Appendix C. Source and Reliability of Estimates

SOURCE OF DATA

The data were collected during the third wave of the 1984 panel of the Survey of Income and Program Participation (SIPP). The SIPP universe is the noninstitutionalized resident population of persons living in the United States.[1] However, information collected from persons in the farm population or living in group quarters is not included in this report.

The 1984 panel SIPP sample is located in 174 areas comprising 450 counties (including one partial county) and independent cities. Within these areas, the bulk of the sample consisted of clusters of two to four living quarters (LQ's), systematically selected from lists of addresses prepared for the 1970 decennial census. The sample was updated to reflect new construction.

Approximately 26,000 living quarters were designated for the sample. For wave 1, interviews were obtained from the occupants of about 19,900 of the designated living quarters. Most of the remaining 6,100 living quarters were found to be vacant, demolished, converted to nonresidential use, or otherwise ineligible for the survey. However, approximately 1,000 of the 6,100 living quarters were not interviewed because the occupants refused to be interviewed, could not be found at home, were temporarily absent, or were otherwise unavailable. Thus, occupants of about 95 percent of all eligible living quarters participated in wave 1 of the survey.

For the subsequent waves, only original sample persons (those interviewed in the first wave) and persons living with them were eligible to be interviewed. With certain restrictions, original sample persons were to be followed if they moved to a new address. All noninterviewed households from wave 1 were automatically designated as noninterviews for all subsequent waves. When original sample persons moved without leaving forwarding addresses or moved to extremely remote parts of the country, additional noninterviews resulted.

Noninterviews. Tabulations in this report were drawn from interviews conducted from May through August 1984. Table C-1 summarizes information on nonresponse for the interview months in which the data used to produce this report were collected.

Table C-1. Sample Size, by Month and Interview Status

Month	Eligible	Interviewed	Non interviewed	Nonresponse rate (%)*
May 1984	5400	4900	500	10
June 1984	5500	4800	700	13
July 1984	5400	4700	700	13
August 1984	5500	4700	700	14

*Due to rounding of all numbers at 100, there are some inconsistencies. The percentage was calculated using unrounded numbers.

Some respondents do not respond to some of the questions. Therefore, the overall nonresponse rate for some items is higher than the nonresponse rates in table C-1. (See appendix D.)

Estimation. The estimation procedure used to derive SIPP person weights involved several stages of weight adjustments. In the first wave, each person received a base weight equal to the inverse of his/her probability of selection. For each subsequent interview, each person received a base weight that accounted for following movers.

A noninterview adjustment factor was applied to the weight of every occupant of interviewed households to account for households which were eligible for the sample but were not interviewed. (Individual nonresponse within partially interviewed households was treated with imputation. No special adjustment was made for noninterviews in group quarters.) A factor was applied to each interviewed person's weight to account for the SIPP sample areas not having the same population distribution as the strata from which they were selected.

An additional stage of adjustment to person weights was performed to bring the sample estimates into agree-

[1]The noninstitutionalized resident population includes persons living in group quarters, such as dormitories, rooming houses, and religious group dwellings. Crew members of merchant vessels, Armed Forces personnel living in military barracks, and institutionalized persons, such as correctional facility inmates and nursing home residents, were not eligible to be in the survey. Also, U.S. citizens residing abroad were not eligible. With these qualifications, persons who were at least 15 years of age at the time of interview were eligible to be interviewed.

ment with independent monthly estimates of the civilian (and some military) noninstitutional population of the United States by age, race, and sex. These independent estimates were based on statistics from the 1980 Census of Population; statistics on births, deaths, immigration, and emigration; and statistics on the strength of the Armed Forces. To increase accuracy, weights were further adjusted in such a manner that SIPP sample estimates would closely agree with special Current Population Survey (CPS) estimates by type of householder (married, single with relatives or single without relatives by sex and race) and relationship to householder (spouse or other).[2] The estimation procedure for the data in the report also involved an adjustment so that the husband and wife of a household received the same weight.

RELIABILITY OF ESTIMATES

SIPP estimates in this report are based on a sample; they may differ somewhat from the figures that would have been obtained if a complete census had been taken using the same questionnaire, instructions, and enumerators. There are two types of errors possible in an estimate based on a sample survey: nonsampling and sampling. The magnitude of SIPP sampling error can be estimated, but this is not true of nonsampling error. Found below are descriptions of sources of SIPP nonsampling error, followed by a discussion of sampling error, its estimation, and its use in data analysis.

