The Current Population Survey Variances, Inter-Relationships, and Design Effects

George Train, Lawrence Cahoon, U.S. Bureau of the Census
Paul Makens, Bureau of Labor Statistics

I. Introduction. The CPS is a probability sample survey of the U.S. population conducted monthly by the U.S. Bureau of the Census for the U.S. Bureau of Labor Statistics. Its primary purpose is to provide monthly estimates of labor force characteristics. This paper provides an analysis of various features of the survey design using selected estimates and variances.

In recent years the CPS has been expanded to provide estimates of labor force characteristics by State. Prior to 1978 the national CPS was actually two nearly independent multi-stage stratified samples which together consisted of housing units in 461 primary sampling units. Each PSU consisted of an independent city or a group of one or more contiguous counties. Of the 376 strata in the design, 156 were comprised of only one PSU (designated as self-representing or SR PSU's). The remaining 220 strata contain more than one PSU (which are called nonself-representing or NSR PSU's).

The two samples which make up the national CPS design, called the A and C samples, utilize the same PSU and stratum definitions. Both designs share the same SR PSU's. In addition, the A sample has one PSU drawn with probability proportionate to size (pps) from each of the 220 NSR strata. For the C sample, the 220 strata were paired and one stratum selected with equal probability from each pair. From each of the selected strata a sample PSU was independently selected with pps. As a result of this sampling, CPS national estimates consist of a weighted average of the A and C sample estimates. The housing units within PSU's are selected in segments, or ultimate sampling units (USU's), of expected size four. The basic sampling interval during 1975 was about 1 in 1,500.

In order to obtain more precise estimates of changes over time, the CPS sample is divided into eight equal, separate systematic subsamples referred to as rotation groups. One new rotation group is introduced each month and one old one is replaced. Each new rotation group is in sample for four months, then excluded for eight months, and then is returned for four months.

The published CPS monthly labor force estimates are the result of several distinct processes: preparation of base estimates; adjustment for nonresponse in the sample; two stages of ratio estimation; a composite estimation procedure which uses data from preceding months; and, for certain key labor force characteristics, a seasonal adjustment. A brief description of the estimation procedure follows.

The raw survey data is first weighted by the inverse of the probability of selection of the individual units in the sample. As in all surveys, a percentage of the sample, for a variety of reasons, does not respond. For this reason a nonresponse adjustment is then applied to the data producing what are referred to as unbiased estimates.

A first stage ratio adjustment is applied to data coming from NSR PSU's and is used to reduce the between-PSU component of variance.

The second stage ratio estimate adjusts the sample estimates of population by rotation group in a number of age-sex-race groups to independently derived current estimates of the population in each of these groups. This adjustment is used to both reduce variance and adjust for undercoverage in the CPS.

The composite estimate is a weighted average of estimates resulting from the two stages of ratio estimation and an estimate consisting of the composite estimate for the preceding month to which has been added an estimate of the change from the preceding month to the present month. The estimate of change is based on the six rotation groups common to both months. The composite estimate is used to reduce the variance of estimates of change as well as for some estimates of level.

For certain key characteristics, a seasonal adjustment is made to the estimates to adjust for seasonal fluctuations in the data. Past studies indicate that this does not substantially increase the variance [10]. We do not discuss in this paper the variances of seasonally adjusted estimates in-as-much as the published variances do not take account of the seasonal adjustment. The most complete description of the CPS sample design and estimation is contained in [10].

II. Variance Estimation in the CPS. The method currently used is a revised form of the paired difference method discussed in [2] which is based on work by Keyfitz [8]. A first order Taylor series approximation of the CPS estimator is obtained. The variance of this approximation is the same as the variance of the CPS estimator under conditions consistent with the CPS design. The best description of the current variance estimator is in appendix K of [10].

A. SR Variance. The SR PSU's were collapsed into 54 geographically homogeneous Keyfitz clusters, each of about 2.4 million people in size. The estimates of variance within the SR PSU's are based on eight partially balanced replicated half-samples within these clusters.

B. NSR Variance. Two different techniques are used in estimating the variance components. One technique, which is used to estimate solely the NSR within-PSU variance component, is the same as the technique for SR PSU's except for the definitions of the Keyfitz clusters.

