Appendix C. SOURCE AND ACCURACY OF ESTIMATES

SOURCE OF DATA

The SIPP universe is the noninstitutionalized resident population living in the United States. This 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, are not eligible to be in the survey. Also, United States citizens residing abroad are not eligible to be in the survey. Foreign visitors who work or attend school in this country and their families are eligible; all others are not eligible. With the exceptions noted above, field representatives interview eligible persons who are at least 15 years of age at the time of the interview.

The 1990 panel SIPP sample is located in 230 Primary Sampling Units (PSU's) each consisting of a county or a group of contiguous counties. Within these PSUs, we systematically selected expected clusters of two living quarters (LQ's) from lists of addresses prepared for the 1980 decennial census to form the bulk of the sample. To account for LQ's built within each of the sample areas after the 1980 census, we selected a sample containing clusters of four LQ's from permits issued for construction of residential LQ's up until shortly before the beginning of the panel.

In jurisdictions that have incomplete addresses or do not issue building permits, we sampled small land areas, listed expected clusters of four LQ's, and then subsampled. In addition, we selected a sample of LQ's from a supplemental frame that included LQ's identified as missed in the 1980 census.

The 1990 panel differs from other panels as a result of oversampling for low income households. The panel contains an oversample of Black headed households, Hispanic headed households and female headed family households with no spouse present and living with relatives.

The first interview occurred during February, March, April, or May of 1990. Interviews for approximately one-fourth of the sample took place in each of these months. For the remainder of the panel, interviews for each person occurred every 4 months. At each interview the reference period was the 4 months preceding the interview month. Occupants of about 93 percent of all eligible living quarters participated in the first interview of the panel. For later interviews, field representatives interviewed only original sample persons (those in Wave 1 sample households and interviewed in Wave 1) and persons living with them. The Bureau automatically designated all first wave noninterviewed households as noninterviews for all subsequent interviews. Field representatives conducted personal interviews in the first, second, and sixth waves only. The remaining interviews were telephone interviews. For personal interviews we followed original sample persons if they moved to a new address, unless the new address was more than 100 miles from a SIPP sample area. If the original sample persons moved farther than 100 miles from a SIPP sample area, we attempted telephone interviews. When original sample persons moved to remote parts of the country and were unreachable by telephone, moved without leaving a forwarding address, or refused the interview, additional noninterviews resulted.

Noninterviews. Tabulations in this report were drawn from interviews conducted from February through May of 1991. Table C-1 summarizes information on nonresponse for the interview months in which we collected the data used to produce this report.

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

Month	Eligible	Noninter-viewed	Nonre-sponse rate(%)[1]
February 1991	5,300	900	16
March 1991	5,400	900	16
April 1991	5,200	900	17
May 1991	5,200	900	17

[1]Due to rounding of all numbers to the nearest 100, there are some inconsistencies. We calculated the percentage using unrounded numbers.

Some respondents do not respond to some of the questions. Therefore, the overall nonresponse rate for some items such as income and money related items is higher than the nonresponse rates in table C-1. For more discussion of nonresponse, see the *Quality Profile for the Survey of Income and Program Participation,* May 1990, by T. Jabine, K. King, and R. Petroni, available from Customer Services, Data Users Services Division, of the U.S. Census Bureau (301-763-6100).

WEIGHTING PROCEDURE

We derived SIPP person weights in each panel from several stages of weight adjustments. In the first wave, we gave each person a base weight equal to the inverse of his/her probability of selection. For each subsequent interview, the Bureau gave each person a base weight that accounted for following movers.

We applied a factor to each interviewed person's weight to account for the SIPP sample areas not having the same population distribution as the strata they are from.

We applied a noninterview adjustment factor to the weight of every occupant of interviewed households to account for persons in noninterviewed occupied households which were eligible for the sample. (The Bureau treated individual nonresponse within partially interviewed households with imputation. We made no special adjustment for noninterviews in group quarters.)

The Bureau used complex techniques to adjust the weights for nonresponse. For a further explanation of the techniques used, see the *Nonresponse Adjustment Methods for Demographic Surveys at the U.S. Bureau of the Census*, November 1988, Working paper 8823, by R. Singh and R. Petroni. The success of these techniques in avoiding bias is unknown. An example of successfully avoiding bias is in "Current Nonresponse Research for the Survey of Income and Participation" (paper by Petroni, presented at the Second International Workshop on Household Survey Nonresponse, October 1991).

