods, or areas by reweighting (reaveraging) a group of standard specific ratios according to a different population distribution (age, sex, etc.) than originally used. The method is akin to the many forms of standardization, the method of expected cases, etc. See U.S. Bureau of the Census, **The Methods and Materials of Demography**, by Henry S. Shryock, Jacob S. Siegel, and Associates, GPO, Second Printing, 1973, pp. 326-327; and Maria Elena Gonzalez, "Use and Evaluation of Synthetic Estimates," pp. 46-50 in U.S. Bureau of the Census, **Statistical Methodology of Revenue Sharing and Related Estimate Studies, Census Tract Papers**, Series GE-40 No. 10, 1974.

of net undercount rates for the various race categories, or age, sex, and race categories, are applied to the corresponding population figures for each State. This procedure assumes that there is no variation from State to State in the undercount rate for each of these categories. The synthetic method produces variable estimates of the rate of underenumeration for the total population of each State, differing from the estimate for the total population of the United States (2.5 percent), principally as a joint result of the difference in the national rates of underenumeration for whites and blacks and the variation from State to State in the racial composition of the population. The synthetic procedure thus involves a reweighting of the national estimates of the net undercount rates for each of the race categories, or each of the age, sex, and race categories, according to the proportions of the populations in each of these categories in each State. Where the proportion of blacks in the population is larger than in the country as a whole, the underenumeration rate for that area would tend to be larger than for the United States (2.5 percent); where the proportion is smaller, the underenumeration rate would tend to be smaller.

Several sets of estimates of population corrected by the synthetic method (designated here "synthetic method" or "basic synthetic method") or variants of it ("modified synthetic methods") have been developed to provide illustrative guides to the variation in population resulting from a coverage adjustment. The first set of illustrative estimates of the rates of net underenumeration for States has been derived on the specific assumption that the Census Bureau's preferred national estimates of net undercount rates for whites, blacks, and "other races," by age and sex, corresponding to "all-ages" estimates of 1.9 percent for whites, 7.7 percent for blacks, and 0.0 percent for "other races," applied to the population of each State in 1970. The resulting rates are shown in table 1; a summary of these figures is given in table A.

The only extreme figure—6.4 percent—is that for the District of Columbia, which has a very large proportion of blacks. Except for the District of Columbia, only 8 States have rates above 3 percent and they fall between 3.0 and 4.0 percent. These States are all in the South, where the proportions of blacks are well above the national average.

The factors of age and sex have very little impact on the variation in the overall level of underenumeration of States when the synthetic method is used, inasmuch as the sex and age composition of State populations, unlike their race composition, is rather similar. The population corrected only for race composition, commonly differs from the population corrected jointly for race, age, and sex composition by 0.1 percent or less (table 1). The difference is as great as 0.2 percent in only five cases and goes up to only 0.5 percent (Hawaii). The distribution of State rates of underenumeration derived from the use of national rates for race groups only is therefore about the same as the State distribution of rates derived from the use of national rates for age, sex, and race groups combined:

Basic synthetic method--race only

Percent	Number of States
Total (2.5 percent)....	51
Under 2.0.....	17
2.0 to 2.4.....	15
2.5 to 2.9.....	10
3.0 to 3.4.....	5
3.5 to 3.9.....	2
4.0 and over.....	[1]2

[1]Includes the District of Columbia.

Table A. Number of States With Specified Rates of Net Underenumeration According to the Population Corrected by the Basic Synthetic Method, by Regions: 1970

(Based on national rates of net underenumeration for age, sex, and race groups)

Percent	United States	Northeast	North Central	South	West
Total (2.5 percent).....	51	9	12	17	13
Under 2.0.....	15	3	4	-	8
2.0 to 2.4.....	17	4	5	3	5
2.5 to 2.9.....	10	2	3	5	-
3.0 to 3.4.....	5	-	-	5	-
3.5 to 3.9.....	3	-	-	3	-
4.0 and over.....	[1]1	-	-	[1]1	-

[1]District of Columbia.

The distribution of rates of net underenumeration differs to only a moderate extent from the distribution just given, when the population is adjusted separately for race composition and Spanish heritage on the arbitrary and possibly extreme assumption that the population of Spanish heritage was undercounted at the same rate as the black population:

Basic synthetic method--race and Spanish heritage

Percent	Number of States
Total (2.5 percent)....	51
Under 2.0.....	20
2.0 to 2.4.....	11
2.5 to 2.9.....	11
3.0 to 3.4.....	3
3.5 to 3.9.....	4
4.0 and over.....	[1]2

[1]Includes the District of Columbia.

The synthetic method represents one possible way of measuring underenumeration of State populations and provides a useful basis for evaluating illustratively the possible changes in allocations of funds to States under various laws or in political representation of or within the States resulting from an adjustment for undercoverage of population. The method is easy to apply, is uniformly applicable to each State, gives apparently reasonable results, and is unbiased in the sense that the resulting coverage estimates for States are consistent with the overall national coverage rate. On the other hand, the synthetic method fails to take account of the possibly wide variation from State to State in coverage rates for particular age, sex, and race groups. As a result, the estimates of corrected population for some States may seriously overstate or understate the true population, the population figures for some States may be more in error after correction by this method than before, and the relative distribution of State population may have been improved only very little, if at all. Furthermore, the magnitude of the errors in the rates is completely unknown.

In view of the limitations and uncertainties of the synthetic method, consideration was given to the development of alternative illustrative methods of measuring the coverage of State populations in 1970 that could take account of State variations in coverage for each race group. For the most part, the methods envisaged extend the synthetic method to allow for State variations in the coverage of the races on the basis of various symptomatic data (i.e., data presumably or possibly correlated with underenumeration) or employ various techniques of demographic analysis, including comparison with aggregated administrative record data.[18]

Symptomatic data on coverage. We know little in formal quantitative terms about the types of areas, households, and persons that are most subject to undercounting. Yet, this is the kind of information needed to impute variations for States in national coverage figures. One might surmise that the coverage rates for areas whose average income and average educational level are relatively low would be lower than the coverage rates for areas with relatively high average incomes and educational levels. There is some evidence supporting this hypothesis from the 1950 Census—Post-Enumeration Survey Match Study and the 1970 Census—Current Population Survey Match Study. Neither study represents the level and variations in undercoverage closely, but the types of differentials they indicate are believed to be at least roughly valid.

The 1950 Census—PES Match Study shows a general tendency for undercoverage to be somewhat greater among persons of lower educational, economic, and occupational status.[19] This finding applies to all races combined, however; it is not known whether it applies to each race separately.

The 1970 Census—CPS Match Study provides further evidence supporting the hypothesis that coverage is inversely related to income and educational level.[20] For example, 4.4 percent of persons in families earning less than $7,500 in 1969 were missed, but the rate was about 2.1 percent for persons in families earning more than $7,500; median family income of persons missed in the census was only about 73 percent as great as the median family income of the entire population. This pattern of differences applied precisely to the whites but only roughly, if at all, to the blacks. For example, 8 percent of blacks in families earning less than $7,500 in 1969 were missed, and 6 percent of blacks in families earning more than $7,500; the median family income of blacks missed in the census was about the same as the median family income of all blacks. In spite of our

[18]In planning for the evaluation of the 1980 census, the Bureau is giving particular attention to the use of demographic analysis, but is also considering a wide variety of other techniques, such as participant observer studies, longitudinal studies, low altitude aerial photography, post-enumeration surveys, matching studies using administrative records, "multiplicity" designs for enumeration, and intensive coverage of experimental areas using local lists of many kinds. These methods are designed to provide a maximum amount of information on this problem which can be used to supplement and extend the results of the demographic method.

[19]U.S. Bureau of the Census, Technical Paper No. 4, **op. cit.**, p. 11.

[20]U.S. Bureau of the Census, **Census-CPS Match Study**, unpublished **op. cit.**

expectations, therefore, we have only faint evidence of variation of coverage according to income among blacks. The 1970 Census–CPS Match Study also showed a higher missed rate for unemployed workers (4.2 percent) than for employed workers (2.5 percent), but for blacks in particular the omission rate for the employed (6.0 percent) appears to be substantially higher than for the unemployed (3.7 percent). The 1970 Census–CPS Match Study also showed a higher missed rate for persons who had completed only eight years of schooling or less (3.8 percent) than for persons who had had some high school education (2.5 percent). This relation applied to both blacks and whites, but the relative difference was much smaller for blacks than for whites. (We note again that these rates of omission require a downward adjustment because census data excluding imputations were employed.)

We would also expect enumeration to be more difficult in geographically isolated areas and in areas where the pattern of the distribution of housing units is very irregular, whether in the open country or the inner city. The 1950 Census–PES Match Study indicates rather pronounced differences in the level of coverage error between residence categories (size of city, rural farm vs. rural nonfarm residence),[21] but these differences do not fully support the hypothesis set forth. The rate of net underenumeration was highest for the rural-nonfarm population and lowest for the rural-farm population and urban places under 50,000. Coverage rates for cities of 1,000,000 or more and cities of 50,000 to 1,000,000 were not significantly different from the national average.

Studies of the coverage of housing units in 1960 and 1970 show that in 1960 coverage of housing units varied according to city-size, with the least satisfactory coverage in the largest cities and in rural areas, but that in 1970 coverage was fairly similar from one residence category to another, except for the higher rates in rural areas.[22] The estimated missed rate for occupied housing units in "mail-back" areas in 1970 was about 1.3 percent; that is, coverage of occupied housing units in metropolitan areas was nearly complete.[23] These studies also show that the missed rate for occupied units was lower in metropolitan areas (1.4 percent) than in nonmetropolitan areas (2.0 percent).

The 1970 Census–Medicare Match Study shows little variation between urban and rural areas, metropolitan and nonmetropolitan areas, or the principal parts of urban (urbanized-nonurbanized) and metropolitan (central city-outside central city) areas in the rate of gross omissions of elderly persons from the census.[24] This general invariance by residence category also applies to the figures for each race separately.

The 1970 Census–CPS Match Study also provides information on the variation of coverage rates by type of residence. This study does not provide support to the commonly held view that coverage is poorer in large cities. It shows a lower omission rate for urban areas than for rural areas and a lower omission rate for metropolitan areas than for nonmetropolitan areas.[25] Within metropolitan areas there is little or no difference between the central city and the area outside the central city, and the size of the metropolitan area makes no difference in the coverage rate.

In sum, the available studies do not permit us to make a categorical statement that the people who were missed in the census were disproportionately concentrated in large cities, as is often assumed. Although the most serious problems of conducting the enumeration in the 1970 census seem to have occurred in the inner city and the field operations were most protracted there, these are also the areas where the most intensive and sustained efforts were applied and where experienced census staff members were often employed in supervisory capacities. Moreover, the use of the address register, a verified list of addresses, in the built-up areas of the country, served to bring about nearly complete enumeration of housing units in metropolitan areas. In view of the higher undercoverage rate of the black population, however, it is reasonable to surmise that cities having heavy concentrations of blacks have higher undercoverage rates than areas with much smaller concentrations of blacks.

One further classification of omissions from the decennial census may shed light on regional variation in coverage rates. Omissions of persons living in households which were missed may be distinguished from omissions of persons living in households which were enumerated. It appears that in 1960 the former group constituted about three-fifths of all persons missed but only one-third of blacks missed; the latter group constituted only two-fifths of all persons missed but about two-thirds of the blacks missed.[26] In the 1970 census,

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[21] U.S. Bureau of the Census, Technical Paper No. 4, **op. cit.**, p. 11.

[22] U.S. Bureau of the Census, PHC(E)-5, **op. cit.**, chart 1, p. 7.