Nonsampling variability. Nonsampling errors can be attributed to many sources, e.g., inability to obtain information about all cases in the sample, definitional difficulties, differences in the interpretation of questions, inability or unwillingness on the part of the respondents to provide correct information, inability to recall information, errors made in collection such as in recording or coding the data, errors made in processing the data, errors made in estimating values for missing data, biases resulting from the differing recall periods caused by the rotation pattern and failure to represent all units within the universe (undercoverage). Quality control and edit procedures were used to reduce errors made by respondents, coders, and interviewers.

Undercoverage in SIPP results from missed living quarters and missed persons within sample households. It is known that undercoverage varies with age, race, and sex. Generally, undercoverage is larger for males than for females and larger for blacks than for nonblacks. Ratio estimation to independent age-race-sex population controls partially corrects for the bias due to survey undercoverage. However, biases exist in the estimates to the extent that persons in missed households or missed persons in interviewed households have different characteristics than the interviewed persons in the same age-race-sex group. Further, the independent population controls used have not been adjusted for undercoverage in the decennial census.

The Bureau has used complex techniques to adjust the weights for nonresponse, but the success of these techniques in avoiding bias is unknown.

Comparability with other statistics. Caution should be exercised when comparing data from this report with data from earlier SIPP publications or with data from other surveys. The comparability problems are caused by sources such as the seasonal patterns for many characteristics, definitional differences, and different nonsampling errors.

Sampling variability. Standard errors indicate the magnitude of the sampling error. They also partially measure the effect of some nonsampling errors in response and enumeration, but do not measure any systematic biases in the data. The standard errors for the most part measure the variations that occurred by chance because a sample rather than the entire population was surveyed.

The sample estimate and its standard error enable one to construct confidence intervals, ranges that would include the average result of all possible samples with a known probability. For example, if all possible samples were selected, each of these being surveyed under essentially the same conditions and using the same sample design, and if an estimate and its standard error were calculated from each sample, then approximately 90 percent of the intervals from 1.6 standard errors below the estimate to 1.6 standard errors above the estimate would include the average result of all possible samples.

The average estimate derived from all possible samples is or is not contained in any particular computed interval. However, for a particular sample, one can say with a specified confidence that the average estimate derived from all possible samples is included in the confidence interval.

Standard errors may also be used for hypothesis testing, a procedure for distinguishing between population parameters using sample estimates. The most common types of hypotheses tested are 1) the population parameters are identical or 2) they are different. Tests may be performed at various levels of significance, where a level of significance is the probability of concluding that the parameters are different when, in fact, they are identical.

All statements of comparison in the report have passed a hypothesis test at the 0.10 level of significance or better. This means that, for differences cited in

[2]These special CPS estimates are slightly different from the published monthly CPS estimates. The differences arise from forcing counts of husbands to agree with counts of wives.

the report, the estimated absolute difference between parameters is greater than 1.6 times the standard error of the difference.

Note when using small estimates. Summary measures (such as percent distributions) are shown in the report only when the base is 200,000 or greater. Because of the large standard errors involved, there is little chance that summary measures would reveal useful information when computed on a smaller base. Estimated numbers are shown, however, even though the relative standard errors of these numbers are larger than those for the corresponding percentages. These smaller estimates are provided primarily to permit such combinations of the categories as serve each user's needs. Also, care must be taken in the interpretation of small differences. For instance, in case of a borderline difference, even a small amount of nonsampling error can lead to a wrong decision about the hypotheses, thus distorting a seemingly valid hypothesis test.

Standard error parameters and tables and their use. To derive standard errors that would be applicable to a wide variety of statistics and could be prepared at a moderate cost, a number of approximations were required. Most of the SIPP statistics have greater variance than those obtained through a simple random sample of the same size because clusters of living quarters are sampled for SIPP. Two parameters (denoted "a" and "b") were developed to calculate variances for each type of characteristic.

The "a" and "b" parameters vary by subgroup. Table C-4 provides "a" and "b" parameters for characteristics of interest in this report. The "a" and "b" parameters may be used to directly calculate the standard error for estimated numbers and percentages. Because the actual variance behavior was not identical for all statistics within a group, the standard errors computed from parameters provide an indication of the order of magnitude of the standard error for any specific statistic.

