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THE PROS AND CONS OF "SELF-ENUMERATION"*

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RESUMEN

Los datos censales pueden obtenerse enviando el cuestionario al jefe del hogar, quien delvolverá, la información por Correo, o por medio de la visita de un enumerador al hogar, quien obtiene personalmente la información. Los méritos de cada uno de estos métodos han dado lugar a una amplia discusión sobre el particular. El primer método mencionado, de uso común en Europa, fué adoptado por la Oficina de Censo de los Estados Unidos, en 1960. Este artículo pretende resumir que efectos, tuvo esta decisión en la precisión de los datos censales. Se concluye que este método de enumeración no cubre una mayor cantidad, produce una tasa mayor de no-respuesta, y no reduce los errores de clasificación. De hecho, esta tasa parece aumentar en los grupos socio-económicos mas bajos de la población. Se concluye que ambos mótodos, tal como han sido usados en el pasado, producen estadísticas menos precisas que las que se necesitan para las investigaciones demográficas; debe prestarse apoyo a estudios que hagan relación con maneras de mejorar estos sistemas. Se sugiere que para obtener en el largo plazo mayor precisión con el método de enumeradores, la selección, entrenamiento y supervisión de los mismos debe ser en extremo rigurosa. Sin embargo, una respuesta definitiva sólo podrá darse, cuando se sepa más de los errores cometidos tanto por los Jefes del Hogar como por los enumeradores.

I. HOUSEHOLDER VERSUS ENUMERATOR COLLECTION OF DATA

Two alternative procedures are available for the collection of population data: the "householder" approach and the "canvasser" approach.[1] Using the first, the information required by the census is recorded by the household head or someone he designates. Using the second procedure, the recording is made by an enumerator who visits each house, asks the questions printed on the census schedule, and records the information as it is provided by a respondent who is deemed to be qualified.

Both systems have been in use for many years. The householder approach has been used primarily in European countries. Until the 1960 census the canvasser approach was used by the United States Census; in 1960 an approach was substituted that relied primarily upon the householder to provide the required data. The new procedure, widely but incorrectly termed "self-enumeration," is almost certain to be used in the 1970 and other future censuses of the United States. Inasmuch as the Bureau of the Census tends to set statistical styles, there is a growing trend for other data collection operations to use "self-enumeration" in conducting household surveys.

The present paper seeks to promote wider research and discussion of a question which deserves international as well as internal discussion: *"What are the pros and cons of the householder versus the canvasser approach to the collection of population data?"* It will try to present the hypotheses that are involved, to sum-

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[1] For a full description and discussion of each, see United Nations, *Handbook of Population Census Methods*, I, *General Aspects of a Population Census* (New York, 1958), pp. 88–98.

marize the arguments favoring each, and to review some of the evidence available from the 1960 census and other sources. The conclusion will be reached that, although the question is a highly important one, the data needed to test many of the basic hypotheses either are not available or else yield results that are inconclusive —as of right now there is insufficient scientific or economic basis for clearly preferring one approach over the other. An evaluation of the results obtained by the two alternative approaches indicates that neither mode of enumeration yields sufficiently precise data to meet the current needs of scientific demography. It is hoped that demographers all over the world will become increasingly sensitive to the problem of data quality and will keep an open mind on the problem, continuing to explore it by pooling their findings—irrespective of the particular procedures they may be using to collect their data at the present time.

II. THE QUALITY OF CENSUS DATA: FACT AND NEED

The question of how to collect census data cannot be answered without considering two questions: "How precise do we think census data need to be for the conduct of contemporary demographic research?" and "How precise, for purposes of demographic research, are the data of past censuses taken by the enumerator and the householder approach?" No census organization in the world has equalled the United States Census for concern over these questions. It is only because this staff of outstanding technicians has been so sensitive to the need and desires of its "customers" that it is possible to discuss the topic in more than academic terms. On the one hand, panels of advisors have been organized by the Census in order to learn more about the needs of those who use census data in their professional work, and, on the other, panels of technical advisors have been organized and encouraged to promote a continuous critical evaluation of the results of past censuses and of procedures proposed for future ones. Meanwhile, task forces of census statisticians have been assigned to study and report on the quality of census data. The appended bibliography of their published writings is most impressive; no other national census has been so completely and publicly critical of its own work.