[23] U.S. Bureau of the Census, PHC(E)-5, **op. cit.**, table F, p.6.

[24] U.S. Bureau of the Census, PHC(E)-7, **op. cit.**, tables 3 and 4, pp. 13-14.

[25] U.S. Bureau of the Census, **Census-CPS Match Study**, unpublished **op. cit.**

[26] Adapted from: Leon Pritzker and N.D. Rothwell, "Procedural Difficulties in Taking Past Censuses in Predominantly Negro, Puerto Rican, and Mexican Areas," **Social Statistics and the City**, David M. Heer, Editor, Report of a Conference Held in Washington, D. C., June 22-23, 1967, Joint Center for Urban Studies of the Massachusetts Institute of Technology and Harvard University, 1968, p. 78.

coverage of housing units was improved over 1960. As a result, the proportion of all persons who were omitted because their housing unit was missed dropped to only about one-half. For blacks the proportion was between one-quarter and one-third; i.e., nearly three-fourths of the blacks missed were missed in enumerated housing units.[27]

The factors accounting for omission of occupied housing units included the incompleteness of the address register in the mail-out/mail-back areas, the geographic isolation of housing units, and the irregularity of the pattern of the distribution of housing units. These factors may be described also in terms of inadequacies on the part of the Census Bureau or the U.S. Post Office, including error, carelessness, and apathy on the part of census enumerators and postal workers. The principal factors accounting for omission of persons in households which were enumerated may be classified as deliberate concealment, carelessness and confusion in filing the form, and apathy on the part of respondents. The Census Bureau may also have contributed to undercoverage in enumerated households in some ways, such as through possible deficiency in the design of the questionnaire, occasional failure to follow up requests for additional questionnaires by large households or to investigate more intensively "close-out" cases or "vacant" households, etc. In addition, the design of the census may not have allowed adequately for persons who do not fit into any household according to the conventional rules of residence.

[27] Estimated from data in PHC(E)-4, op. cit., and Census-CPS Match Study, unpublished op. cit.

We do not know the relative importance of these factors and they are not readily expressed in terms of geographic or residence areas as defined in the census. In sum, we do not know with any practical precision the net effect of the various influences mentioned on regional variations in coverage rates. We do not, therefore, have a firm basis for varying the national coverage rates within the framework of the synthetic method to represent State coverage rates.

Variants of the synthetic method. Although the evidence regarding State variation in national group-specific coverage rates is not clear or consistent, additional series of net underenumeration rates for States have been prepared allowing for such variation. They are based on partly arbitrary assumptions and are illustrative of only some of the possible levels of State coverage. Three sets of estimates of coverage rates for the States have been prepared by modifying the basic synthetic method to reflect State variations in the economic or educational status of the population for each race group. The first illustrative set of coverage estimates was prepared on the assumption that the population below the low-income level for each race group in each State had twice the rate of underenumeration as the population above the low-income level. A second set of estimates was derived by assuming that the rate of underenumeration for each race group varies inversely with the level of median family income in each State. A third set of figures was derived by assuming that the rate of underenumeration for each race group varies inversely with the level of educational attainment (i.e., median years of school completed) in each State. The distribution of the rates of underenumeration for States according to the various assumptions described are shown in tables B and C.

Table B. Number of States With Specified Rates of Net Underenumeration According to the Population Corrected by the Basic Synthetic Method and by Various Modified Synthetic Methods: 1970

Percent	Basic synthetic method		Modified synthetic method		
	Age, sex, and race	Race only	Proportion at low-income level	Median family income	Educational level
Total (2.5 percent)	51	51	51	51	51
Under 1.0	-	1	1	1	1
1.0 to 1.9	15	16	19	14	20
2.0 to 2.9	27	25	23	25	20
3.0 to 3.9	8	7	6	4	5
4.0 and over	[1]1	[1]2	[1]2	[1]7	[1]5

[1] Includes the District of Columbia.

Table C. Number of States With Specified Rates of Net Underenumeration According to the Population Corrected by a Modified Synthetic Method, by Regions: 1970

(Synthetic method modified on the basis of median family income)

Percent	United States	Northeast	North Central	South	West
Total (2.5 percent).....	51	9	12	17	13
Under 2.0.....	15	4	2	-	9
2.0 to 2.4.....	21	5	10	2	4
2.5 to 2.9.....	4	-	-	4	-
3.0 to 3.4.....	2	-	-	2	-
3.5 to 3.9.....	2	-	-	2	-
4.0 and over.....	[1]7	-	-	[1]7	-

[1]Includes the District of Columbia.

When poverty status is used as a determinant of the coverage level for States as described above, the resulting coverage rates differ little from those obtained by the basic synthetic method (either variant), although there is some tendency for the rates to fall. When median family income is the criterion, several fewer States show rates of 3 to 4 percent and several more show rates of 4 percent or more. The rates for several Southern States go up substantially. With the use of educational attainment as a criterion of coverage variation, substantial shifts occur in the coverage rates for States; many more States show low undercoverage rates (under 2.0 percent) than with the basic synthetic method, fewer show intermediate rates (2 to 4 percent), and several more show high rates (over 4 percent). The estimated undercoverage rates obtained on the basis of the various assumptions are shown for States in table 1. Again, it should be noted that these figures should not be taken to represent official estimates of the rates of underenumeration for States, but rather as suggestive of the possible variation in coverage rates between States which may be useful for illustrating some of the political and fiscal effects of underenumeration.

Demographic analysis. Demographic analysis, supplemented perhaps by the results of matching studies, offers a more logical basis for measuring net underenumeration for States. In this method the available demographic data for States are explicitly taken into account to measure State variations in coverage. A principal problem in developing a demographic model for estimating the "true" population of States is that the component method cannot be employed in conventional fashion, since this method would require data on lifetime internal migration (in addition to data on international migration, births, and deaths), and we do not have a source of such data external to the census itself. In applying the component method, we can avoid use of the census data on lifetime internal migration (i.e., data on State of birth) in estimating the "true" population initially, but later we have to make assumptions as to whether coverage error is a function of State of birth, current State of residence, or some combination of these, and as to the degree to which coverage rates of interstate lifetime migrants differ from the coverage rates of nonmigrants. Since the data available for developing the estimates by the analytic method are subject to errors of many kinds and numerous broad assumptions have to be made in applying the method, any effort to develop coverage estimates for States by this method would necessarily be experimental and there can be no guarantee that satisfactory estimates of coverage for States will be derived. Such an experimental project is now under way at the Census Bureau. The general plan involves use of different procedures for ages under 35 years, 35 to 64, and 65 and over.

For the ages under 35, births in each State by race for the period 1935 to 1970 are carried forward by life-table survival rates and further reduced by the number of native Americans who left the country, to estimate the expected number of persons who would be counted in the 1970 census as born in each State. Comparison of State-of-birth data from the census with the estimates of expected population born in each State based on births provides estimates of the coverage of the population born in each State. The task, however, is to evaluate the census data on the population resident in each State rather than the population born in each State. The coverage estimates for the population born in each State are then employed to derive estimates of coverage for the population resident in each State.

To accomplish this conversion, various alternative assumptions are introduced. When coverage is assumed to depend on the State of birth, the 51 coverage rates according to State of birth are weighted together for each State according to the proportions of the residents

of each State born in each of the 51 States. When coverage is assumed to depend on State of residence, then one has a matrix representing 51 simultaneous equations which can be solved by matrix inversion. These calculations can be extended to allow for differences in the omission rates of interstate migrants and nonmigrants, for example in the ratio of 3 to 1.

Although the methodology planned is essentially the same for the black population as for the white population, the compilation and "processing" of the data present many more problems. These include the greater frequency of gaps in the series of required data and the greater scope and seriousness of biases.

Thus far the Bureau has secured some preliminary results for the white and black populations under 35 years of age, by sex. These results do show regional variation in undercoverage rates, with the highest rates in the South and the lowest in the Northeast. The alternative assumptions do not appear to make much difference; essentially the same pattern of State undercount rates is obtained whether it is assumed that coverage depends on State of birth or on State of residence, or that underenumeration rates are equal for interstate migrants and nonmigrants or are higher for interstate migrants than nonmigrants. This is understandable since roughly two-thirds of the population under 35 years of age is living in its State of birth. Several States show overcounts at some of the ages under age 35 in the preliminary figures. These are not reasonable figures and the source and resolution of this problem have to be determined. A major source of the problem seems to be a bias in the reporting of State of birth in the 1970 census, specifically the tendency to report State of occurrence of birth in the census rather than State of residence of the mother when the child was born.

For the ages 65 and over, we are trying to employ the aggregated data on Medicare enrollments. There are difficult problems here, however, because people may report a mailing address for Medicare different from their residence on April 1, the census date. For example, the Bureau enumerates many people in Florida who do not report Florida as their mailing address in Medicare, so that the census figure for Florida appears to be an "overcount."

We are also currently engaged in planning the methodology for the calculation of estimates for the intermediate ages 35 to 64. These ages will present special problems, since there is no direct basis for estimating them. If the patterns of variation in coverage rates by States under 35 and 65 and over show some similarity, we may consider interpolating these patterns to the intermediate ages. Once coverage rates for females can be determined satisfactorily, expected sex ratios can be employed, but it will be difficult to derive them because of the migration factor.

The degree of error in estimates of census coverage derived by demographic analysis or other methods can only be considered theoretically. Since the true population is not really known, the accuracy of the estimates cannot be measured very directly or very precisely. Accuracy can be measured only indirectly; e.g., in terms of the demographic logic of the method; the consistency of results obtained by use of alternative "equally" reasonable data, basic assumptions, or methods; and the variation in results obtained by statistical sensitivity tests, which measure the bias involved in specific assumptions; etc. We plan to use some or all of these methods in evaluating our estimates for States derived by demographic analysis. As noted before, there is a question as to whether this procedure will be successful.

Areas Within States

Problems in application of synthetic method. The problems of developing reliable estimates of underenumeration for areas within States are much greater than those for the States. It has been proposed that the synthetic method employing national net undercount rates for age, sex, and race groups be used to derive estimates of corrected population figures for counties and cities in the absence of immediate satisfactory alternatives. Such a procedure is computationally possible, of course, but in view of the unknown but necessarily wide variation in these rates for cities and counties, the procedure is technically very weak.

The proposal to use the synthetic method in this way raises questions regarding the accuracy of the method when applied to counties and cities as compared with their application to States, and particularly regarding the theoretical problems in error measurement. When we make the assumption that the national rates of underenumeration in specific age, sex, and race categories apply to each State, we are, in effect, assuming that there is no dispersion around the U.S. average for these categories. The extent of the dispersion of the rates for the States around the national average depends upon the factors that affect the degree of underenumeration and their relative importance in each State. There may be sufficient heterogeneity of "census" conditions in some States to produce coverage rates for these States that are not unlike the U.S. figure, but this would not be true for most States.

Similarly, if we make the assumption that the national rates of underenumeration apply to each county within the State, we are in effect assuming both that there is no dispersion of State figures around the U.S. average and no dispersion of county figures around the State averages. The combination of the actual dispersion of the State values around the national values and of the county values around the State values strongly suggests that the county values may deviate by considerable amounts from the national average and

hence that estimates based on the synthetic method for counties would be subject to major errors. Although synthetic estimates may possibly serve a useful illustrative purpose with State data, they may be more misleading than useful for counties and cities.

Alternative methods. Any refined work for making estimates of coverage for counties and cities has to be dealt with separately from the work for States because of important differences in the data available and, hence, in the possible methods to be used. A method involving demographic analysis similar to that being employed for the States cannot be used because the required data on the distribution of the population by place of birth are not available.

