EVALUATING THE QUALITY OF THE 1970 CENSUS

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Considerations in Determining Evaluation Program

Papers presented in earlier years, and published reports, have described in general terms the program to evaluate the quality of the 1970 United States Census of Population and Housing. This paper will provide further details of the program. However, before going on to a description of the various projects used in the evaluation process, it seems useful to discuss the considerations taken into account in determining the evaluation program, and why it took the particular form it did.

In a mathematical model extensively used by the United States Bureau of the Census and other statistical organizations, both measurement and sampling errors are identified as contributing to variance and bias which are then separately estimated in experimental studies. This model has been utilized effectively to guide census and survey design. In a sense, the variance can be considered to reflect the "noise" in the census-taking process and bias the misinformation in the system. Of course, what contributes to variance and what contributes to bias depends on what is being held fixed. A given questionnaire may have a certain consistent or average error effect, defined as bias, but if we consider this particular questionnaire as a sample of one from a population of possible questionnaires that might be considered for the survey, the differences among such questionnaires would contribute to variance.

A desire to measure both response bias and response variance of Census statistics had a major effect on the methods used to evaluate the Census. Frequently, the best method of measuring bias is to compare Census data with outside, presumably more accurate, sources. Although as much of this was done as possible, other devices had to be superimposed in order to measure response variance as well. Generally, the additional programs also had secondary values in providing breakdowns of the biases for sub-classes of the population. As a result of these and other considerations, projects were developed using the following methods for evaluation. (1) checks of the reasonableness of Census totals and distributions by comparing them against outside data;

(2) examination of distributions for internal consistency;

(3) review of the effect of operating procedures, such as accuracy of coding, imputation for nonresponse, etc;

(4) re-interviews of samples of households or persons with case-by-case matching of results;

(5) record checks in which information from outside sources for a sample are compared case-by-case, with Census data;

(6) designed experiments; in 1970, primarily a randomization of work units among a set of enumerators.

The evaluation program also included experiments to test the effects of proposed changes in census-taking process in contrast to procedures in use, although such experiments obviously do not directly measure the quality of the Census.

Given that these were the measurement methods to be used, decisions were still needed on what aspects of census-taking should be studied and the emphasis to be given to each. The criteria used in allocating priorities involved determining that the evaluation program should satisfy the following broad classes of objectives:

(1) To determine the effectiveness of the new procedures adopted for the conduct of the 1970 Census. In a sense, one of the purposes of the 1970 evaluation program is to ascertain whether the Census moved in the right direction in adopting the procedures utilized for the first time in 1970 (and for that matter, in continuing the methods first introduced in 1960).

(2) To obtain another round of readings on the components of mean square error of important census statistics. (1970 would be the third point in a time series on evaluation.)

(3) To solve some problems of evaluation that were inadequately dealt with in 1960.

(4) To pursue more intensively the correlates and causes of error in census statistics.

Description of Evaluation Projects

A group of projects was developed to measure, as accurately as possible, the extent and cause of coverage and content errors. About half of the resources to be devoted to the evaluation program was assigned to each of these classes. The first ones we shall describe are those that involved checks of Census totals and distributions, analyses of internal consistency, and reviews of Census operating procedures:

1. Demographic analysis of coverage. This comprises techniques that check census statistics against data derived from combination and manipulation of birth and death statistics, previous census results, data on migration into and out of the country.

2. Comparisons of Census totals and distributions with other available aggregated statistics, e.g., comparing labor force distributions with the Current Population Survey figures, school enrollment with Office of Education data, etc. Of course, such comparisons can raise serious questions on the accuracy of different statistical sources and what are appropriate standards. This is a problem that permeates the entire evaluation program and one that is better dealt with on a project-by-project basis.

3. Analysis of the size and potential effect of nonresponses and the methods used to impute for them.

4. The effect of special procedures used for the first time in the 1970 Census to improve coverage in difficult-to-enumerate areas. Insofar as possible, we are obtaining counts of the numbers and some characteristics of persons added by these procedures. Unfortunately, this is only possible for some of the devices used. There is no practical method for isolating the effects of some coverage improvement techniques; for example, more intensive training of enumerators and crew leaders in selected areas.