The estimates of the total NSR variance and between-stratum variance are produced using a modification of the collapsed stratum variance estimator. For each pair of strata, there are three PSU's selected. The two A-sample PSU's represent the strata to which they belong. The other PSU (C-sample) represents the PSU's in both strata. Thus for NSR estimates there are within-PSU and between-PSU within-strata components of variance, but due to the contribution of the C-sample there is, in addition, a between-stratum component of variance.

C. Total Variance. The estimate of the total sampling variance is the sum of the SR within-PSU variance estimate and the total NSR variance estimate. As currently estimated the within-PSU components estimate the variance among USU's within PSU's plus the simple response variance. If the within-PSU variance (SR and NSR) is subtracted from the total sampling variance, the difference consists of the variance between strata and a residual

Table 1. Efficiency and Design Effects for Monthly CPS Estimates of Level

Characteristic[1]	Average Composite Estimate x 10^3	Average Variance of the Composite Estimate x 10^6	Efficiency Relative to Composite Estimate			Composite Estimate Design Effect	
			Unbiased Estimate	First Stage Ratio Estimate	First and Second Stage Combined Ratio Estimate	Based on Population 16+	Based on the Age-Sex-Race Cell for Which the Characteristic is Defined
CLF-Total	92,612	51,991	8.32	8.25	1.14	0.99	0.99
CLF-Nonwhite	10,529	7,228	8.32	7.31	1.10	0.51	1.15
CLF-Teenage	8,799	6,811	3.33	3.21	1.03	0.57	1.15
Ag. Emp.-Total	3,381	10,720	1.48	1.06	1.11	2.21	2.21
Ag. Emp.-Nonwhite	284	970	1.16	1.02	1.14	2.22	2.26
Nonag. Emp.							
Blue Collar	26,664	41,899	1.89	1.85	1.15	1.27	1.27
Self-Emp.	5,626	9,380	1.27	1.26	1.18	1.18	1.18
Unemp.-Total	7,830	15,313	1.16	1.16	1.00	1.41	1.41
Unemp.-Nonwhite	1,459	3,044	1.29	1.21	0.98	1.44	1.56
Unemp.-Teenage	1,752	3,114	1.13	1.12	0.96	1.23	1.37

[1] The following abbreviations have been used in the characteristic definitions: (1) CLF-Civilian Labor Force, (2) Nonag.-Nonagriculture, (3) Emp.-Employed, (4) Unemp.-Unemployed, and (5) Ag.-Agriculture.

component. The residual component (usually referred to as the between-PSU variance) consists of the variance among the PSU's within strata and a portion of the correlated response variance. The variance between strata comprises the variance among stratum totals within pairs of strata.

III. Analysis. In this section analysis of the six data tables for this report is presented. These tables are provided for selected population characteristics and are based on 1975 sample data. Tables are available for a total of 100 population characteristics upon request. We do not consider in this paper the effects of nonsampling error.

A. Efficiency and Design Effects-Tables 1 and 2. These tables are intended to show the impact of the stages of estimation on the variances. Efficiencies of the other stages of estimation are shown relative to the composite stage for estimates of level. Design effects for the levels of estimation are shown by the control totals used in the ratio estimation.

Table 1 shows that the percent reduction in variance of the first stage estimates as compared to the unbiased estimates is generally small. The rural items as a group benefit most from the first stage ratio estimation. Evidently between PSU variability is greater relative to the total variance for rural population characteristics. The second stage ratio estimate is intended to adjust for under-coverage and to reduce the resultant bias. The changes in variance caused by the second stage ratio estimation are by far the most dramatic. The Agriculture Employed items actually show a slight increase in variance. Certain other characteristics have a large reduction in variance. These items all have in common that their population total constitutes a very large percentage of some second stage age-sex-race cells. The remaining items, excluding characteristics which are rural or comprise a small percentage of age-sex-race cells, have small reductions in variance.

The composite estimate is generally the best for monthly estimates in terms of variance. There are, however, exceptions. These exceptions are generally for smaller estimates like those for unemployment characteristics where minor increases in variance are noted. From table 2 it can be seen that the composite estimate does substantially better in terms of variance reduction for estimates of month-to-month change than it does for estimates of level.

B. Variance Components - Tables 2 through 4. In a complex survey the total variance can be partitioned into components reflecting the various stages of sampling. For the CPS there are within-PSU, between-PSU and between-stratum components of variance. Tables 3 and 4 present estimates of the percent distribution of the variance components for the various stages of estimation. Table 2 presents the percent distribution of the components of variance for the composite estimate of month-to-month change. In these tables total and within-PSU variances are calculated directly. Between-PSU and between-stratum variances are estimated by subtraction. Consequently between variance components are less stable than the within-PSU component.