If it proves possible to develop adequate estimates of net underenumeration for States by the method of demographic analysis or some combination of methods, it may then be useful to consider applying the modified synthetic method to the principal areas within each State, using variations of the net undercount rates for race, age, and sex categories applicable to a particular State. We may also consider developing and applying a correlation-estimating equation relating underenumeration rates with median income, education attainment, migration rates, and other characteristics, for States. The resulting estimates would be subject to considerable error since it is rather evident at this juncture that the "demographic" estimates for States themselves can be only moderately satisfactory.

We also want to consider use of proxy variables that may reflect more directly the relative levels of coverage of the population of counties and cities. Even if we could identify such variables, we would have to be concerned about the availability of data on them for small areas as well as States and the degree of the relationship between the proxy variables and the coverage rate. The proxy measures that seem relevant are the proportion of the population of the area for which imputations of persons were made in the census because they could not be actually interviewed and the proportion of the population for which one or more allocations of demographic or social characteristics were made in the census returns. Although suggestions have been made to use these measures as proxy variables,[28] the procedure does not now appear to provide a very satisfactory basis for measuring local variation in net underenumeration. The necessary census data on the population added by imputation because of noninterview are not readily available for counties and cities and there is doubt that the two variables mentioned are highly correlated with the census omission rate. At this time there is no way to validate the use of imputations or allocations as proxy variables for underenumeration. If satisfactory estimates of coverage for States can be developed, the relationship between coverage rates and imputation rates or allocation rates for States can be examined.

We shall consider carefully the suggestions of the Committee on Census Enumeration of the National Academy of Sciences regarding possible analytical studies of small-area census coverage that may aid in the discovery of the demographic, social, and economic characteristics of an area associated with coverage errors.[29] The position of the Committee was quite guarded, however, regarding the possibility of developing usable quantitative estimates of coverage error for small areas. It does not now appear likely that census underenumeration for counties and cities can be measured accurately and on a comparable basis. The necessary data and methodology do not exist. Unless a sound methodology is employed, one risks producing estimates of underenumeration that have greater errors of estimate than the underenumeration rates being measured. Later research may lead to a change in our preliminary view.

IMPLICATIONS FOR POLITICAL REPRESENTATION AND DISTRIBUTIONS OF PUBLIC FUNDS

A specific purpose of this report is to assess illustratively the effect of underenumeration on representation in legislative bodies at various levels of government and on the distribution of funds under various public programs. In connection with political representation we will consider separately the effect on Congressional apportionment and the effect on Congressional districting, State legislative districting, and city councilmanic districting. There are two dimensions to the consideration of the public distribution of funds—first, whether the funds are allotted on a per capita basis or apportioned on the basis of a fixed total and, second, whether the allocation or apportionment is made on the basis of total population, some segment of the population, or other factors in addition to population, such as per capita income.

Political Representation

Congressional apportionment. Principal interest lies in the possible effect of underenumeration in the census on the apportionment of representatives from the States to the House of Representatives. Under the method of "equal proportions," the method used to determine the number of Congressmen from each State, the shift in

[28] National Academy of Sciences, **America's Uncounted People**, Report of the Advisory Committee on Problems of Census Enumeration, Division of Behavioral Sciences, National Research Council, edited by Carole W. Parsons, Washington, D.C., 1972, pp. 107-109.

[29] National Academy of Sciences, **America's Uncounted People**, **op. cit.**, Chapter 6.

the population of a State required to produce a change in the State's representation, may be merely a few hundred persons or a few hundred thousand persons, depending on the precise populations of all the States.

When the population figures for the States are adjusted for underenumeration by the basic synthetic method, employing the preferred national rates of net undercounts for each age, sex, and race group (three groups), Congressional apportionment remains unchanged from the apportionment now in effect. If the test calculations are based on synthetic estimates modified to allow for differences in the proportion at the low-income level from State to State for whites and Negroes separately, as described earlier, again the apportionment remains unaffected. When variations in median family income are taken into account, two States are affected, Alabama (7 to 8 representatives) and California (43 to 42 representatives). When variations in educational attainment are taken into account, again two States are affected, Alabama (7 to 8) and Oklahoma (6 to 5).

Congressional, State, and local districting. It has been suggested that the use of corrected census data in the delineation of Congressional districts, State legislative districts, or city councilmanic districts could have an important effect on these delineations. In particular, it has been suggested that, in view of the relatively greater omission rate for some parts of States or cities as compared with the other parts of the same States or cities, an additional representative (Congressman, State legislator or councilman) might be elected to the appropriate ligeslative body from the former areas at the expense of the latter areas, if the census counts were corrected.

In the reconstitution of the legislative districts in a State or city the total number of districts represented in the Federal Congress or State or city legislative body does not change. Given an apportionment formula for determining representation in a given legislative body (Congress, State legislature, city council), a new legislative district can be created only if it is carved out of existing districts in a State or city, one of which would be eliminated. The possibility of the occurrence of such a situation depends on the average size of the legislative districts, the coverage rates of the major groups of the population (e.g., race groups), the proportionate distribution of the population by major groups (e.g., race groups), and the number of contiguous legislative districts with high undercoverage rates. Such a situation is more likely to arise in a large city, where several adjacent councilmanic districts may be inhabited largely by blacks.

A relatively simple analysis gives a generalized indication of the possibility of an increase in the number of Congressmen, legislators, or councilmen for a designated part of a State or city **specifically resulting from a coverage correction** in the 1970 census (with a corresponding loss in the number of legislators for the remaining part). Table D shows model values for the number of contiguous legislative districts and the total contiguous population which would be minimally required to establish an additional legislative district, corresponding to various coverage rates by race, various proportions of whites and blacks, and various average populations per legislative district. Model results are shown for three levels of coverage rates for the principal races—the national average coverage rates, the national averages plus one mean deviation based on State data (median family income series), and the national averages minus one mean deviation based on State data (median family income series); for five levels of the proportion black in the population; and for seven levels of the average population per legislative district.

From these model calculations, we see that the possibility of a shift in the number of Congressional districts for the regions of a State is very small. For example, a population of about 9 million persons residing in about 20 contiguous Congressional districts in a particular region of a State would be minimally necessary to establish another Congressional district in that region of the State, assuming that the average population per Congressional district is 465,000, that the coverage rate for each race group corresponds to the United States average (1.9 percent for whites; 7.7 percent for blacks), and that half the population is black. It is also assumed that the population of the remainder of the State was completely enumerated, but this population also requires some adjustment, which would offset gains in the first area. No State qualifies for a shift in the regional location of its districts on this basis. Even if the population of a broad area of a State is 75 percent black and the undercoverage rates of whites and blacks are well above average (2.2 percent and 9.2 percent, respectively), a contiguous population of nearly 6 million persons residing in 12 contiguous Congressional districts in a particular region of a State would be minimally required to establish another Congressional district in that region of the State.

The chances are somewhat greater, but still small, for a shift in State legislative districts or city councilmanic districts in spite of the possibility of higher omission rates and their concentration in one part of the State or city. If we assume, for example, that the undercoverage rates of whites and blacks are well above average (2.2 percent and 9.2 percent, respectively), that the population of a major section of a city is largely black (75 percent), and that each councilman represents 10,000 persons, then a population of more than 120,000 persons residing in about 12 contiguous councilmanic districts in a particular section of the city would be minimally required to establish another district in that area of the city. Again, undercoverage adjustments for the remainder of the city would reduce the likelihood that a shift in the location of the districts would occur.

Table D. Minimal Model Values for the Number of Contiguous Legislative Districts and the Total Contiguous Population Required to Establish an Additional District, According to the Underenumeration Rate by Race, the Population Distribution by Race, and the Average Population Per District

Underenumeration rate and percent black	Approximate number of contiguous legislative districts	Total contiguous population required to establish an additional district						
		Average population of legislative district						
		465,000	400,000	200,000	100,000	50,000	25,000	10,000
Medium underenumeration rate--white 1.9 percent, black 7.7 percent[1]								
Percent black								
0	52	24,008,000	20,652,000	10,326,000	5,163,000	2,582,000	1,291,000	516,000
25	28	13,141,000	11,304,000	5,652,000	2,826,000	1,413,000	707,000	283,000
50	20	9,049,000	7,784,000	3,892,000	1,946,000	973,000	487,000	195,000
75	15	6,896,000	5,932,000	2,966,000	1,483,000	742,000	371,000	148,000
100	12	5,575,000	4,796,000	2,398,000	1,199,000	600,000	300,000	120,000
Low underenumeration rate--white 1.7 percent, black 6.1 percent[2]								
Percent black								
0	58	26,886,300	23,128,000	11,564,000	5,782,000	2,891,000	1,445,500	578,200
25	34	15,916,950	13,692,000	6,846,000	3,423,000	1,711,500	855,750	342,300
50	24	11,304,150	9,724,000	4,862,000	2,431,000	1,215,500	607,750	243,100
75	19	8,765,250	7,540,000	3,770,000	1,885,000	942,500	471,250	188,500
100	15	7,156,350	6,156,000	3,078,000	1,539,000	769,500	384,750	153,900
High underenumenation rate--white 2.2 percent, black 9.2 percent[3]								
Percent black								
0	44	20,673,900	17,784,000	8,892,000	4,446,000	2,223,000	1,111,500	444,600
25	24	11,020,500	9,480,000	4,740,000	2,370,000	1,185,000	592,500	237,000
50	16	7,509,750	6,460,000	3,230,000	1,615,000	807,500	403,750	161,500
75	12	5,696,250	4,900,000	2,450,000	1,225,000	612,500	306,250	122,500
100	10	4,589,550	3,948,000	1,974,000	987,000	493,500	246,750	98,700

[1]National average rate of underenumeration.
[2]National average rate of underenumeration minus one mean deviation based on State data (median family income series).
[3]National average rate of underenumeration plus one mean deviation based on State data (median family income series).

It may be maintained that a more important, and also a more likely, consequence of correcting census data for underenumeration than the creation of an additional legislative district is the possibility of additional influence of disadvantaged segments of the population in existing districts. A legislator's awareness of the exact socioeconomic and ethnic composition of a constituency, combined with a knowledge of the views particular segments of this constituency have on public matters, could influence the legislative decision-making process. If the legislator knows that a given segment of the constituency is more numerous than the census indicates and to what extent this is true, presumably the views of the group would receive more weight. Furthermore, disadvantaged groups might be represented in larger proportions in public or private programs as a result of their numbers; this might lead to a change in attitudes on the part of the general population and greater support for the needs of the disadvantaged groups. This is apart from the fact that, regardless of "census enumeration status," everyone has the right to vote and can wield power through the use of the ballot.

A different issue, considered by the courts and of major importance to disadvantaged groups of the population, is whether voting district lines are drawn in a manner which minimizes the voting influence of such groups. Consideration of whether a given set of adjustments for underenumeration in geographic areas would have any impact on how voting district boundaries are drawn would involve a major study in itself and is outside the scope of the Census Bureau's competence. Hence, discussion of this topic was not included in this report.

Implications for one-man one-vote rule. Possible geographic variation in the undercount rate has implications for the implementation of the Supreme Court one-man one-vote rule. In a series of decisions (**Baker v. Carr**, 1962; **Gray v. Sanders**, 1963; **Wesberry v. Sanders**, 1964; **Kirkpatrick v. Preisler**, 1969) the Supreme Court ruled that Congressional districts, as well as State legislative districts, should be equal in size, so that each legislator would represent an equal number of constituents. The court did not specify the exact degree of

variation in population which would be acceptable under the rule, but the more recent decisions clearly required the States to strive for equality in the size of legislative districts. We want to consider illustratively, using data for New Jersey, whether possible variations in the undercount rate would introduce a much larger variation in the population of Congressional districts and State legislative districts than pertains with respect to the census counts.