5. A study of the composition of the 20 percent sample in the Census to ascertain whether any bias has occurred in the sample selection.

6. Analyses of the effectiveness of the various quality control devices (for both field and office operations) used in the Census to control error.

A greater part of the resources in the evaluation program was devoted to a series of projects in which samples of the population or housing units were selected and subjected to various operations to provide measures of error. The operations consisted of such techniques as recordchecks with outside, and presumably more accurate, sources; re-interviews, sometimes with more probing questionnaires; randomizing the work units assigned to a set of enumerators; examining the effects of different stages of census processing, etc.

It should be noted that some of these processes seem to imply that there is always a correct answer to a question and that the difference between the correct reply and the one actually obtained is the error in the individual response or measurement. Without going into a discussion of the nature of truth. in some cases at least this notion is unproductive. The idea of "correct" or "incorrect" is uncertain for a number of items in the Census which are not defined with the precision necessary for an unambiguous reply to exist in all cases; for example, mother tongue, and vocational training. For these items, the re-interview focuses on providing insights on how the respondents interpreted the questions.

The specific projects in the evaluation program are listed in table 1. Some comments are in order.

For overall understanding of census counts, the Bureau is relying on demographic analysis with breaks by age, race, and sex. The detailed projects relating to coverage in table 1 complement the demographic analysis studies in a number of ways. Two studies are designed to improve these estimates. The Birth Registration Study examines the completeness of registration of births. The number of births is an important component of the estimates developed by demographic analysis, and they are obtained by adjusting registered births by estimates of nonregistration. The second study is the Coverage Check of Persons 65 Years and Over, the age group for which demographic estimates are probably weakest. This study has been performed by selecting a sample of Medicare registrants and determining whether they have been enumerated. The remaining studies are intended to explore various aspects of undercoverage. Several projects will measure various aspects of coverage of housing units, partly to shed light on the extent to which living quarters were omitted from the Census, partly

to detect any weaknesses that might exist in the mail techniques introduced in 1970, and partly to evaluate the effectiveness of a number of procedures used in 1970 specifically to improve coverage. The remaining coverage projects explore the extent and reasons for missing selected classes of the population.

Measures of response errors, generally referred to as "content" errors, are mainly derived from record checks, re-enumerative studies, and the randomized enumerator variance study. The 1970 program has expanded the number of record checks, as compared to the 1960 and 1950 evaluations. The record checks appear to be the best devices to measure possible biases in Census statistics. The record checks were performed by matching census reports for a sample of households with independent record sources. In regard to the re-interview program, analyses of the results of the 1950 and 1960 programs indicated that, for most population items, re-enumeration does not provide satisfactory measures of bias, at least with the techniques used. Since adequate measures of simple response variance are coming from the CPS-Census match, most of these population items are omitted from the 1970 evaluation program. Instead it concentrates on: (a) housing statistics, (b) population items for which earlier experience indicates adequate measures of bias can be obtained, (c) new items not in CPS and for which no 1950 or 1960 evaluation data exist. The total response variance, including the correlated component produced by the tendency of some enumerators to make consistent errors, is measured by the randomization study. A more efficient randomization procedure was used than in 1960 or 1950 and more precise measures of variance are expected.

Two of the projects do not neatly fit into any of these categories. One is a study of the accuracy of geographic coding in the approximately 60 percent of the United States in which the codes were computer-assigned. The second, referred to as the National Edit Sample, traces a sample of questionnaires through various stages of census processing, to see how editing, follow-up, clean-up, etc., affected the quality.