For those users who wish further simplification, we have also provided general standard errors in tables C-2 and C-3. Note that these standard errors must be adjusted by a factor from table C-4. The standard errors resulting from this simplified approach are less accurate. Methods for using these parameters and tables for computation of standard errors are given in the following sections.

Standard errors of estimated numbers. The approximate standard error, S_x, of an estimated number of persons, and so forth, shown in this report can be obtained in two ways. Note that neither method should be applied to dollar values.

It may be obtained by use of the formula

$$S_x = fs \qquad (1)$$

where f is the appropriate factor from table C-4, and s is the standard error on the estimate obtained by interpolation from table C-2. Alternatively, S_x may be approximated by the formula

$$S_x = \sqrt{ax^2 + bx} \qquad (2)$$

from which the standard errors in table C-2 were calculated. Use of this formula will provide more accurate results than the use of formula 1 above. Here x is the size of the estimate and "a" and "b" are the parameters associated with the particular type of character istic being estimated.

Illustration. SIPP estimates given in text table 1 show that there were 1,968,000 persons age 18-24 that earned a bachelors as their highest degree. The appropriate parameters and factor from table C-4 and the appropriate general standard error from table C-2 are

$$a = -.0000471,\ b = 6{,}073,\ f = .55,\ s = 197{,}000$$

Using formula 1, the approximate standard error is

$$S_x = .55 \times 197{,}000 = 108{,}000$$

Using formula 2, the approximate standard error is

$$\sqrt{(-.0000471)\ (1{,}968{,}000)^2 + (6{,}073)\ (1{,}968{,}000)} = 108{,}000$$

The approximate 90-percent confidence interval as shown by the data is from 1,795,000 to 2,141,000. Therefore, a conclusion that the average estimate derived from all possible samples lies within a range computed in this way would be correct for roughly 90 percent of all samples.

Table C-2. Standard Errors of Estimated Numbers of Persons
(Numbers in thousands)

Size of estimates	Standard error	Size of estimate	Standard error
200	63	50,000	883
300	77	80,000	1,020
600	109	100,000	1,062
1,000	141	130,000	1,062
2,000	199	135,000	1,055
5,000	312	150,000	1,021
8,000	392	160,000	987
11,000	457	180,000	886
13,000	494	200,000	725
15,000	528	210,000	609
17,000	560	220,000	446
22,000	629	26,000	678
30,000	721		

Table C-3. Standard Errors of Estimated Percentages of Persons

Base of estimated percentage (thousands)	Estimated percentage					
	1 or 99	2 or 98	5 or 95	10 or 90	25 or 75	50
200	3.1	4.4	6.9	9.5	13.7	15.8
300	2.6	3.6	5.6	7.7	11.2	12.9
600	1.8	2.6	4.0	5.5	7.9	9.1
1,000	1.4	2.0	3.1	4.2	6.1	7.1
2,000	1.0	1.4	2.2	3.0	4.3	5.0
5,000	0.6	0.9	1.4	1.9	2.7	3.2
8,000	0.5	0.7	1.1	1.5	2.2	2.5
11,000	0.4	0.6	0.9	1.3	1. 8	2.1
13,000	0.4	0.5	0.8	1.2	1.7	2.0
17,000	0.34	0.5	0.7	1.0	1.5	1.7
22,000	0.29	0.4	0.7	0.9	1.3	1.5
26,000	0.28	0.4	0.6	0.8	1.2	1.4
30,000	0.26	0.4	0.6	0.8	1.1	1.3
50,000	0.20	0.3	0.4	0.6	0.9	1.0
80,000	0.16	0.2	0.3	0.5	0.7	0.8
100,000	0.14	0.2	0.3	0.4	0.6	0.7
130,000	0.12	0.17	0.3	0.4	0 .5	0.6
220,000	0.10	0.13	0.2	0.3	0.4	0.5

Standard error of a mean. A mean is defined here to be the average quantity of some item per person and so forth. Standard errors are provided in the detailed tables for all displayed means.

Standard errors of estimated percentages. The reliability of an estimated percentage, computed using sample data for both numerator and denominator, depends upon both the size of the percentage and the size of the total upon which the percentage is based. When the numerator and denominator of the percentage have different parame ters, use the parameter (and appropriate factor) of the numerator.