The State of New Jersey contains 15 Congressional districts, with an average population in 1970 of 477,877 according to the census counts and 490,801 according to census figures corrected for underenumeration using the basic synthetic method (race only). The average deviation of the population of the 15 districts from the average size of the districts is only 0.1 percent for the census figures and 0.4 percent for the corrected figures. A much more stringent test is the relative difference between the population of the largest district and the population of the smallest district. The percent excess in population of the largest district over the smallest district is 1.0 percent for the census counts and 3.2 percent for the corrected figures. On the basis of corrected figures, the largest district exceeds the average by 2.4 percent.

To illustrate the possible effect of census undercounts on the relative size of the population of the State legislative districts, the basic synthetic method (race only) was used to adjust the population of the forty legislative districts into which the State of New Jersey was divided after the 1970 census. The average population of the legislative districts is 179,204 according to the census counts and 184,050 according to the corrected figures. The average deviation of the population of the districts from the average size of the districts is 0.7 percent of the average population according to the census counts and 0.9 percent of the average according to the corrected figures. The percent excess of the population of the largest district over the population of the smallest district is much larger in each case but the adjustment for undercount makes little difference. The figures are 5.2 percent for the census counts and 6.8 percent for the corrected figures. The largest and smallest districts would differ from the average by only a fraction of these figures. On the basis of corrected data, the respective figures would be 4.0 percent and 2.6 percent.

The results would differ, of course, if the adjustment calculations were carried out for other States and/or other methods. Hence, caution is necessary in making generalizations on the basis of the illustrations given.

Distribution of Public Funds

Some issues involved in adjusting official data. We come next to a discussion of the implications of underenumeration in the 1970 census for disbursements of public funds. In this connection it is useful to consider, first, the basis by which the adequacy of disbursements is to be judged.

One criterion for determining the adequacy of a given allocation is the equity of that allocation. Perfect equity would be achieved if the allocation of funds were based on perfect data, but since perfect data and hence a perfect allocation are not attainable, the principle of equity is not easy to apply. Application of the principle of equity must be related to the criteria of accuracy which are used. We can identify several different criteria of accuracy relating to the estimates for a class of governmental units, such as, the average percentage difference between the estimate and the unknown true figure, the percent of the units for which the estimate differs from the unknown true figure by some stated large percentage (e.g., 5 or 10 percent), or the proportion of all units for which the estimate exceeds or falls below the unknown true figure. One distribution of funds may have a lower average percent "error" than another, while the second distribution may have a lower proportion of extreme errors. We may wish to be more concerned about an under-allocation of 10 percent for some area than the fact that the average error of the method is "lowest." Under this criterion of equity, we may prefer to reduce the funds assigned to several areas and even raise the average error, in order to increase substantially the funds assigned to the single area which has been disadvantaged. Or we might take the contrary view and prefer a series which has the lower average error. Note, however, that the errors are not really known and may be unknowable.

There are practical issues in changing the apportionment of funds abruptly on the presumed but uncertain basis of greater accuracy. In our illustrative calculations, under a change in the apportionment of funds based on a correction of the basic data for undercoverage, many more areas lose money than gain money. Local communities which are not favored by the results may dispute both the principle of correcting census data and the particular method of correcting them. Any method that we might use would be subject to serious question, and it may be difficult to defend the use of estimates based on partly arbitrary criteria in lieu of "counts" in this situation.

Another important consideration is the need to incorporate corrections for all components in the apportionment formula that may affect the final distribution. Adjustment of the population counts for underenumeration may be possible and desirable in some formulas and not in others because corrections for errors in related data required in the latter formulas are not available. For example, if an apportionment formula, such as General Revenue Sharing, calls for data on population and aggregate income, only insofar as corrections are made for the income data does it appear

justifiable to correct the population data, since the corrections are known to offset one another in some cases and to be additive in others.

The interdependence of the Federal statistical system suggests considerable caution before the census counts for geographic units are altered. Population data are used widely in combination at many different geographic levels and with many other types of statistical series for which adequate corrections cannot be obtained.

Effect of adjustment for population only. Many Federal programs involve disbursement of funds on the basis of population. Sometimes population figures are used to determine the areas that qualify for certain funds, which may then be distributed on the basis of various factors other than or in addition to population. Funds may be distributed on a per capita basis and, hence, the total amount distributed depends on the number of persons affected. Typically, however, Federal programs have an apportionment feature, that is, a pre-established sum of money is distributed to a class of governmental units.

The special attention given to the implications of underenumeration of population in the census on the apportionment of public funds should not obscure the fact that there are many State and local programs in which funds are allocated on a per capita basis. Under such circumstances any allocation of funds is directly affected by the underenumeration of population, and as a result groups in special classes or in particular geographic areas may receive less than their proper share of public services. This consequence of underenumeration is much more apparent than the implications of underenumeration that are discussed here and is not considered further.

It is apparent that, if money is distributed solely on the basis of population under an apportionment formula and if the population of the coordinate governmental units is adjusted uniformly for underenumeration by a common percentage, however large, the funds apportioned to each governmental unit would be the same after the adjustment as before the adjustment. Shifts in the funds apportioned depend, therefore, on the variation in the underenumeration rates among the coordinate governmental units.

The synthetic procedure employing corrections for age, sex, and race (white, black, other) provides one set of corrected figures that reflect variation between the States in the overall rate of population underenumeration and that, therefore, can be employed to illustrate the effect of underenumeration on apportionment formulas. The size and variation among the States of these rates of underenumeration are seen to be much greater than the size and variation of the percentage shifts in the funds apportioned among the States resulting from the use of these very underenumeration rates. Under an apportionment rule based on population size, correction of the population figures by the synthetic procedure using the national age-sex-race specific undercount rates makes little difference in the funds distributed for the vast majority of States.

The rates of underenumeration would vary from 1.3 percent to 3.8 percent, excluding the District of Columbia (6.4 percent), but the shifts in apportioned funds would vary from 0.0 percent to 1.3 percent (with the District of Columbia at 3.9 percent). The population shifts by 2 percent or more in 35 States and the District of Columbia and by 3 percent or more in eight States (all 3 to 4 percent) and the District of Columbia, but the funds apportioned would shift by 2 percent or more only in the District of Columbia (table E). Forty-six States would gain or lose less than one percent of the funds apportioned to them and about half of these would gain or lose less than one-half percent. The funds apportioned among the States would shift by only 0.6

Table E. Number of States With Specified Shifts in Apportioned Funds According to the 1970 Census Population Corrected by the Basic Synthetic Method

(Based on national rates of net underenumeration for age, sex, and race groups)

Percent shift	Population	Apportioned funds		
		Total	Gain	Loss
Total	51	51	18	33
Under 1.0	-	46	14	32
1.0 to 1.9	15	4	3	1
2.0 to 2.9	27	-	-	-
3.0 to 3.9	8	-	-	-
4.0 and over	[1]1	[1]1	[1]1	-

[1]District of Columbia.

percent on the average. In general, simple apportionment formulas dampen considerably the effect of any variable adjustment of a set of data.

Many more States would lose money (33) than would gain money (18) under the changed apportionment. Under the assumption that the total sum to be apportioned is $1 billion, seven States and the District of Columbia would experience gains in excess of $100,000 (0.01 percent of the total) and four States would experience losses in excess of $100,000. The States in addition to the District of Columbia, which would experience large absolute gains are all located in the South—Alabama, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Virginia—and the States which would experience large absolute losses are all located in the North and West—California, Massachusetts, Minnesota, and Wisconsin. The variation in the proportion of black population from State to State accounts almost entirely for these variations in apportioned funds.

The funds apportioned on the basis of population figures corrected by the synthetic formula employing corrections for race only (white, black, other races) are not very different from the funds apportioned on the basis of population corrected jointly by age, sex, and race. The percent shifts in apportioned funds, compared with the shifts in population, under the "race only" correction, are as follows:

Percent shift	Basic synthetic method--race only	
	Population	Apportioned funds
Total.....	51	51
Under 1.0.....	1	46
1.0 to 1.9.....	16	4
2.0 to 2.9.....	25	-
3.0 to 3.9.....	7	[1]1
4.0 and over.....	[1]2	-

[1]Includes the District of Columbia.

(This result recalls the similarity of the underenumeration rates under these two synthetic procedures.) The shift in the apportionment when the population figures are corrected by the synthetic formula employing corrections for the population of Spanish heritage (arbitrarily set at the same rate as for the black population) in addition to race remains quite small. The percent shifts in apportioned funds, compared with the shifts in population, under the "race and Spanish heritage" correction, are as follows:

Percent shift	Basic synthetic method--race and Spanish heritage	
	Population	Apportioned funds
Total.....	51	51
Under 1.0.....	1	43
1.0 to 1.9.....	19	7
2.0 to 2.9.....	22	-
3.0 to 3.9.....	7	[1]1
4.0 and over.....	[1]2	-

[1]Includes the District of Columbia.

Since the method depends heavily on the assumption of "no variation" in underenumeration rates for race groups, any question about the soundness of this assumption brings the above results into question. If, for example, the coverage rate is much better for those blacks with higher educational attainment and higher family income than for those with lower educational attainment and lower family income, then the national average coverage rate for blacks greatly understates the coverage rate for blacks in some States (and overstates it in others), and hence the use of the synthetic method results in an overstatement (or understatement) of the funds due to such States. Modifying the synthetic estimates to take low-income status, median family income, or educational attainment rates for each State, for whites and blacks separately, into account in determining rates of underenumeration for States has a more pronounced effect on the apportionment of funds than the use of the basic synthetic method. Yet, even in these cases the shifts in funds due to the coverage adjustment vary far less than the rates of underenumeration themselves (i.e., the shifts in population) and are typically much smaller, as shown in table F.

When the population is adjusted on the basis of median family income, it shifts by two percent or more in 35 States and the District of Columbia and by three percent or more in 10 States and the District of Columbia, but the funds apportioned shift by two percent or more in only 5 States. Forty-nine States and the District of Columbia would gain or lose less than three percent of the funds apportioned to them, 40 States would gain or lose less than one percent, and 18 of these would gain or lose less than one-half percent. The corresponding apportionment figures based on an adjustment in terms of the low-income proportion and of educational level are more concentrated at the lowest percents. Quite clearly, however the rates of underenumeration vary, the effect of such underenumeration on the distribution of funds is dampened considerably when a fixed total sum of money is apportioned.

Table F. Number of States With Specified Shifts in Apportioned Funds According to the 1970 Census Population Corrected by Various Modified Synthetic Methods

Percent shift	Proportion at low-income level		Median family income		Educational level	
	Population	Apportioned funds	Population	Apportioned funds	Population	Apportioned funds
Total.....	51	51	51	51	51	51
Under 1.0.....	1	44	1	40	1	42
1.0 to 1.9.....	19	[1]5	14	[1]6	20	6
2.0 to 2.9.....	23	2	25	4	20	[1]3
3.0 to 3.9.....	6	-	4	-	5	-
4.0 and over.....	[1]2	-	[1]7	1	[1]5	-

[1]Includes the District of Columbia.