We performed an additional stage of adjustment to persons' weights to reduce the mean square errors of the survey estimates. We accomplished this by ratio adjusting the sample estimates to agree with monthly Current Population Survey (CPS) type estimates of the civilian (and some military) noninstitutional population of the United States by demographic characteristics including age, sex, and race as of the specified date. The Bureau brought CPS estimates by age, sex, and race into agreement with adjusted estimates from the 1980 decennial census. Adjustments to the 1980 decennial census estimates reflect births, deaths, immigration, emigration, and changes in the Armed Forces since 1980. In addition, we controlled SIPP estimates to independent Hispanic controls and made an adjustment to assign equal weights to husbands and wives within the same household. We implemented all of the above adjustments for each reference month and the interview month.

ACCURACY OF ESTIMATES

We base SIPP estimates on a sample. The sample estimates may differ somewhat from the values obtained from administering a complete census using the same questionnaire, instructions, and enumerators. The difference occurs because with an estimate based on a sample survey two types of errors are possible: nonsampling and sampling. We can provide estimates of the magnitude of the SIPP sampling error, but this is not true of nonsampling error. The next few sections describe SIPP nonsampling error sources, followed by a discussion of sampling error, its estimation, and its use in data analysis.

Nonsampling Variability. We attribute nonsampling errors to many sources, including:

- 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 (e.g., 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 interviewing pattern used,
- undercoverage.

We used quality control and edit procedures to reduce errors made by respondents, coders, and interviewers. More detailed discussions of the existence and control of nonsampling errors in the SIPP are in the *SIPP Quality Profile*.

Undercoverage in SIPP resulted 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 when persons in missed households or missed persons in interviewed households have characteristics different from those of interviewed persons in the same age-race-sex group. Further, we did not adjust the independent population controls for undercoverage in the Census.

A common measure of survey coverage is the coverage ratio, the estimated population before ratio adjustment divided by the independent population control. Table C-2 shows CPS coverage ratios for age-sex-race groups for 1992. The CPS coverage ratios can exhibit some variability from month to month; however, this table shows a typical set of coverage ratios. Other Census Bureau household surveys like the SIPP experience similar coverage.

Table C-2. **1992 CPS Coverage Ratios**

Age	Non-Black		Black		All persons		
	M	F	M	F	M	F	Total
0-14	0.963	0.965	0.927	0.926	0.957	0.959	0.958
15	0.962	0.949	0.899	0.919	0.952	0.944	0.948
16	0.969	0.936	0.923	0.907	0.962	0.932	0.947
17	0.981	0.975	0.945	0.862	0.975	0.957	0.966
18	0.939	0.926	0.883	0.846	0.930	0.913	0.922
19	0.860	0.872	0.754	0.801	0.844	0.861	0.853
20-24	0.913	0.927	0.734	0.832	0.889	0.913	0.901
25-26	0.927	0.940	0.688	0.877	0.897	0.931	0.914
27-29	0.910	0.954	0.707	0.864	0.885	0.941	0.914
30-34	0.893	0.948	0.691	0.883	0.870	0.939	0.905
35-39	0.910	0.949	0.763	0.899	0.895	0.942	0.919
40-44	0.929	0.951	0.824	0.906	0.919	0.946	0.933
45-49	0.956	0.966	0.903	0.956	0.951	0.965	0.958
50-54	0.940	0.961	0.807	0.877	0.927	0.951	0.940
55-59	0.944	0.941	0.826	0.825	0.932	0.928	0.930
60-62	0.965	0.956	0.792	0.850	0.948	0.944	0.946
63-64	0.905	0.907	0.669	0.872	0.884	0.903	0.894
65-67	0.935	0.979	0.783	0.875	0.921	0.969	0.947
68-69	0.925	0.942	0.789	0.831	0.913	0.931	0.923
70-74	0.926	0.993	0.856	1.014	0.920	0.995	0.962
75-99	0.977	0.989	0.764	0.912	0.961	0.983	0.975
15+	0.928	0.953	0.782	0.883	0.912	0.944	0.929
0+	0.936	0.955	0.827	0.895	0.923	0.947	0.935

Comparability with Other Estimates. Exercise caution when comparing data from this report with data from other SIPP publications or with data from other surveys. Comparability problems are from varying seasonal patterns for many characteristics, different nonsampling errors, and different concepts and procedures. Refer to the *SIPP Quality Profile* for known differences with data from other sources and further discussion.