Each of tables 3 and 4 shows that the majority of the total variance is within-PSU variance. Only for agriculture characteristics does the within-PSU variance drop to less than 80 percent of the total variance.

Table 3 also shows the impact of the first stage ratio estimation when applied on top of the unbiased level. As described in section I, the first-stage estimate does not change the magnitude of within-PSU variance. Table 3 shows, as expected, that between-PSU variance has an equal or smaller percentage of the total variance for all characteristics than it had before the first stage ratio estimation was applied. The drop was particularly large for agriculture items. Nevertheless, the size of the between-PSU variance remains rather large, greater than 10 percent of total variance, for some items. This could be the result of changes in characteristics of PSU's since the last CPS redesign, or non-homogeneity between-PSU's within a strata at the time of the last redesign, or both.

The effect of the second stage on the distribution of variance can be seen by comparing tables 3 and 4. Table 4 shows, as would be expected, the use of the composite estimate has very little effect on the distribution of the overall variance.

C. Variances of Averages Over Time-Table 5.

1. Introduction. In order to obtain greater reliability, quarterly, six month or annual average estimates are sometimes used in place of the

Table 2. Efficiency and Distribution of Variance of the CPS Estimate of Month-to-Month Change

Characteristic	Average Composite Estimate of Change x 10^3	Average Variance of Composite Estimate of Change x 10^6	Distribution of Variance CPS Composite Estimate of Month-to-Month Change: Percent Within PSU	Percent Between PSU	Percent Between Stratum	Efficiency of First and Second Stage Ratio Estimate of Change Relative to the Composite Estimate of Change
CLF-Total	624	27,892	98.9	0.7	0.4	1.41
CLF-Nonwhite	110	4,691	99.0	1.3	-0.3	1.32
CLF-Teenage	533	6,633	97.2	3.2	-0.4	1.13
Ag. Emp.-Total	115	4,810	87.4	12.6	0	1.39
Ag. Emp.-Nonwhite	95	656	86.6	15.8	-2.4	1.22
Nonag. Emp.-Blue Collar	470	21,406	99.3	0.8	-0.1	1.39
Nonag. Emp.-Self-Emp.	134	5,931	97.3	2.6	0.2	1.42
Unemp.-Total	442	15,281	100.0	-0.7	0.7	1.09
Unemp.-Nonwhite	87	3,311	99.3	0.9	-0.2	1.08
Unemp.-Teenage	192	4,003	99.1	1.0	0	1.03

usual monthly estimates.

Table 5 displays the reduction in variance obtained when such estimates are used. This table permits comparisons with similar calculations made for earlier CPS designs. Previously, these computations were made only for the first and second stage combined ratio estimate and not for the composite estimate (see Banks and Shapiro [2]). Table 5 also allows for a comparison of composite estimates with first and second stage combined ratio estimates for three, six, nine and twelve month average estimates.

2. The Effects of Averages Over Time. An analysis of the data provided in table 5 shows that the reduction in variance obtained when using average estimates varies considerably and is dependent on the type of characteristic being studied and the number of months being averaged. The magnitude of the variance reduction obtained is limited by the interaction of the sample overlap pattern of CPS and its effects (see section III.D.) together with the number of months being averaged. Because of the sample overlap the reduction in variance is dependent upon the stability of the specific labor force characteristic. By stability, we mean the amount and frequency of movement into and out of a given labor force category. For relatively stable characteristics like total civilian labor force or nonagriculture employment the reduction in variance achieved by averaging over successive months is smaller than that achieved for less stable characteristics like unemployment.

3. Comparison of the First and Second Stage Combined Ratio Estimator with the Composite Estimator. A comparison of these two estimators can be made by examining their relative efficiency. It is clear that a greater reduction in variance is obtained for averages of first and second stage combined ratio estimates than for averages of composite estimates. However, for most estimates, particularly the larger estimates, the variance of the monthly composite estimate is less than that for the monthly first and second stage ratio estimate. Thus, for monthly estimates the efficiency of the first and second stage ratio estimate compared to the composite estimate is about 1.14 for total civilian labor force (table 1 or table 6). However, for the three, six, nine, and twelve month averages the efficiences are 1.07, 1.00, 0.96 and 0.95 respectively. Table 6 displays the efficiency of the first and second stage combined ratio estimate as compared to the composite estimate for averages over time for a few key estimates. For the characteristics shown in table 6 it appears that the composite estimate is the preferred estimate for monthly level while, with the exception of Nonwhite agriculture employment, the first and second stage combined ratio estimate is preferred for annual averages. These evaluations are made only on the basis of the estimated sample variance and do not take into consideration any possible biases in the estimators.