Effect of adjustment for population and other factors (income). When the formula for distributing funds involves factors in addition to population, then the adequacy of the data on these additional factors also has a bearing on the adequacy of the allocations. Here, as when population alone is a factor, the effect of an adjustment of the factors on the allocation is far less when a fixed sum is apportioned among the constituent areas than when the total sum being distributed evolves directly from the application of the formula. Many Federal programs involve disbursement of funds on the basis of factors in addition to population, such as per capita income, and have an apportionment feature. Such programs include the State and Local Fiscal Assistance Act of 1972 (General Revenue Sharing), the Comprehensive Employment and Training Act of 1973, the Elementary and Secondary Education Act of 1965, the Vocational Education Act of 1963, and the Housing and Community Development Act of 1974.

Considerable interest now lies in the allocations under the General Revenue Sharing program because of the huge sums of money involved ($30.2 billion over the 5-year period, 1972 to 1976) and the number of governmental units directly receiving funds (38,700). The formulas for States and the governmental units within States, as specified in the Act, differ in several respects—the inclusion of two additional components in an alternative formula for States (urbanized population and State income tax collections), use of special constraints (upper and lower limits) in applying the formula for governmental units within States, and a different basis of determining aggregate income in the "tax effort" factor of the formulas for States and local governments. Nevertheless, the General Revenue Sharing formula may be viewed as basically involving three factors—population; per capita income, the ratio of aggregate money income to population; and "tax effort," the ratio of net taxes collected to aggregate personal income (States) or aggregate money income (local government units)—and may be represented very simply by:

$$P \div \frac{I}{P} \times \frac{T}{I} \quad \text{or} \quad T \div \left(\frac{I}{P}\right)^2 \quad \text{or} \quad T \times \left(\frac{P}{I}\right)^2$$

where P represents population, $\frac{I}{P}$ per capita income, and $\frac{T}{I}$ "tax effort."

In the application to States, the income data in the "tax effort" factor are provided by the Bureau of Economic Analysis (BEA) and represent aggregate personal income of a given State secured from administrative records. They are implicitly corrected for both the omission of the income of persons not enumerated and the understatement of the income of persons enumerated. The income component in the per capita income factor for States, total money income, is derived from the census and does suffer from these limitations. In the application of the formula to counties and cities, census data are used for the income component in the tax effort factor as well as in the per capita income factor, as the General Revenue Sharing Act specifies. (Note, therefore that at the State level I in per capita income and I in tax effort have different values whereas at the local level they are the same; and when I for States is adjusted as described below, they are approximately the same.)

If, in the calculation of the amounts of General Revenue Sharing money for States by the three-factor formula, population and per capita income are adjusted for the underenumeration of population and the omission of the income of persons not enumerated, on the

assumption that the per capita income of missed persons equals that of enumerated persons, then per capita income is not changed by the adjustment and the correction of the population factor alone modifies the result. Since this reduces virtually to a simple apportionment procedure involving a population adjustment, the effect is generally quite small, as we have already seen. The effect is still expected to be small even if the per capita income of missed persons is assumed to be somewhat lower than that of enumerated persons, as is probably the case, because of the small weight of missed persons in the total population.

The amounts allocated under General Revenue Sharing would be substantially altered for many States if the income component were fully adjusted for understatement, that is, if the income component in the per capita income factor were adjusted to include both the income not reported by persons enumerated as well as the income of persons missed in the census. For our illustrative calculations, adjusted estimates of total money income, consistent with the BEA data on aggregate personal income, were substituted for the census income data. Adjustments of census income data for States for understatement tend to be much larger than the adjustments of population for underenumeration. Income then emerges as the dominant element in the possible correction of revenue-sharing allocations for understatement of the components at the State level.

This finding is reflected in the illustrative allocations of revenue-sharing funds for States given in tables 3 and 4. These tables show the distribution of $5.3 billion, the amount which the Act specified should be distributed to State and local governments for calendar year 1972, the first year of the Act, according to two assumptions for correcting the population for undercoverage—the basic synthetic method and the synthetic method modified on the basis of median family income.

In the first series, population data adjusted by the basic synthetic method (age, sex, and race) and adjusted total money income data were substituted for census population data and census income data, respectively (table 3). Table G summarizes these calculations for regions in terms of the number of States that would gain or lose money as a result of the adjustments of

Table G. Number of States Gaining or Losing General Revenue Sharing Funds as a Result of the Adjustment of the Population Factor (Basic Synthetic Method), the Income Factor, or Both Factors, by Regions

("Net gain" or "net loss" refers to the effect of adjusting both the population factor and the per capita income factor jointly; gain or loss from population refers to the effect of adjusting the general population factor and the urbanized population factor; and the gain or loss from income refers to the effect of adjusting the per capita income factor. The adjustment of the per capita income factor includes a population adjustment based on the basic synthetic method (age, sex, and race) and an income adjustment incorporating the "BEA" income data)

Gain or loss	United States	North-east	North Central	South	West
Total	51	9	12	17	13
Net gain	20	3	1	10	6
Gain from population	9	-	-	9	-
Gain from income	8	-	-	8	-
Loss from income	[1]1	-	-	[1]1	-
Loss from population	11	3	1	1	6
Gain from income	11	3	1	1	6
Loss from income	(X)	(X)	(X)	(X)	(X)
Net loss	31	6	11	7	7
Gain from population	8	1	2	5	-
Gain from income	(X)	(X)	(X)	(X)	(X)
Loss from income	8	1	2	5	-
Loss from population	[2]23	5	9	[2]2	7
Gain from income	2	1	-	1	-
Loss from income	20	4	9	-	7

X Not applicable.
[1]District of Columbia.
[2]One State shows no change due to the income factor.

population and income. Separate tallies are shown for the number of States which would gain or lose money from the adjustment for both population and income, the adjustment for the population factor only (including urbanized population), and the adjustment for the per capita income factor only. Many more States would lose money (31) than would gain money (20). Sixteen States and the District of Columbia would gain money from the population adjustment considered separately, but eight of these would sustain a net loss in funds received as a result of the fact that the gain through the population adjustment is more than offset by a loss through the income adjustment. Most (five) of the latter States are in the South. The eight other States among the 16 would gain through the income adjustment as well as the population adjustment and, hence, would show a net gain in funds received. These eight States are all in the South.

Thirty-four States would lose funds as a result of the population adjustment considered separately. Eleven of these states, mostly (6) in the West, would show a net gain in funds received as a result of the fact that the gains from the income adjustment exceed the losses from the population adjustment. For most (20) of the 34 States losses from population would be combined with losses from income to produce larger net losses in funds received. These States are all in the North and West.

According to this series, the adjustment of the population factor is never responsible for any significant change in funds apportioned to the States under General Revenue Sharing (table 4). When the population factor alone (including urbanized population) is corrected, all 50 States shift by less than 2 percent (2.2 percent for the District of Columbia), 46 shift by less than 1 percent, and 27 shift by less than one-half of 1 percent. The effect of adjusting the per capita income factor is much greater, with 14 States showing shifts over 2 percent, 10 States over 3 percent, and 4 States over 6 percent. Still, 36 States and the District show shifts under 2 percent and 26 States show shifts under 1 percent. When the two factors are both adjusted at once, their effects may be additive and now 17 States show shifts in excess of 2 percent. Still, 33 States and the District of Columbia show shifts of less than 2 percent and 27 States and the District show shifts of less than 1 percent. (See table H.)

More States would gain revenue-sharing funds and fewer would lose funds if the synthetic method modified on the basis of median family income were used to adjust the population factor rather than the basic synthetic method (table 4 and table I). Thirteen States and the District of Columbia would gain funds from the adjustment of the population factor only and all of these except the District would show a net gain in revenue-sharing funds, even though four of these States would lose funds from the adjustment of the income factor only. Thiry-seven States would lose funds as a result of the population adjustment but nine of these would show a net gain in revenue-sharing funds because of the offsetting effect of the income adjustment. Most States (24) losing through the population adjustment would also lose through the income adjustment and hence would experience a net loss in revenue-sharing funds.

Table H. Number of States With Specified Percentage Shifts in Population and in Funds Apportioned Under General Revenue Sharing, According to Factor Adjusted: Population Adjustment by Basic Synthetic Method

(National coverage rates for population by age, sex, and race)

Percent shift	Population	Apportioned funds		
		Population only	Per capita income only	Population and per capita income
Total	51	51	51	51
Under 1.0	-	46	26	[1]28
1.0 to 1.9	15	4	[1]11	6
2.0 to 2.9	27	[1]1	4	7
3.0 to 3.9	8	-	4	4
4.0 to 4.9	-	-	2	2
5.0 to 5.9	-	-	-	-
6.0 and over	[1]1	-	4	4

[1]Includes the District of Columbia.

Table I. Number of States Gaining or Losing General Revenue Sharing Funds as a Result of the Adjustment of the Population Factor (Modified Synthetic Method Based on Median Family Income), the Income Factor, or Both Factors, by Regions

("Net gain" or "net loss" refers to the effect of adjusting both the population factor and the per capita income factor jointly; gain or loss from population refers to the effect of adjusting the general population factor and the urbanized population factor; and the gain or loss from income refers to the effect of adjusting the per capita income factor. The adjustment of the per capita income factor includes a population adjustment based on the modified (median family income) synthetic method and an income adjustment incorporating the "BEA" income data)

Gain or loss	United States	North-east	North Central	South	West
Total	51	9	12	17	13
Net gain	22	1	1	15	5
Gain from population	13	-	-	13	-
Gain from income	9	-	-	9	-
Loss from income	4	-	-	4	-
Loss from population	9	1	1	2	5
Gain from income	9	1	1	2	5
Loss from income	(X)	(X)	(X)	(X)	(X)
Net loss	29	8	11	2	8
Gain from population	1	-	-	1	-
Gain from income	(X)	(X)	(X)	(X)	(X)
Loss from income	[1]1	-	-	[1]1	-
Loss from population	[2]28	[2]8	11	1	8
Gain from income	3	2	-	-	1
Loss from income	24	5	11	1	7

X Not applicable.
[1]District of Columbia.
[2]One State shows no change due to the income factor.

Even with the more extreme adjustments of the modified synthetic method, the allocations for the large majority of States (45) and the District of Columbia change less than 2 percent as a result of the population adjustment and the allocations for 42 States and the District change less than 1 percent (table J). The combined effect of the adjustment of population and per capita income is to cause changes of 3 percent or more in 13 States, but still 35 States and the District change less than 2 percent.

With an apportionment of $5.3 billion, under the assumption that the population factor should be adjusted by the basic synthetic method and the per capita income factor should be fully adjusted for understatement of income and population, two States would gain more than $3 million (less than 0.1 percent of the national total) and two States would lose more than $3 million. The former States are Florida and Alabama, and the latter States are New York and Iowa. When the synthetic method modified on the basis of median family income is used to adjust the population, five States gain more than $3 million and five States lose more than $3 million. The States which would experience large absolute gains are all located in the South and the States which would experience large absolute losses are all located in the North and West.

The role of the income component is even more dominant when the General Revenue Sharing formula is applied to counties and cities. As for the States, if the income component is corrected solely for the omission of the income of those missed in the census and if it is assumed that the per capita income of missed persons equals or approximates that of enumerated persons, then the corrections of population and income in the per capita income factor tend wholly to offset one another, and there would remain only the adjustment of population in the population factor. At the local level, however, the income component in the tax effort factor also requires adjustment and if the adjustment is limited to the inclusion of the income of those missed, then the adjustments for the population factor and for the income component in the tax effort factor tend wholly

Table J. Number of States With Specified Percentage Shifts in Population and in Funds Apportioned Under General Revenue Sharing, According to Factor Adjusted: Population Adjustment by Modified Synthetic Method (Median Family Income)

Percent shift	Population	Apportioned funds		
		Population only	Per capita income only	Population and per capita income
Total	51	51	51	51
Under 1.0	1	[1]43	28	19
1.0 to 1.9	14	3	11	[1]17
2.0 to 2.9	25	4	[1]3	2
3.0 to 3.9	4	-	1	4
4.0 to 4.9	[1]5	1	4	4
5.0 to 5.9	1	-	-	-
6.0 and over	1	-	4	5

[1]Includes the District of Columbia.

to offset one another, as suggested by the formula $T \times \left(\frac{P}{I}\right)^2$. The adjustments for population and income then have virtually no effect on the revenue-sharing allocations at the county and city levels. If the income component is further corrected for the understatement of the income of those who were counted in the census, then quite clearly the income correction dominates the adjustments (since the adjustment is squared) and local areas with relatively small income corrections will be relatively favored. The constraints which the General Revenue Sharing Act calls for in the allocation formula for counties and cities tend to eliminate extreme differences in per capita allotments. They impose some qualifications on the generalization made here but the essential conclusion stands.