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 mostly measure the variations that occurred by chance because we surveyed a sample rather than the entire population.

USES AND COMPUTATION OF STANDARD ERRORS

Confidence Intervals. 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 we selected all possible samples and surveyed each of these under essentially the same conditions and with the same sample design, and if we calculated an estimate and its standard error from each sample, then:

1. Approximately 68 percent of the intervals from one standard error below the estimate to one standard error above the estimate would include the average result of all possible samples.
2. 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.
3. Approximately 95 percent of the intervals from two standard errors below the estimate to two 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 confidence interval includes the average estimate derived from all possible samples.

Hypothesis Testing. One may also use standard errors for hypothesis testing. Hypothesis testing is a procedure for distinguishing between population characteristics using sample estimates. The most common type of hypothesis tested is: (1) the population characteristics are identical versus (2) they are different. One can perform tests at various levels of significance, where a level of significance is the probability of concluding that the characteristics are different when, in fact, they are identical.

Unless noted otherwise, all statements of comparison in the report passed a hypothesis test at the 0.10 level of significance or better. This means that, for differences cited in the report, the estimated absolute difference between parameters is greater than 1.6 times the standard error of the difference.

To perform the most common test, compute the difference $X_A - X_B$, where X_A and X_B are sample estimates of the characteristics of interest. A later section explains how to derive an estimate of the standard error of the difference $X_A - X_B$. Let that standard error be s_{DIFF}. If $X_A - X_B$ is between -1.6 times s_{DIFF} and +1.6 times s_{DIFF}, no conclusion about the characteristics is justified at the 10 percent significance level. If, on the other hand, $X_A - X_B$ is smaller than -1.6 times s_{DIFF} or larger than +1.6 times s_{DIFF}, the observed difference is significant at the 10 percent level. In this event, it is a commonly accepted practice to say that the characteristics are different. Of course, sometimes this conclusion will be wrong. When the characteristics are, in fact, the same, there is a 10 percent chance of concluding that they are different.

Note that as we perform more tests, more erroneous significant differences will occur. For example, at the 10 percent significance level, if we perform 100 independent hypothesis tests in which there are no real differences, it is likely that about 10 erroneous differences will occur. Therefore, interpret the significance of any single test cautiously.

Note Concerning Small Estimates and Small Differences. We show summary measures in the report only when the base is 200,000 or greater. Because of the large standard errors involved, there is little chance that estimates will reveal useful information when computed on a base smaller than 200,000. Also, nonsampling error in one or more of the small number of cases providing the estimate can cause large relative error in that particular estimate. We show estimated numbers, however, even though the relative standard errors of these numbers are larger than those for the corresponding percentages. We provide smaller estimates primarily to permit such combinations of the categories as serve each user's needs. Therefore, be careful in the interpretation of small differences since even a small amount of nonsampling error can cause a borderline difference to appear significant or not, thus distorting a seemingly valid hypothesis test.

Standard Error Parameters and Tables and Their Use. Most SIPP estimates have greater standard errors than those obtained through a simple random sample because we sampled clusters of living quarters for the SIPP. To derive standard errors at a moderate cost and applicable to a wide variety of estimates, we made a number of approximations. We grouped estimates with similar standard error behavior and developed two parameters (denoted "a" and "b") to approximate the standard error behavior of each group of estimates. Because the actual standard error behavior was not identical for all estimates within a group, the standard errors we computed from these parameters provide an indication of the order of magnitude of the standard error for any specific estimate. These "a" and "b" parameters vary by characteristic and by demographic subgroup to which the estimate applies. Use base "a" and "b" parameters found in table C-5 for wave 4 1990 panel estimates.

For users who wish further simplification, we also provide general standard errors in tables C-3 and C-4. Note that you need to adjust these standard errors by a factor from table C-5. 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 sub sections.