4. Comparison with an Earlier Design. For the earlier CPS design, table 5 of the Banks and Shapiro paper [2] provides data equivalent to that in table 7 in this paper. It is somewhat useful to compare the results obtained in that paper with those presented in this paper for reductions in variances for averages over time. Table 7 shows the comparison for several key characteristics. Comparisons between the two sets of results are subject to several limitations. It is known that the numbers provided in table 7 are dependent on the level of unemployment. Greater efficiency can be achieved by averaging the unemployment estimates when the unemployment rate is low. This results because when the unemployment rate is low, the duration of unemployment is generally lower and the correlation between monthly estimates of unemployment is lower. This becomes important when interpreting table 7. The unemployment rate for 1975 was approximately 8 to 9 percent as compared to 4 to 5 percent in 1969-1970. This change in level of unemployment makes comparisons very difficult. The best that can be said about the differences evidenced in table 7 is that the ratios changed in a direction consistent with an increase in the level of unemployment between 1969 and 1975. A review of the variance estimates for monthly level and month-to-month change from 1973 through 1975 which covers a period when the unemployment rate ranged from 4.5 to 9 percent seems to indicate that most of the differences observed in table 7 are due to the change in the level of unemployment. A better understanding must await a more detailed investigation utilizing several years of data.

D. Relationships Between Estimates Produced for Differing Months - Table 8. In order to obtain more reliable estimates of change the CPS uses rotation groups to provide for an overlapping sample. Thus the correlations between estimates

Table 3. Distribution of Variance - CPS Unbiased and First Stage Estimates of Level

Characteristic	Average Estimate x 10^3	Distribution of Variance: Percent Within-PSU Total	SR	NSR	Percent Between PSU	Percent Between Stratum
Unbiased Estimate						
CLF-Total	88,975	94.8	58.8	36.0	4.0	1.2
CLF-Nonwhite	9,487	89.5	63.4	26.1	9.1	1.4
CLF-Teenage	8,697	96.1	61.1	35.0	4.0	-0.1
Ag. Emp.-Total	3,308	65.4	15.5	49.9	30.5	4.1
Ag. Emp.-Nonwhite	257	68.4	13.3	55.2	33.2	-1.7
Nonag. Emp.-Blue Collar	26,299	88.5	51.4	37.1	9.5	2.0
Nonag. Emp.-Self-Emp.	5,466	89.8	53.1	36.8	9.8	0.3
Unemp.-Total	7,588	90.4	58.2	32.2	8.3	1.3
Unemp.-Nonwhite	1,353	90.3	63.5	26.8	9.6	0.1
Unemp.-Teenage	1,766	93.6	62.3	31.3	6.2	0.2
First Stage Estimate						
CLF-Total	88,872	95.7	59.3	36.4	3.5	0.9
CLF-Nonwhite	9,523	101.8	72.1	29.8	-2.6	0.8
CLF-Teenage	8,687	96.4	61.3	35.1	3.7	-0.1
Ag. Emp.-Total	3,261	91.3	21.7	69.6	6.7	2.0
Ag. Emp.-Nonwhite	259	78.1	15.1	63.0	24.9	-3.0
Nonag. Emp.-Blue Collar	26,247	99.2	52.4	37.8	8.0	1.8
Nonag. Emp.-Self-Emp.	5,457	90.1	53.2	36.9	9.3	0.1
Unemp.-Total	7,583	90.7	58.4	32.3	8.1	1.2
Unemp.-Nonwhite	1,357	96.4	67.8	28.6	3.8	-0.3
Unemp.-Teenage	1,765	94.0	62.6	31.5	5.9	0.1

Table 4. Components of Variance - CPS First and Second Stage and Composite Estimates of Level 1975