The Census Bureau has not carried out any illustrative calculations of corrected disbursements under General Revenue Sharing for areas within States. Such illustrative calculations have been presented elsewhere.[30] These all fail to make adequate allowance in the application of the formula for the understatement of the income component or to take account of the apportionment feature of the Act. The review of the data employed by the Office of Revenue Sharing in the calculation of the revenue-sharing allocations, conducted by the Stanford Research Institute at the request of the Office of Revenue Sharing, calls attention to the errors in the data on population and aggregate income and presents illustrative estimates of corrected allocations for the counties in a single State (California) and for local governmental units in three counties. For the county calculations the adjustment for population employs the basic synthetic method (race and Spanish origin only) and no adjustment is made in the per capita income factor or the income component of the tax effort factor. As expected, the changes in allocations are very small or trivial; most counties gain only 0.1 percent in funds, largely because California was estimated to gain 0.1 percent in funds. Similar results are obtained for the subcounty units for which illustrative figures are given.

Although the amounts of money shift only a little for most areas in the illustrative calculations of the Stanford Research Institute and in the other studies, even these shifts may not be in the direction of equity. Without an adequate adjustment of the income data in the calculations, the results may be misleading and less equitable than if no adjustment whatever is made. Our illustrative calculations indicate clearly that the results of applying the revenue-sharing formula are often counterintuitive and that one cannot anticipate the true size and even the true direction of change in revenue-sharing allotments on the basis of the assumed adjustments for the population factor alone.

[30]Robert B. Hill and Robert B. Steffes, "Estimating the 1970 Census Undercount for State and Local Areas," National Urban League Data Service, Washington, D.C., 1973. I. Richard Savage and Bernard M. Windham, **The Importance of Bias Removal in Official Use of United States Census Counts**, The Florida State University, Department of Statistics, Tallahassee, Florida, July 1973. Robert P. Strauss and Peter B. Harkins, **The 1970 Census Undercount and Revenue Sharing: Effect on Allocations in New Jersey and Virginia**, Joint Center for Political Studies, Washington, D.C., June 1974. Stanford Research Institute, **General Revenue Sharing Data Study**, Vol. III, **Evaluation of Current and Alternative Data Sources**, by W. C. Grindley et. al., prepared for the Office of Revenue Sharing, Department of the Treasury, Menlo Park, California, August 1974.

Table 1. RATES OF NET UNDERENUMERATION ACCORDING TO THE POPULATION CORRECTED BY THE BASIC SYNTHETIC METHOD AND BY VARIOUS MODIFIED SYNTHETIC METHODS, FOR STATES, DIVISIONS, AND REGIONS: 1970

(See text for explanation of methods)

Region, division, and State	Basic synthetic method		Modified synthetic method		
	Age, sex, and race	Race only	Proportion at low income level	Median family income	Educational attainment
United States, total	2.5	2.5	2.5	2.5	2.5
Northeast	2.4	2.4	2.3	2.1	2.3
New England	2.1	2.1	2.0	1.8	2.0
Maine	1.9	1.9	1.9	2.2	1.8
New Hampshire	1.9	1.9	1.8	1.9	1.8
Vermont	1.9	1.9	1.9	2.0	1.8
Massachusetts	2.1	2.1	2.0	1.8	2.0
Rhode Island	2.1	2.1	2.0	2.0	2.1
Connecticut	2.3	2.3	2.1	1.8	2.1
Middle Atlantic	2.6	2.5	2.3	2.2	2.4
New York	2.6	2.6	2.4	2.2	2.4
New Jersey	2.6	2.5	2.3	2.0	2.4
Pennsylvania	2.4	2.4	2.3	2.2	2.3
North Central	2.4	2.4	2.2	2.1	2.3
East North Central	2.5	2.5	2.3	2.1	2.4
Ohio	2.5	2.5	2.3	2.1	2.3
Indiana	2.3	2.3	2.2	2.1	2.2
Illinois	2.7	2.7	2.5	2.1	2.5
Michigan	2.6	2.6	2.3	2.0	2.4
Wisconsin	2.1	2.1	2.0	1.9	2.0
West North Central	2.2	2.1	2.1	2.2	2.1
Minnesota	2.0	1.9	1.9	1.8	1.9
Iowa	2.0	2.0	1.9	2.0	1.9
Missouri	2.5	2.5	2.4	2.5	2.5
North Dakota	1.9	1.9	1.9	2.3	1.9
South Dakota	1.9	1.8	1.9	2.3	1.8
Nebraska	2.1	2.1	2.0	2.2	2.0
Kansas	2.2	2.2	2.1	2.3	2.1
South	3.0	3.1	3.0	3.6	3.3
South Atlantic	3.1	3.2	3.1	3.4	3.4
Delaware	2.8	2.8	2.6	2.5	2.7
Maryland	3.0	3.0	2.7	2.3	2.9
District of Columbia	6.4	6.1	5.1	4.2	5.1
Virginia	3.0	3.0	2.9	3.0	3.2
West Virginia	2.0	2.1	2.2	2.7	2.4
North Carolina	3.2	3.2	3.2	3.9	3.6
South Carolina	3.7	3.7	3.8	4.7	4.5
Georgia	3.4	3.5	3.4	4.1	4.0
Florida	2.8	2.8	2.8	3.2	2.9
East South Central	3.0	3.1	3.2	4.4	3.6
Kentucky	2.3	2.3	2.4	2.9	2.7
Tennessee	2.8	2.9	2.9	3.5	3.1
Alabama	3.3	3.5	3.6	4.8	4.0
Mississippi	3.8	4.1	4.5	7.2	5.1
West South Central	2.8	2.8	2.9	3.5	3.0
Arkansas	2.9	3.0	3.2	4.8	3.5
Louisiana	3.6	3.7	3.8	5.1	4.2
Oklahoma	2.3	2.2	2.3	2.8	2.2
Texas	2.7	2.7	2.6	2.9	2.6
West	2.2	2.1	2.0	1.9	1.9
Mountain	2.0	2.0	1.9	2.0	1.9
Montana	1.9	1.8	1.8	2.0	1.8
Idaho	1.9	1.9	1.9	2.1	1.8
Wyoming	1.9	1.9	1.9	2.0	1.8
Colorado	2.1	2.1	2.0	2.0	1.9
New Mexico	1.9	1.9	2.0	2.2	1.8
Arizona	2.0	2.0	1.9	2.0	1.9
Utah	1.9	1.9	1.9	1.9	1.8
Nevada	2.3	2.2	2.1	1.9	2.1
Pacific	2.2	2.2	2.0	1.8	2.0
Washington	2.0	2.0	1.9	1.8	1.9
Oregon	2.0	2.0	1.9	1.9	1.9
California	2.3	2.3	2.1	1.9	2.1
Alaska	2.1	1.8	1.6	1.2	1.6
Hawaii	1.3	0.8	0.8	0.7	0.7

Table 2. DISTRIBUTION OF ONE BILLION DOLLARS BY STATES, DIVISIONS, AND REGIONS ACCORDING TO THE 1970 CENSUS POPULATION COUNT AND THE 1970 CENSUS POPULATION CORRECTED BY THE BASIC SYNTHETIC METHOD AND BY VARIOUS MODIFIED SYNTHETIC METHODS

(See text for explanation of methods. Numbers in thousands)