Current Status of Program

<u>Coverage:</u> In a paper presented in the 1970 Annual Meeting of the American Statistical Association, Jacob Siegel reported that an analysis of a historical series of rates of net

underenumeration for 1880-1970 supports the view that coverage of censuses has been improving, albeit irregularly, and that the 1970 Census had the lowest underenumeration rate over this period. The preliminary evidence is that the 1970 rate of underenumeration is lower than the 1960 rate, with the decrease in the neighborhood of 0.1 or 0.2 percent. (It must be emphasized that these are only preliminary figures and the Census Bureau will issue a full, final and more accurate report when it completes further work.) This decrease occurred in spite of the fact that changes in the age-sex-color composition of the population between 1960 and 1970 increased the proportion of the more-difficult-to-enumerate categories in 1970. If the same underenumeration rates for age-sex-color groups had occurred in 1970 as in 1960, the total underenumeration would have increased by about 0.2 percent.

Accuracy of Response: Comparisons are being made between Census tabulations and other sources of data for a number of statistics. As mentioned earlier, it is not always clear which source is "better." Furthermore, there are frequently small differences in the population covered, the definitions used, or the reference period which makes exact comparability impossible. However, such comparisons do indicate whether any serious problems exist and the general order of magnitude of errors.

Comparison of the Census with results of the Current Population Survey are shown in table 2 for a number of key subjects--labor force, income, educational attainment, and school enrollment. In general, CPS and Census data are quite close. The largest differences are in some school enrollment categories and these are probably due to the difference between the fall date for enrollment figures in CPS and the later date for the Census. (There are also some large differences in the proportions enrolled in public vs. private schools.) The compensating differences between the different levels of persons completing high school and college are, we believe, mostly due to the better reporting in the Census as a result of self-enumeration.

School enrollment figures were compared with data compiled by the Office of Education, although differences in timing do not permit exact comparability. The two sets of figures are generally similar, except for the division of private schools between parochial and others, where a major discrepancy exists. In general, the quality of the statistics on items that have been traditionally collected in the Census and current surveys is similar to that in prior years. Some of the newer items in the Census were known to be difficult to collect, either because of lack of clarity in the concepts or because many of the respondents simply do not know the correct answer. Evaluations completed to date on two such items confirm the existence of high response errors. For example, the number reported as disabled in the Census appears to be low by about 30 percent. Such difficulties were anticipated and in the 1970 Census there was a conscious decision that the requirements for information for small areas were such that partial data would be useful.

As you can see, only scattered preliminary results are available at this time and these, of course, do not include the larger projects. These programs tend to be complex and slow, requiring a considerable amount of detailed work. In addition, there are always needs for priorities on work assignments and, of course, these are normally assigned to the production of the regular census publications.

We expect most of the projects to be completed within the next year. The results will be made available to the public in a series of 1970 Census publications which will be identified in the PHC-E series. The series will be announced in the usual manner of census publications.

The final evaluation of the quality of the 1970 Census, both in absolute terms, and as compared to earlier censuses must await these final reports.

Sample Sizes

Table 1. 1970 Census Evaluation Projects

Project

Coverage:

Birth Registration Study	15,000 children under 5 years of age7,500 white children7,500 children of races other than white
Coverage Check of Persons with Motor Vehicle Operators' Licenses	1,000 licenses issued or renewed less than a year before the 1970 census to males in their 20's in District of Columbia tracts where the residents were low-income and predominantly of the Negro race.
Coverage Check of Persons 65 years and over	8,000 persons 65 years of age and over, registered for Medicare.
Housing Unit Coverage	A relisting of addresses in 9,000 small-area segments (usually about the size of a city block). In addition, a recheck of 20,000 addresses for completeness of coverage of all housing units at those addresses.
Misclassified "Vacant" Units	3,000 units enumerated as vacant in the Census
Erroneously Deleted Housing Units	1,300 units originally listed, but later deleted from the Census
Coverage Errors based on the Definition of a Housing Unit	1,800 housing units enumerated in the Census, but with characteristics that indicate a potential undercount. 900 housing units enumerated in the Census but with character- istics that indicate a potential overcount.
Matching of Housing Units from the Current Population Survey Against the Census	56,000 housing units checked for inclusion in the Census. Persons in 10,000 housing units checked for inclusion in the Census.