Characteristic	Average Estimate x 10^3	Distribution of Variance: Percent Within PSU	Percent Between PSU	Percent Between Stratum
First and Second Stage Estimate				
CLF-Total	92,888	86.4	12.3	1.3
CLF-Nonwhite	10,610	97.3	2.5	0.2
CLF-Teenage	8,913	94.9	5.0	0.1
Ag. Emp.				
Total	3,392	90.0	7.5	2.5
Nonwhite	288	77.2	26.0	-3.1
Nonag. Emp.				
Blue Collar	27,669	90.4	6.6	3.0
Self-Emp.	5,662	90.1	9.4	0.5
Unemp.-Total	7,979	92.2	6.4	1.5
Unemp.-Nonwhite	1,516	97.1	3.3	-0.4
Unemp.-Teenage	1,808	94.7	5.4	-0.1
Composite Estimate				
CLF-Total	92,612	83.7	14.7	1.6
CLF-Nonwhite	10,529	94.6	5.1	0
CLF-Teenage	8,799	93.9	6.0	0.1
Ag. Emp.				
Total	3,381	87.0	9.7	3.3
Nonwhite	284	78.2	23.6	-1.8
Nonag. Emp.				
Blue Collar	27,663	89.4	7.2	3.3
Self-Emp.	5,626	88.7	11.0	0.3
Unemp.-Total	7,830	93.1	5.4	1.5
Unemp.-Nonwhite	1,459	95.5	5.1	-0.5
Unemp.-Teenage	1,752	96.0	3.9	0.2

from differing months, as shown in table 8, are dependent on the sample overlap and time span involved. The CPS is designed so that samples for any 2 months are composed of identical and nonidentical rotation groups. An identical rotation group is a subsample of housing units which is present in the CPS both months. Nonidentical rotation groups are subsamples of nearby housing units within the sample PSU which are not present in CPS in both months.

The correlation between identical rotation groups is much higher than between nonidentical rotation groups. Also, the correlation between nonidentical rotation groups is nonnegative. The following table gives the sample overlap by months apart. As can be seen from the table, when estimates are produced 1 and 2 months apart there is a large sample overlap and a correspondingly high correlation. Estimates 4 to 8 months apart have uniformly lower correlations and no rotation groups in common.

n(months apart)	1	2	3	4	5	6	7	8
Percent sample overlap	75	50	25	0	0	0	0	0

9	10	11	12	13	14	15	16+
12.5	25	37.5	50	37.5	25	12.5	0

As the time span increases between the estimates and as the mix of identical and nonidentical rotation groups changes, so do the correlations. Table 8 illustrates the effects of time span on the average correlation of estimates n months apart.

Generally speaking, the average correlation between estimates n months apart is lower for the first and second combined ratio estimate than for the composite estimate. This explains the greater reduction in variance achieved for averages over time of the first and second stage combined ratio estimate relative to the corresponding composite estimate.

IV. Summary. In the first sections of this paper we discussed various features of the CPS and their impact on the variances and covariances of the sample estimates. Several tables of data on the CPS variances were presented which show empirically the effects discussed earlier. Data is presented on the effects on the variance of such aspects of the CPS design as the multiple stages of sampling,

Table 5. Ratio of Variance of Average Over Time to Variance of Monthly Estimate 1975

Characteristic	First and Second Stage Estimate				Composite Estimate			
	Three Month	Six Month	Nine Month	Twelve Month	Three Month	Six Month	Nine Month	Twelve Month
CLF-Total	0.73	0.55	0.45	0.40	0.78	0.62	0.53	0.49
CLF-Nonwhite	0.70	0.52	0.40	0.35	0.75	0.58	0.48	0.42
CLF-Teenage	0.59	0.40	0.28	0.24	0.62	0.44	0.33	0.29
Ag. Emp.-Total	0.78	0.60	0.53	0.49	0.83	0.67	0.60	0.56
Ag. Emp.-Nonwhite	0.72	0.51	0.44	0.39	0.64	0.54	0.46	0.41
Nonag. Emp.-Blue Collar	0.76	0.59	0.49	0.44	0.80	0.65	0.56	0.51
Nonag. Emp.-Self-Emp.	0.70	0.48	0.38	0.32	0.74	0.55	0.46	0.39
Unemp.-Total	0.60	0.39	0.30	0.25	0.63	0.44	0.34	0.29
Unemp.-Nonwhite	0.57	0.38	0.26	0.22	0.61	0.42	0.30	0.25
Unemp.-Teenage	0.51	0.31	0.23	0.18	0.54	0.34	0.26	0.21