Region, division, and State	Census count	Basic synthetic method[1]	Modified synthetic method			Difference from census count							
						Basic synthetic method[1]		Modified synthetic method					
			Proportion at low income level	Median family income	Educational attainment	Amount	Percent	Proportion at low income level		Median family income		Educational attainment	
								Amount	Percent	Amount	Percent	Amount	Percent
United States, total	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	-	-	-	-	-	-	-	-
Northeast	241,348	241,066	240,863	240,238	240,762	-283	-0.1	-485	-0.2	-1,111	-0.5	-586	-0.2
New England	58,293	58,028	58,011	57,878	57,968	-265	-0.5	-282	-0.5	-415	-0.7	-325	-0.6
Maine	4,889	4,857	4,862	4,873	4,855	-32	-0.7	-27	-0.6	-16	-0.3	-35	-0.7
New Hampshire	3,630	3,607	3,607	3,605	3,604	-23	-0.6	-23	-0.6	-25	-0.7	-26	-0.7
Vermont	2,188	2,174	2,176	2,177	2,172	-14	-0.7	-12	-0.5	-12	-0.5	-16	-0.7
Massachusetts	27,993	27,861	27,853	27,778	27,829	-132	-0.5	-140	-0.5	-215	-0.8	-165	-0.6
Rhode Island	4,673	4,649	4,651	4,646	4,650	-24	-0.5	-22	-0.5	-27	-0.6	-23	-0.5
Connecticut	14,920	14,880	14,862	14,800	14,858	-40	-0.3	-58	-0.4	-120	-0.8	-61	-0.4
Middle Atlantic	183,056	183,037	182,851	182,359	182,794	-18	-	-205	-0.1	-696	-0.4	-262	-0.1
New York	89,754	89,831	89,712	89,426	89,660	+77	+0.1	-42	-	-328	-0.4	-94	-0.1
New Jersey	35,270	35,275	35,218	35,078	35,226	+4	-	-52	-0.1	-193	-0.5	-44	-0.1
Pennsylvania	58,031	57,931	57,921	57,856	57,907	-100	-0.2	-110	-0.2	-175	-0.3	-124	-0.2
North Central	278,382	277,921	277,763	277,122	277,616	-462	-0.2	-619	-0.2	-1,260	-0.5	-766	-0.3
East North Central	198,059	197,928	197,735	197,083	197,680	-132	-0.1	-324	-0.2	-976	-0.5	-380	-0.2
Ohio	52,412	52,357	52,318	52,173	52,303	-55	-0.1	-94	-0.2	-239	-0.5	-110	-0.2
Indiana	25,555	25,195	25,479	25,428	25,471	-60	-0.2	-76	-0.3	-127	-0.5	-84	-0.3
Illinois	54,685	54,762	54,685	54,458	54,669	+77	+0.1	-	-	-227	-0.4	-16	-
Michigan	43,669	43,683	43,622	43,430	43,621	+14	-	-47	-0.1	-239	-0.5	-48	-0.1
Wisconsin	21,738	21,630	21,631	21,594	21,616	-108	-0.5	-107	-0.5	-144	-0.7	-122	-0.6
West North Central	80,323	79,993	80,028	80,039	79,936	-330	-0.4	-295	-0.4	-284	-0.4	-386	-0.5
Minnesota	18,722	18,608	18,614	18,586	18,592	-114	-0.6	-108	-0.6	-136	-0.7	-131	-0.7
Iowa	13,900	13,818	13,826	13,830	13,807	-82	-0.6	-74	-0.5	-71	-0.5	-93	-0.7
Missouri	23,015	23,003	23,009	23,005	22,995	-12	-0.1	-6	-	-10	-	-19	-0.1
North Dakota	3,040	3,019	3,023	3,031	3,020	-21	-0.7	-17	-0.6	-9	-0.3	-20	-0.6
South Dakota	3,278	3,255	3,259	3,269	3,253	-24	-0.7	-19	-0.6	-9	-0.3	-25	-0.8
Nebraska	7,301	7,265	7,269	7,278	7,257	-36	-0.5	-32	-0.4	-23	-0.3	-44	-0.6
Kansas	11,066	11,025	11,029	11,040	11,012	-41	-0.4	-37	-0.3	-26	-0.2	-55	-0.5
South	308,993	310,423	310,858	312,512	311,387	+1,430	+0.5	+1,865	+0.6	+3,519	+1.1	+2,393	+0.8
South Atlantic	150,915	151,823	151,850	152,305	152,219	+908	+0.6	+935	+0.6	+1,389	+0.9	+1,304	+0.9
Delaware	2,697	2,703	2,700	2,695	2,700	+6	+0.2	+3	+0.1	-2	-0.1	+3	+0.1
Maryland	19,300	19,393	19,345	19,260	19,366	+93	+0.5	+45	+0.2	-40	-0.2	+66	+0.3
District of Columbia	3,722	3,871	3,825	3,786	3,824	+152	+4.1	+103	+2.8	+64	+1.7	+102	+2.7
Virginia	22,872	22,985	22,972	22,989	23,025	+112	+0.5	+100	+0.4	+117	+0.5	+152	+0.7
West Virginia	8,582	8,537	8,565	8,597	8,566	-45	-0.5	-17	-0.2	+15	+0.2	-16	-0.2
North Carolina	25,006	25,167	25,198	25,349	25,278	+161	+0.6	+192	+0.8	+343	+1.4	+272	+1.1
South Carolina	12,746	12,891	12,921	13,041	13,003	+145	+1.1	+175	+1.4	+295	+2.3	+257	+2.0
Georgia	22,583	22,789	22,809	22,946	22,927	+207	+0.9	+226	+1.0	+363	+1.6	+344	+1.5
Florida	33,407	33,183	33,515	33,641	33,530	+76	+0.2	+108	+0.3	+234	+0.7	+123	+0.4
East South Central	63,004	63,293	63,524	64,204	63,683	+290	+0.5	+520	+0.8	+1,200	+1.9	+680	+1.1
Kentucky	15,840	15,800	15,838	15,898	15,864	-40	-0.3	-2	-	+57	+0.4	+24	+0.1
Tennessee	19,308	19,356	19,396	19,503	19,422	+48	+0.3	+88	+0.5	+195	+1.0	+113	+0.6
Alabama	16,947	17,083	17,148	17,348	17,200	+137	+0.8	+201	+1.2	+401	+2.4	+253	+1.5
Mississippi	10,908	11,054	11,142	11,455	11,198	+146	+1.3	+234	+2.1	+547	+5.0	+290	+2.7
West South Central	95,074	95,307	95,484	96,003	95,484	+232	+0.2	+410	+0.4	+929	+1.0	+410	+0.4
Arkansas	9,463	9,493	9,540	9,690	9,558	+29	+0.3	+77	+0.8	+227	+2.4	+95	+1.0
Louisiana	17,926	18,118	18,179	18,404	18,244	+192	+1.1	+253	+1.4	+478	+2.7	+319	+1.8
Oklahoma	12,593	12,553	12,569	12,620	12,543	-40	-0.3	-24	-0.2	+27	+0.2	-50	-0.4
Texas	55,092	55,144	55,196	55,290	55,139	+51	+0.1	+104	+0.2	+197	+0.4	+46	+0.1
West	171,276	170,591	170,517	170,128	170,235	-685	-0.4	-759	-0.4	-1,148	-0.7	-1,041	-0.6
Mountain	40,759	40,521	40,547	40,540	40,476	-237	-0.6	-212	-0.5	-219	-0.5	-282	-0.7
Montana	3,417	3,393	3,395	3,399	3,389	-24	-0.7	-22	-0.6	-18	-0.5	-27	-0.8
Idaho	3,508	3,484	3,488	3,494	3,482	-24	-0.7	-20	-0.6	-14	-0.4	-26	-0.7
Wyoming	1,636	1,625	1,626	1,627	1,624	-11	-0.7	-10	-0.6	-9	-0.5	-12	-0.7
Colorado	10,861	10,811	10,812	10,799	10,791	-50	-0.5	-49	-0.5	-61	-0.6	-69	-0.6
New Mexico	4,999	4,965	4,975	4,982	4,961	-34	-0.7	-24	-0.5	-18	-0.4	-38	-0.8
Arizona	8,721	8,668	8,676	8,671	8,664	-53	-0.6	-45	-0.5	-50	-0.6	-57	-0.7
Utah	5,212	5,177	5,181	5,179	5,172	-36	-0.7	-31	-0.6	-33	-0.6	-40	-0.8
Nevada	2,405	2,398	2,395	2,389	2,393	-6	-0.3	-10	-0.4	-16	-0.7	-12	-0.5
Pacific	130,518	130,069	129,970	129,588	129,759	-448	-0.3	-548	-0.4	-930	-0.7	-758	-0.6
Washington	16,774	16,683	16,680	16,640	16,657	-92	-0.5	-94	-0.6	-134	-0.8	-117	-0.7
Oregon	10,290	10,226	10,233	10,226	10,219	-64	-0.6	-57	-0.6	-64	-0.6	-72	-0.7
California	98,178	97,940	97,857	97,538	97,692	-237	-0.2	-321	-0.3	-640	-0.7	-486	-0.5
Alaska	1,487	1,479	1,474	1,466	1,472	-8	-0.5	-13	-0.9	-20	-1.4	-14	-1.0
Hawaii	3,788	3,740	3,725	3,717	3,719	-48	-1.3	-63	-1.7	-71	-1.9	-69	-1.8

- Rounds to less than 500,000 or to less than ± 0.05 percent.

[1]Based on population adjusted by national underenumeration rates for age, sex, and race groups.

Table 3. AMOUNTS OF GENERAL REVENUE SHARING MONEY BASED ON 1970 CENSUS REPORTED DATA AND 1970 CENSUS DATA CORRECTED BY THE BASIC SYNTHETIC METHOD FOR STATES, DIVISIONS, AND REGIONS

(Numbers in thousands. Coverage rates for population are national rates by age, sex, and race)

Region, division, and State	Census[1]	Corrected population only[2]	Corrected per capita income	Corrected population[2] and per capita income	Difference from census					
					Corrected population only		Corrected per capita income		Corrected population and per capita income	
					Amount	Percent	Amount	Percent	Amount	Percent
United States, total	5,300,000	5,300,000	5,300,000	5,300,000	-	-	-	-	-	-
Northeast	1,362,034	1,360,954	1,354,551	1,353,474	-1,080	-0.1	-7,483	-0.5	-8,560	-0.6
New England	322,209	321,108	320,991	319,896	-1,101	-0.3	-1,218	-0.4	-2,313	-0.7
Maine	32,678	32,458	31,382	31,171	-220	-0.7	-1,296	-4.0	-1,507	-4.6
New Hampshire	16,544	16,437	17,017	16,908	-107	-0.6	+473	+2.9	+364	+2.2
Vermont	14,855	14,759	14,875	14,779	-96	-0.6	+20	+0.1	-76	-0.5
Massachusetts	166,005	165,535	165,447	164,978	-470	-0.3	-558	-0.3	-1,027	-0.6
Rhode Island	24,255	24,168	24,150	24,062	-87	-0.4	-105	-0.4	-193	-0.8
Connecticut	67,872	67,751	68,120	67,998	-121	-0.2	+248	+0.4	+126	+0.2
Middle Atlantic	1,039,825	1,039,846	1,033,560	1,033,578	+21	-	-6,265	-0.6	-6,247	-0.6
New York	593,420	593,603	587,520	587,698	+183	-	-5,900	-1.0	-5,722	-1.0
New Jersey	167,380	167,370	168,398	168,388	-10	-	+1,018	+0.6	+1,008	+0.6
Pennsylvania	279,025	278,873	277,642	277,492	-152	-0.1	-1,383	-0.5	-1,533	-0.5
North Central	1,378,138	1,376,007	1,366,908	1,364,835	-2,131	-0.2	-11,230	-0.8	-13,303	-1.0
East North Central	962,671	962,144	961,000	960,463	-527	-0.1	-1,671	-0.2	-2,208	-0.2
Ohio	214,929	214,879	214,239	214,189	-50	-	-690	-0.3	-740	-0.3
Indiana	114,321	114,035	114,185	113,901	-286	-0.3	-136	-0.1	-420	-0.4
Illinois	275,147	275,483	272,917	273,250	+336	+0.1	-2,230	-0.8	-1,897	-0.7
Michigan	223,954	224,109	223,536	223,690	+155	+0.1	-418	-0.2	-264	-0.1
Wisconsin	134,320	133,638	136,123	135,433	-682	-0.5	+1,803	+1.3	+1,113	+0.8
West North Central	415,467	413,863	405,908	404,372	-1,604	-0.4	-9,559	-2.3	-11,095	-2.7
Minnesota	106,828	106,459	106,579	106,211	-369	-0.3	-249	-0.2	-617	-0.6
Iowa	76,508	76,045	73,413	72,970	-463	-0.6	-3,095	-4.0	-3,538	-4.6
Missouri	98,813	98,750	98,425	98,374	-63	-0.1	-388	-0.4	-439	-0.4
North Dakota	19,891	19,752	19,470	19,334	-139	-0.7	-421	-2.1	-557	-2.8
South Dakota	23,633	23,456	21,878	21,715	-177	-0.7	-1,755	-7.4	-1,918	-8.1
Nebraska	38,389	38,195	35,595	35,415	-194	-0.5	-2,794	-7.3	-2,974	-7.7
Kansas	51,405	51,206	50,548	50,353	-199	-0.4	-857	-1.7	-1,052	-2.0
South	1,605,758	1,612,893	1,619,428	1,626,540	+7,135	+0.4	+13,670	+0.9	+20,782	+1.3
South Atlantic	762,690	766,518	775,934	779,790	+3,828	+0.5	+13,244	+1.7	+17,100	+2.2
Delaware	16,066	16,082	15,824	15,839	+16	+0.1	-242	-1.5	-227	-1.4
Maryland	107,297	107,596	108,068	108,370	+299	+0.3	+771	+0.7	+1,073	+1.0
District of Columbia	23,937	24,465	23,551	24,065	+528	+2.2	-386	-1.6	+128	+0.5
Virginia	106,383	106,701	107,427	107,751	+318	+0.3	+1,044	+1.0	+1,368	+1.3
West Virginia	50,903	50,630	51,167	50,893	-273	-0.5	+264	+0.5	-10	-
North Carolina	135,591	136,444	133,724	134,567	+853	+0.6	-1,867	-1.4	-1,024	-0.8
South Carolina	71,580	72,383	71,801	72,608	+803	+1.1	+221	+0.3	+1,028	+1.4
Georgia	108,049	109,023	109,431	110,418	+974	+0.9	+1,382	+1.3	+2,369	+2.2
Florida	142,884	143,194	154,941	155,279	+310	+0.2	+12,057	+8.4	+12,395	+8.7
East South Central	359,764	361,619	360,972	362,813	+1,855	+0.5	+1,208	+0.3	+3,049	+0.8
Kentucky	85,722	85,492	85,723	85,494	-230	-0.3	+1	-	-228	-0.3
Tennessee	98,049	98,278	99,881	100,115	+229	+0.2	+1,832	+1.9	+2,066	+2.1
Alabama	89,225	89,932	91,806	92,534	+707	+0.8	+2,581	+2.9	+3,309	+3.7
Mississippi	86,768	87,917	83,562	84,670	+1,149	+1.3	-3,206	-3.7	-2,098	-2.4
West South Central	483,304	484,756	482,522	483,937	+1,452	+0.3	-782	-0.2	+633	+0.1
Arkansas	52,670	52,827	50,790	50,942	+157	+0.3	-1,880	-3.6	-1,728	-3.3
Louisiana	122,477	123,769	119,512	120,774	+1,292	+1.1	-2,965	-2.4	-1,703	-1.4
Oklahoma	59,025	58,829	61,226	61,024	-196	-0.3	+2,201	+3.7	+1,999	+3.4
Texas	249,132	249,331	250,994	251,197	+199	+0.1	+1,862	+0.7	+2,065	+0.8
West	954,071	950,143	959,115	955,153	-3,928	-0.4	+5,044	+0.5	+1,082	+0.1
Mountain	227,079	225,791	231,729	230,414	-1,288	-0.6	+4,650	+2.0	+3,335	+1.5
Montana	20,167	20,025	20,030	19,889	-142	-0.7	-137	-0.7	-278	-1.4
Idaho	21,118	20,972	21,467	21,320	-146	-0.7	+349	+1.7	+202	+1.0
Wyoming	9,542	9,478	9,539	9,475	-64	-0.7	-3	-	-67	-0.7
Colorado	54,307	54,126	54,862	54,678	-181	-0.3	+555	+1.0	+371	+0.7
New Mexico	32,817	32,592	32,460	32,238	-225	-0.7	-357	-1.1	-579	-1.8
Arizona	47,707	47,410	49,868	49,558	-297	-0.6	+2,161	+4.5	+1,851	+3.9
Utah	29,907	29,698	32,024	31,801	-209	-0.7	+2,117	+7.1	+1,894	+6.3
Nevada	11,514	11,490	11,479	11,455	-24	-0.2	-35	-0.3	-59	-0.5
Pacific	726,992	724,352	727,386	724,739	-2,640	-0.4	+394	+0.1	-2,253	-0.3
Washington	80,785	80,333	81,607	81,151	-452	-0.6	+822	+1.0	+366	+0.5
Oregon	53,061	52,859	53,510	53,304	-202	-0.4	+449	+0.8	+243	+0.5
California	563,150	561,638	562,432	560,920	-1,512	-0.3	-718	-0.1	-2,230	-0.4
Alaska	6,227	6,211	6,195	6,178	-16	-0.3	-32	-0.5	-49	-0.8
Hawaii	23,769	23,311	23,642	23,186	-458	-1.9	-127	-0.5	-583	-2.5