The type of percentages presented in this report is the percentage of persons sharing a particular characteristic such as the percent of persons holding a bachelors degree.

For percentages of persons, the approximate standard error, $S_{(x,p)}$, of the estimated percentage p can be obtained by the formula

$$S_{(x,p)} = fs \qquad (3)$$

In this formula, f is the appropriate factor from table C-4 and s is the standard error of the estimate from table C-3. Alternatively, it may be approximated by the formula

$$S_{(x,p)} = \sqrt{\frac{b}{x}(p)(100\text{-}p)} \qquad (4)$$

from which the standard errors in table C-3 were calculated. Use of this formula will give more accurate results than use of formula 3 above. Here x is the size of the subclass of social units which is the base of the percentage, p is the percentage and b is the parameter associated with the characteristic in the numerator.

Illustration. Text table 1 shows that 6.9 percent of persons age 18-24 earned a bachelor's as their highest degree. Using formula 3 with the factor from table C-4 and the appropriate standard error from table C-3, the approximate standard error is

$$S_{(x,p)} = .55 \times .68\% = .4\%$$

Using formula 4 with the "b" parameter from table C-4, the approximate standard error is

$$S_{(x,p)} = \sqrt{\frac{6{,}073}{28{,}494{,}000}\ 6.9\%\ (100\%\text{-}6.9\%)} = .4\%$$

Consequently, the approximate 90 percent confidence interval as shown by these data is from 6.3 to 7.5 percent.

Standard error of a difference within this report. The standard error of a difference between two sample estimates is approximately equal to

$$S_{(x\text{-}y)} = \sqrt{S_x^2 + S_y^2} \qquad (5)$$

where S_x and S_y are the standard errors of the estimates x and y. The estimates can be numbers, percents, ratios, etc. The above formula assumes that the sample correlation coefficient, r, between the two estimates is zero. If r is really positive (negative), then this assumption will lead to overestimates (underestimates) of the true standard error.

Illustration. Again using text table 1, 15.7 percent of persons age 25-34 earned a bachelors as their highest

degree and 14.2 percent of persons age 35-44 earned the same degree status. The standard errors for these percentages are computed using formula 4, to be .4 and .5 percent. Assuming that these two estimates are not correlated, the standard error of the estimated difference of 1.5 percentage points is

$$S_{(x-y)} = \sqrt{(.4\%)^2 + (.5\%)^2} = .6\%$$

The approximate 90-percent confidence interval is from .5 to 2.5 percentage points. Since this interval does not contain zero, we conclude that the difference is significant at the 10 percent level.

Standard errors of ratios of means. The standard error for a ratio of means is approximated by:

$$S_{x/y} = \sqrt{\left(\frac{x}{y}\right)^2 \left[\left(\frac{S_y}{y}\right)^2 + \left(\frac{S_x}{x}\right)^2\right]}$$

where x and y are the means , and S_x and S_y are their associated standard errors. Formula 6 assumes that the means are not corre lated. If the correlation between the two means is actually positive (negative), then this procedure will provide an overestimate (underestimate) of the standard error for the ratio of means.

Table C-4. SIPP Generalized Variance Parameters

Characteristic	a	b	factor
Total or White			
16+ Program participation and benefits, poverty (3):			
Both sexes	-0.0000943	16,059	0.90
Male	-0.0001984	16,059	0.90
Female	-0.0001796	16,059	0.90
16+ income and labor force (5):			
Both sexes	-0.0000321	5,475	0.52
Male	-0.0000677	5,475	0.52
Female	-0.0000612	5,475	0.52
Educational attainment (4)	-0.0000471	6,073	0.55
All others[1] (6):			
Both sexes	-0.0000864	19,911	1.00
Male	-0.0001786	19,911	1.00
Female	-0.0001672	19,911	1.00
Black			
Poverty: (1)			
Both sexes	-0.0004930	13,698	0.83
Male	-0.0010522	13,698	0.83
Female	-0.0009274	13,698	0.83
All Others (2):			
Both sexes	-0.0002670	7,366	0.61
Male	-0.0005737	7,366	0.61
Female	-0.0004933	7,366	0.61

[1]For example, use these parameters for work history tabulations, asset and debt tabulations, retirement and pension tabulations, 0+ program participation, 0+ benefits, 0+ income, and 0+ labor force.

Note: For cross-tabulations, use the parameters of the characteristics with the smaller number within the parentheses.