Table 6. Average Efficiency of the First and Second Stage Ratio Estimates as Compared to the Composite Estimates for Three, Six, Nine and Twelve Month Averages, 1975

Characteristic	One Month	Three Month	Six Month	Nine Month	Twelve Month
CLF-Total	1.14	1.07	1.00	0.96	0.95
CLF-Nonwhite	1.10	1.03	0.99	0.92	0.92
Ag. Emp.	1.11	1.04	0.99	0.97	0.97
Ag. Emp.-Nonwhite	1.14	1.13	1.07	1.08	1.08
Nonag. Emp.-Total	1.17	1.10	1.02	1.00	0.99
" " Nonwhite	1.18	1.10	1.06	1.01	0.87
Unemp.	1.00	0.95	0.89	0.87	0.87
Unemp.-Nonwhite	0.98	0.91	0.89	0.86	0.87

Table 7. Ratio of Variances of Averages Over Time to Variances of Monthly Estimates. 1st and 2nd Stage Combined Ratio Estimate Comparisons of the Ratios in 1969 and 1970 to the Ratios in 1975

Characteristic	Year[1]	Three Month	Six Month	Nine Month	Twelve Month
CLF-Total	1969,70	0.75	0.58	0.49	0.46
	1975	0.73	0.55	0.45	0.40
Nonag. Emp.-Total	1969,70	0.76	0.60	0.51	0.49
	1975	0.76	0.56	0.46	0.42
Ag. Emp.-Total	1969,70	0.83	0.69	0.61	0.58
	1975	0.78	0.60	0.53	0.49
Unemp.	1969,70	0.51	0.31	0.23	0.20
	1975	0.60	0.39	0.30	0.25
Unemp.-Nonwhite-Male	1969,70	0.49	0.29	0.21	0.18
	1975	0.58	0.38	0.24	0.21

[1] The data in the Banks and Shapiro paper [2] was based on the estimates for the 18 month period from January 1969 to June 1970.

the rotation scheme and the various stages of estimation.

The tables contain variance information for a select set of key labor force characteristics. In these tables is found data showing the different levels of estimation in terms of variances, month-to-month change, design effects, and the distribution of the various components of the total sampling variance. Also the tables contain information on variances of estimates averaged over time and correlation coefficients of estimates by number of months apart.

An analysis, showing highlights of the data in the tables, has been presented in section III. In this analysis we have focused on only a few specific points. There is certainly much more that can be said about the data provided.

References

1. Bailar, Barbara. "The Effects of Rotation Group Bias on Estimates from Panel Surveys," JASA 349 (March 1975): 23-30.
2. Banks, Martha J., and Shapiro, Gary M. "Variances of the Current Population Survey, Including Within- and Between-PSU Components and the Effect of the Different Stages of Estimation," Proceedings of Social Statistics Section, Annual Meeting of ASA, Fort Collins, Colo., Aug. 23-26, 1971, Washington, D.C., ASA, 1972, pp.40-49.
3. Brooks, Camilla. "The Effects of Controlled Selection on the Between-PSU Variance." Proceedings of the Social Statistics Section, Annual Meeting of ASA, Atlanta, GA., Aug. 25-28, 1975. Washington, D.C., ASA, 1976, pp.335-341.
4. Cochran, William. Sampling Techniques. New York: John Wiley and Sons, 1953.
5. Goodman, Roe and Kish, Leslie. "Controlled Selection: A Technique in Probability Sampling." JASA 45 (September 1950): pp. 350-372.
6. Hansen, Morris H., Hurwitz, William N., and Madow, William G. Sample Survey Methods and Theory. Vol. I., Methods and Applications. New York: John Wiley and Sons, 1956.
7. _____, _____, and _____. Sample Survey Methods and Theory Vol. II, Theory. New York: John Wiley and Sons, 1953.
8. Keyfitz, Nathan. "Estimates of Sampling Variance Where Two Units are Selected from Each Stratum." JASA 52 (December 1957): 503-510.
9. _____, "Sampling with Probabilities Proportional to Size: Adjustment for Changes in the Probabilities," JASA 47 (1952): 49-70.
10. U.S. Dept. of Commerce, Bureau of the Census. The Current Population Survey: Design and Methodology, by Robert H. Hanson. Technical Paper No. 40, Washington, D.C.: GPO, 1968.
11. _____, "General Outline of the Steps in the Keyfitz-Estimate and Variance Programs." Memorandum from P. Bounpane to D. Diskin written by M. Schooley, Nov. 6, 1974.
12. _____, "1970 CPS Redesign: Proposed Method for Deriving Sample PSU Selection Probabilities Within 1970 NSR Strata - Justification of Procedure as Unbiased," Memorandum from Walter M. Perkins to Joseph Waksberg; February 19, 1971.
13. _____, "CPS Variances: Request for Computer Program to Compute Covariances on Averages Over Time," Draft Memorandum from Paul Bettin to David Diskin written by Gary Stanko, February 28, 1978.
14. _____, "CPS Variances: Request for Computer Program to Compute Variances on Averages Over Time," Memorandum from Paul Bettin to David Diskin written by Gary Stanko, February 3, 1978.