- Zero or rounds to less than ± 0.05 percent.

[1]Distribution differs from official entitlements published by the Office of Revenue Sharing partly because the official entitlements exclude money held in reserve.

[2]Pertains to the general population factor and the urbanized population factor.

Table 4. AMOUNTS OF GENERAL REVENUE SHARING MONEY BASED ON 1970 CENSUS REPORTED DATA AND 1970 CENSUS DATA CORRECTED BY A MODIFIED SYNTHETIC METHOD FOR STATES, DIVISIONS AND REGIONS

(Numbers in thousands. Synthetic method modified on the basis of median family income)

Region, division, and State	Census[1]	Corrected population only[2]	Corrected per capita income	Corrected population[2] and per capita income	Difference from census					
					Corrected population only		Corrected per capita income		Corrected population and per capita income	
					Amount	Percent	Amount	Percent	Amount	Percent
United States, total	5,300,000	5,300,000	5,300,000	5,300,000	-	-	-	-	-	-
Northeast	1,362,034	1,356,962	1,351,285	1,346,219	-5,072	-0.4	-10,749	-0.8	-15,815	-1.2
New England	322,209	320,357	320,302	318,443	-1,852	-0.6	-1,907	-0.6	-3,766	-1.2
Maine	32,678	32,504	31,406	31,236	-174	-0.5	-1,272	-3.9	-1,442	-4.4
New Hampshire	16,544	16,399	16,967	16,816	-145	-0.9	+423	+2.6	+272	+1.6
Vermont	14,855	14,749	14,856	14,749	-106	-0.7	+1	-	-106	-0.7
Massachusetts	166,005	165,117	165,054	164,167	-888	-0.5	-951	-0.6	-1,838	-1.1
Rhode Island	24,255	24,133	24,100	23,977	-122	-0.5	-155	-0.6	-278	-1.1
Connecticut	67,872	67,455	67,919	67,498	-417	-0.6	+47	+0.1	-374	-0.6
Middle Atlantic	1,039,825	1,036,605	1,030,983	1,027,776	-3,220	-0.3	-8,842	-0.9	-12,049	-1.2
New York	593,420	591,797	586,076	584,476	-1,623	-0.3	-7,344	-1.2	-8,944	-1.5
New Jersey	167,380	166,557	167,889	167,056	-823	-0.5	+509	+0.3	-324	-0.2
Pennsylvania	279,025	278,251	277,018	276,244	-774	-0.3	-2,007	-0.7	-2,781	-1.0
North Central	1,378,138	1,371,546	1,363,141	1,356,614	-6,592	-0.5	-14,997	-1.1	-21,524	-1.6
East North Central	962,671	958,024	957,793	953,128	-4,647	-0.5	-4,878	-0.5	-9,543	-1.0
Ohio	214,929	214,021	213,626	212,717	-908	-0.4	-1,303	-0.6	-2,212	-1.0
Indiana	114,321	113,539	113,618	112,832	-782	-0.7	-703	-0.6	-1,489	-1.3
Illinois	275,147	274,275	272,119	271,256	-872	-0.3	-3,028	-1.1	-3,891	-1.4
Michigan	223,954	223,010	222,859	221,914	-944	-0.4	-1,095	-0.5	-2,040	-0.9
Wisconsin	134,320	133,179	135,571	134,409	-1,141	-0.8	+1,251	+0.9	+89	+0.1
West North Central	415,467	413,522	405,348	403,486	-1,945	-0.5	-10,119	-2.4	-11,981	-2.9
Minnesota	106,828	106,260	106,350	105,782	-568	-0.5	-478	-0.4	-1,046	-1.0
Iowa	76,508	75,978	73,302	72,788	-530	-0.7	-3,206	-4.2	-3,720	-4.9
Missouri	98,813	98,585	98,199	98,019	-228	-0.2	-614	-0.6	-794	-0.8
North Dakota	19,891	19,796	19,502	19,408	-95	-0.5	-389	-2.0	-483	-2.4
South Dakota	23,633	23,523	21,927	21,823	-110	-0.5	-1,706	-7.2	-1,810	-7.7
Nebraska	38,389	38,193	35,571	35,387	-196	-0.5	-2,818	-7.3	-3,002	-7.8
Kansas	51,405	51,187	50,497	50,279	-218	-0.4	-908	-1.8	-1,126	-2.2
South	1,605,758	1,622,996	1,628,795	1,646,028	+17,238	+1.1	+23,037	+1.4	+40,270	+2.5
South Atlantic	762,690	768,225	777,646	783,216	+5,535	+0.7	+14,956	+2.0	+20,526	+2.7
Delaware	16,066	16,037	15,786	15,758	-29	-0.2	-280	-1.7	-308	-1.9
Maryland	107,297	107,060	107,731	107,487	-237	-0.2	+434	+0.4	+190	+0.2
District of Columbia	23,937	24,155	23,443	23,654	+218	+0.9	-494	-2.1	-283	-1.2
Virginia	106,383	106,585	107,219	107,420	+202	+0.2	+836	+0.8	+1,037	+1.0
West Virginia	50,903	50,898	51,405	51,396	-5	-	+502	+1.0	+493	+1.0
North Carolina	135,591	137,193	134,374	135,950	+1,602	+1.2	-1,217	-0.9	+359	+0.3
South Carolina	71,580	73,097	72,463	73,992	+1,517	+2.1	+883	+1.2	+2,412	+3.4
Georgia	108,049	109,582	109,924	111,474	+1,533	+1.4	+1,875	+1.7	+3,425	+3.2
Florida	142,884	143,618	155,301	156,085	+734	+0.5	+12,417	+8.7	+13,201	+9.2
East South Central	359,764	366,838	365,844	372,971	+7,074	+2.0	+6,080	+1.7	+13,207	+3.7
Kentucky	85,722	85,870	86,047	86,189	+148	+0.2	+325	+0.4	+467	+0.5
Tennessee	98,049	98,853	100,401	101,216	+804	+0.8	+2,352	+2.4	+3,167	+3.2
Alabama	89,225	91,166	93,007	95,022	+1,941	+2.2	+3,782	+4.2	+5,797	+6.5
Mississippi	86,768	90,949	86,389	90,544	+4,181	+4.8	-379	-0.4	+3,776	+4.4
West South Central	483,304	487,933	485,305	489,841	+4,629	+1.0	+2,001	+0.4	+6,537	+1.4
Arkansas	52,670	53,830	51,721	52,855	+1,160	+2.2	-949	-1.8	+185	+0.4
Louisiana	122,477	125,507	121,114	124,100	+3,030	+2.5	-1,363	-1.1	+1,623	+1.3
Oklahoma	59,025	59,041	61,408	61,419	+16	-	+2,383	+4.0	+2,394	+4.1
Texas	249,132	249,555	251,062	251,467	+423	+0.2	+1,930	+0.8	+2,335	+0.9
West	954,071	948,497	956,783	951,139	-5,574	-0.6	+2,712	+0.3	-2,932	-0.3
Mountain	227,079	225,620	231,428	229,917	-1,459	-0.6	+4,349	+1.9	+2,838	+1.2
Montana	20,167	20,025	20,018	19,875	-142	-0.7	-149	-0.7	-292	-1.4
Idaho	21,118	20,992	21,474	21,344	-126	-0.6	+356	+1.7	+226	+1.1
Wyoming	9,542	9,472	9,526	9,455	-70	-0.7	-16	-0.2	-87	-0.9
Colorado	54,307	54,029	54,741	54,457	-278	-0.5	+434	+0.8	+150	+0.3
New Mexico	32,817	32,639	32,486	32,308	-178	-0.5	-331	-1.0	-509	-1.6
Arizona	47,707	47,344	49,768	49,385	-363	-0.8	+2,061	+4.3	+1,678	+3.5
Utah	29,907	29,663	31,966	31,703	-244	-0.8	+2,059	+6.9	+1,796	+6.0
Nevada	11,514	11,456	11,449	11,390	-58	-0.5	-65	-0.6	-124	-1.1
Pacific	726,992	722,877	725,355	721,222	-4,115	-0.6	-1,637	-0.2	-5,770	-0.8
Washington	80,785	79,987	81,205	80,396	-798	-1.0	+420	+0.5	-389	-0.5
Oregon	53,061	52,804	53,405	53,142	-257	-0.5	+344	+0.6	+81	+0.2
California	563,150	560,385	560,998	558,229	-2,765	-0.5	-2,152	-0.4	-4,921	-0.9
Alaska	6,227	6,178	6,172	6,123	-49	-0.8	-55	-0.9	-104	-1.7
Hawaii	23,769	23,523	23,575	23,332	-246	-1.0	-194	-0.8	-437	-1.8

- Zero or rounds to less than ± 0.05 percent.

[1]Distribution differs from official entitlements published by the Office of Revenue Sharing partly because the official entitlements exclude money held in reserve.

[2]Pertains to the general population factor and the urbanized population factor.

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