Table 1 (continued)

Project

Content:

Match of CPS and Census Data

Accuracy of Income Reporting based on Match with the Internal Revenue Service

Accuracy of Occupation and Industry reporting Based on Match against Employer Records

Employment 5 years ago

Record Check on Expenditures for Gas and Electricity

Record Check on the Value of Owned Homes

Reinterview of Census Sample Households for Content Evaluation

Accuracy of Geographic Coding of Addresses to tract, Block, and Minor Civil Divisions

Accuracy of Place of Work reporting and Coding

Disability Study

National Edit Sample (to measure effect of editing follow-up and clean-up on "Not Reported" rate)

Response Variance Study

Other:

Experiment testing the feasibility of extending the mail census to areas of lower population density Sample Sizes

Characteristics of housing units and persons in them compared with Census, for 10,000 housing units.

The 10,000 housing units cited above.

7,500 employed persons (excluding selfemployed, unpaid family workers and farmers).

4,000 persons 14 years and over reporting employment status in the Current Population Survey in July 1963.

5,000 rental housing units in the Census 20 percent sample selected from 5 metropolitan areas.

3,000 homes sold July-December 1971

10,000 housing units occupied in the Census. 1,000 vacant housing units.

11,000 addresses.

4,000 employed persons in the Census sample, in SMSA's

15,000 households with one or more persons reported as disabled. 25,000 households with no persons reported as disabled.

7,500 questionnaires from the Census sample. 7,000 nonsample questionnaires.

1,100 enumerators in 35 Census District Offices.

Five matched pairs of District Offices for comparison of costs and administrative problems.

For a coverage check, 13,000 housing units relisted in small areas selected from 420 enumeration districts.

Table 2.Comparisons of Census and CPS Statistics for
Selected Items, 1960 and 1970

(CPS data for labor force are for April 1970; income and
educational attainment are for March 1970; school enroll-
ment data are for October 1969)

	1970			1960		
Item	Census	C PS	Difference	Census	CPS	Difference
Labor Force (%)						
In civilian labor force	58.4	60.1	- 1.7	55.5	57.0	- 1.5
Employed	55.8	57.5	- 1.7	52.6	54.0	- 1.4
Unemployed	2.6	2.6	-	2.9	3.0	- 0.1
Unemployment rate	4.4	4.3	0.1	5.1	5.2	- 0.1
Not in civilian labor force	41.6	39.9	+ 1.7	44.5	43.0	+ 1.5
Income				•		
Median family income	9590	9433	157	5660	5417	243
Aggregate money income (in billions)	635.5	603.3	32.2	332.3	304.5	27.8
Educational attainment for persons 25 years and over (%)						
Elementary						
0 to 7 years	15.5	14.3	1.2	n.a.	n.a.	n.a.
8 years	12.8	13.4	-0.6	n.a.	n.a.	n.a.
High school						
0 to 3 years	19.4	17.1	2.3	n.a.	n.a.	n.a.
4 years	31.1	34.0	-2.9	n.a.	n.a.	n.a.
College						
l to 3 years	10.6	10.2	0.4	n.a.	n.a.	n.a.
4 years	6.1	6.8	-0.7	n.a.	n.a.	n.a.
5 years or more	4.6	4.3	0.3	n.a.	n.a.	n.a.
<u>School enrollment</u> (thousands of persons						
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Elementary school	33 210	33 788	$\frac{4}{7}$	28 088 3	20 382	1 2
High School	14 481	14 553	-1.7	40,700 A	9 616	-1.5
College	6, 966	7.435	-6.3	2,935	3 340	-12 1
000000	0,700	1, 155	-0.5	2, /33	5,540	- 14.1

Note: Minus sign denotes higher C PS figure.

1/ 1970 data are for persons 3-34 years; 1960 data are for 5-34 years.

2/ Difference shown as percent of C P S totals.