Table 8. Average Correlations Between Estimates Separated by n Months (Based on 13-n Observations Between December 1974 and December 1975)

Characteristic \ n	1	2	3	4	5	6	7	8	9	10	11	12
First and Second Stage Estimate												
CLF-Total	0.67	0.48	0.32	0.20	0.20	0.21	0.23	0.24	0.25	0.29	0.30	0.34
CLF-Nonwhite	0.61	0.43	0.28	0.15	0.16	0.18	0.16	0.13	0.18	0.17	0.22	0.30
CLF-Teenage	0.46	0.27	0.14	0.06	0.06	0.04	0.05	0.06	0.09	0.16	0.17	0.19
Ag. Emp.-Total	0.72	0.56	0.43	0.30	0.32	0.32	0.33	0.32	0.36	0.41	0.41	0.43
Ag. Emp.-Nonwhite	0.65	0.46	0.34	0.21	0.21	0.18	0.18	0.12	0.15	0.32	0.45	0.58
Nonag. Emp.-Blue Collar	0.69	0.52	0.37	0.25	0.25	0.24	0.25	0.26	0.32	0.37	0.41	0.41
Nonag. Emp.-Self-Emp.	0.62	0.41	0.24	0.09	0.10	0.10	0.08	0.05	0.11	0.19	0.30	0.37
Unemp.-Total	0.45	0.28	0.17	0.08	0.07	0.05	0.05	0.08	0.10	0.14	0.09	0.11
Unemp.-Nonwhite	0.40	0.25	0.13	0.05	0.03	0.02	0.04	0.02	0.07	0.09	0.10	0.10
Unemp.-Teenage	0.30	0.20	0.10	0.04	0.01	0	0.01	-0.01	0.02	0.06	0.01	0.08
Composite Estimate												
CLF-Total	0.73	0.57	0.44	0.35	0.30	0.29	0.30	0.31	0.32	0.33	0.33	0.32
CLF-Nonwhite	0.67	0.52	0.38	0.27	0.23	0.22	0.21	0.21	0.23	0.21	0.22	0.25
CLF-Teenage	0.51	0.32	0.21	0.14	0.11	0.09	0.10	0.12	0.13	0.17	0.17	0.16
Ag. Emp.-Total	0.78	0.64	0.53	0.44	0.42	0.39	0.39	0.39	0.36	0.40	0.44	0.45
Ag. Emp.-Nonwhite	0.68	0.50	0.38	0.28	0.26	0.20	0.19	0.15	0.22	0.35	0.43	0.51
Nonag. Emp.-Blue Collar	0.74	0.60	0.47	0.38	0.33	0.30	0.31	0.34	0.39	0.41	0.43	0.42
Nonag. Emp.-Self-Emp.	0.68	0.50	0.34	0.22	0.17	0.14	0.13	0.13	0.16	0.23	0.29	0.31
Unemp.-Total	0.50	0.33	0.23	0.17	0.12	0.07	0.07	0.09	0.09	0.12	0.09	0.07
Unemp.-Nonwhite	0.41	0.31	0.19	0.10	0.04	0.02	0.03	0.03	0.06	0.09	0.07	0.01
Unemp.-Teenage	0.35	0.24	0.14	0.08	0.03	0.01	0.02	0.01	0.02	0.06	0.01	0.08

15. _____, "Comparison of CPS Variance Estimates Using the Regular Keyfitz Variance Program and a Modified Keyfitz Variance Program," Memorandum by Paul Bettin for the Record, July 30, 1973.