Table C-3. **Standard Errors of Estimated Numbers of Households**

(Numbers in thousands)

Size of estimate	Standard error	Size of estimate	Standard error
200	35	40,000	373
300	43	50,000	377
500	55	60,000	363
750	67	70,000	330
1,000	77	80,000	271
2,000	109	90,000	157
3,000	132	94,000	41
5,000	169		
7,500	204		
10,000	232		
15,000	275		
25,000	333		
30,000	352		

Table C-4. **Standard Errors of Estimated Percentages of Households**

Base of estimated percentage (thousands)	Estimated percentages					
	≤ 1 or ≥ 99	2 or 98	5 or 95	10 or 90	25 or 75	50
200	1.73	2.43	3.79	5.20	7.50	8.70
300	1.41	1.99	3.09	4.26	6.20	7.10
500	1.09	1.54	2.40	3.30	4.76	5.50
750	0.89	1.26	1.96	2.69	3.89	4.49
1,000	0.77	1.09	1.69	2.33	3.37	3.89
2,000	0.55	0.77	1.20	1.65	2.38	2.75
3,000	0.45	0.63	0.98	1.35	1.94	2.24
5,000	0.35	0.49	0.76	1.04	1.51	1.74
7,500	0.28	0.40	0.62	0.85	1.23	1.42
10,000	0.24	0.34	0.54	0.74	1.06	1.23
15,000	0.20	0.28	0.44	0.60	0.87	1.00
25,000	0.15	0.22	0.34	0.47	0.67	0.78
30,000	0.14	0.20	0.31	0.43	0.61	0.71
40,000	0.12	0.17	0.27	0.37	0.53	0.61
50,000	0.11	0.15	0.24	0.33	0.48	0.55
60,000	0.10	0.14	0.22	0.30	0.43	0.50
80,000	0.09	0.12	0.19	0.26	0.38	0.43
90,000	0.08	0.11	0.18	0.25	0.35	0.41
100,00	0.08	0.11	0.17	0.23	0.34	0.39

Standard Errors of Estimated Numbers. There are two ways to compute the approximate standard error, s_x, of an estimated number shown in this report. The first uses the formula

$$s_x = fs \quad (1)$$

Table C-5. **SIPP Generalized Variance Parameters**

Characteristics	a	b	f
HOUSEHOLDS			
Total or White	-0.0000641	6,043	1.00
Black	-0.0005290	3,018	0.71

where f is a factor from table C-5, and s is the standard error of the estimate obtained by interpolation from table C-3. Alternatively, approximate s_x using the formula,

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

from which we calculated the standard errors in table C-3. Here x is the size of the estimate and a and b are the parameters in table C-5 associated with the particular type of characteristic. Use of formula 2 will provide more accurate results than the use of formula 1. When calculating standard errors for numbers from cross-tabulations involving different characteristics, use the factor or set of parameters for the characteristic which will give the largest standard error.

Illustration. SIPP estimates show that there were 5,432,000 households with a householder less than 35 years of age where the average monthly household income during 1991 was \$1,071 to \$1,912. The appropriate "a", "b" and "f" parameters from table C-5 and the appropriate general standard error from table C-3 are

$$a = -0.0000641, b = 6.043, f = 1.00, s = 175,000$$

Using formula (1), the approximate standard error is

$$s_x = 1.00 \times 175,000 = 175,000$$

Using formula (2), the appropriate standard error is

$$\sqrt{(-0.0000641)(5,432,000)^2 + (6,043)(5,432,000)} = 176,000$$

The 90-percent confidence interval as shown by the data is from 5,159,000 to 5,714,000. Therefore, a conclusion that the average estimates derived from all possible samples lies within a range computed in this way would be correct for roughly 90 percent of all samples.

Standard Errors of Estimated Percentages. The reliability of an estimated percentage, computed using sample data for both numerator and denominator, depends on the size of the percentage and its base. When the numerator and denominator of the percentage have different parameters, use the parameter (or appropriate factor) from table C-3 indicated by the numerator.

Calculate the approximate standard error, $s_{(x,p)}$, of an estimated percentage "p" using the formula

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

where p is the percentage of persons/families/households with a particular characteristic such as the percent of persons owning their own homes.

In this formula, f is the appropriate "f" factor from table C-5, and s is the standard error of the estimate obtained by interpolation from table C-4.

Alternatively, approximate it by the formula:

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

from which we calculated the standard errors in table C-4. Here x is the total number of persons, families, households, or unrelated individuals in the base of the percentage, p is the percentage ($0 \leq p \leq 100$), and b is the "b" parameter in table C-5 associated with the characteristic in the numerator of the percentage. Use of this formula will give more accurate results than use of formula (3).

Illustration. Suppose that of 18,912,000 households with mean monthly household income of \$1,071 to \$1,912, 12.9 percent were black. Using formula (3) with the "f" factor from table C-5 and the appropriate standard error from table C-4, the approximate standard error is

$$S_p = 0.55 \times 0.71 = 0.39$$

Using formula (4) with the "b" parameter from table C-5, the approximate standard error is

$$S_p = \sqrt{\frac{3,018}{18,912,000} 12.9\,(100-12.9)} = 0.42$$

Consequently, the 90 percent confidence interval as shown by these data is from 12.2 to 13.6 percent.

Another type of percentage presented in this report is the percentage of net worth such as the percent of net worth of households that is held in vehicles. The percentage of net worth may be expressed as

$$P_{(x,p)} = \frac{\hat{P}_A \bar{X}_A}{\bar{X}_n} \qquad (5)$$

where $\hat{P}_A$ is the percentage of households holding a particular asset, $\bar{X}_A$ is the mean value of holdings for a particular asset and $\bar{X}_N$ is the mean value of net worth. Another example of the second income type is the percent of net worth held by households with low income. In this case, $\hat{P}_A$ is the percentage of all households that have low income, $\bar{X}_A$ is the mean new worth of low income households, and $\bar{X}_N$ is the mean net worth of all households.

For the percentage of net worth, the approximate standard error is given by

$$S_{(x,p)} = \sqrt{\left(\frac{\hat{P}_A \bar{X}_A}{\bar{X}_N}\right)^2 \left[\left(\frac{S_p}{\hat{P}_A}\right)^2 + \left(\frac{S_A}{\bar{X}_A}\right)^2 + \left(\frac{S_B}{\bar{X}_N}\right)^2\right]} \qquad (6)$$

where S_p is the standard error of $\hat{P}_A$, S_A is the standard error of $\overline{X}_A$ and S_B is the standard error of $\overline{X}_N$. (To calculate S_p, use formula (5). The standard errors of $\overline{X}_N$ and $\overline{X}_A$ are given in table 8.)

Note that there is frequently some correlation between $\hat{P}_A$ and $\overline{X}_N$, and between $\overline{X}_A$ and $\overline{X}_N$. In most cases, the above formula will give an overestimate of the standard error.

Illustration. Of all household assets in the report, 6.4 percent was held in vehicles (table D). The mean value of vehicles is $7,527 (table 5) and the mean value of net worth is $ 102,118 (table H). The standard error of the 86.4 percent of households that own vehicles (table A) is 0.32 percent, the standard error of the mean value of vehicles owned by households is $83 (table 8) and the standard error of the mean value of net worth of households is $1,631 (table 8). Using the formula (6), the approximate standard error is

$$S_p = \sqrt{\left[\frac{(86.4)(7{,}527)}{102{,}118}\right]^2 \left[\left[\frac{0.32}{86.4}\right]^2 + \left[\frac{83}{7.527}\right]^2 + \left[\frac{1{,}631}{102{,}118}\right]^2\right]} = 0.13\%$$

Consequently, the 90 percent confidence interval as shown by these data is from 6.2 to 6.6 percent.

Standard Error of a Difference. The standard error of a difference between two sample estimates, x and y, is approximately equal to

$$s_{(x-y)} = \sqrt{s_x^2 + s_y^2 - 2rs_xs_y} \qquad (7)$$

where s_x and s_y are the standard errors of the estimates x and y and r is the correlation coefficient between the characteristics estimated by x and y. The estimates can be numbers, averages, percents, ratios, etc. Underestimates or overestimates of standard error of differences result if the estimated correlation coefficient is overestimated or underestimated, respectively. In this report, we assume r is 0.

Illustration. SIPP estimates show that in 1991 the mean value of total household wealth for white households is $111,910 and the mean value of total household wealth for black households is $27,840 (table H in the report). The standard errors for these estimates are given in table 8. They are $1,937 and $1,129, respectively. Assuming that these two estimates are not correlated, the standard error of the estimated difference of $84,070 is

$$s_{(x-y)} = \sqrt{(1{,}937)^2 + (1{,}129)^2} = \$2{,}242$$

The 90-percent confidence interval is from $80,483 to $87,657.