A very large share of the empirical data we have with which to study these problems has been created by the United States Census as part of a long-term program to collect special data concerning census errors. Two ambitious research programs, following the 1950 and the 1960 censuses, have produced a large quantity of data. Research on the problems of data collection is becoming in itself an important subfield of demography, as a result.

The appropriate perspective from which to view the problem of census data quality was succinctly stated more than a decade ago by Morris Hansen, Director of the Census Division for Research and Development and leading architect in the search for facts about census errors, and two of his collaborators in this sustained program, William N. Hurwitz and Leon Pritzker:

> We should like to call attention to a major change in attitude with respect to census taking. Until recently, the emphasis in census taking has been primarily on producing the most accurate census possible, without any particular attention being given to the question of the required accuracy and to what extent it is worth an additional cost to increase the accuracy. [Instead] . . . emphasis has been placed on achieving results of needed accuracy at minimum cost and on attempting to consider the overall accuracy required in relation to the costs and the purposes to be served. . . . Instead of striving for perfection, we view the task as that of balancing the costs of producing statistics against the losses from errors in the statistics.
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> What is the significance of census errors? . . . We believe that a solution of the problem calls for, among other things, recognition of the principle that considerations of accuracy

and of utility are inseparable. We have been forced to this recognition by having to view the Bureau of the Census as a factory engaged in the production of statistical tables. In the management of that factory just as in the management of any other factory, . . . management is required to examine the costs of production and relate them to the value of what is produced. The value of our product depends on the uses that are made of it and, depending on the use and the risks and losses associated in making a mistake in the use, the allowable tolerances of error may vary. Instead of the principle of highest possible accuracy, then, this view substitutes the principle of determining the level of accuracy that is optimum by balancing the losses due to errors against the costs of greater accuracy.[2]

Every census in the world needs to seek an answer to the Hansen-Hurwitz-Pritzker question, "How serious is the loss in terms of opportunity costs now being incurred because of inadequacies in census data?" Demography, as a profession, should help to supply a sincere and honest reply to it. A complete answer would require a thorough canvass of research demographers. It would be presumptuous for any one person to try to speak for the profession. The present writer seeks only to utter an opinion, based on the experience of having made extensive research use of 1940, 1950, and 1960 censuses, at the national, state, and micro-demographic level. This opinion is one which he believes is shared by many if not most statisticians who make intensive use of census data—that these losses are substantial and serious. *Despite the valiant and heroic efforts of the world's leading group of census experts, the research needs of demographers appear to be running ahead of the quality (precision) of the available data, and the gap between present quality of data and the quality needed by the research is widening instead of lessening. In fact, the research demands are so varied, so detailed, and backed by such important considerations for public welfare as well as academic "theory" that they drive the "needed" level of precision much nearer the old-fashioned ideal of census perfection than many may realize.* In other words, it may now be desirable to think of an acceptable level of error for a census as being not significantly lower than that now being achieved in the best of the national sample surveys, and that achieving it should be the goal in planning future censuses. The evidence now available suggests that the modern demographer, by the uses he attempts, implicitly desires and is asking for nothing less. It is to be hoped that demographic and statistical ingenuity and research all over the world will accept this need for precision as a challenge and will unite their talents and redouble their research endeavors in a drive to achieve it.

If such high precision is accepted as the standard, then the choice of the appropriate method for collecting the data for any census should be that method which offers the best hope for ultimately achieving the hoped for precision. It would be short-sighted to adopt a procedure that is no worse than any other if it later proves to reach a barrier of imprecision through which it cannot pass on the way to achieve the necessary.

III. THE NEED FOR PRECISION

The above strong assertions about the need for precision in census data require documentation. Below are identified twelve distinctive types of common research situations, found either singly or in combination with each other, that require high precision in population data. Space permits only a brief statement and illustration of each.

1. *Detailed classifications involving fine discrimination.*—Demographers increasingly find need for tabulations of age in terms of single years for studies of fertility, nuptiality, and migration. Users of economic data find much use for the detailed classifications of occupation (297 categories) and of industry (149 categories) instead of the dozen general cate-

[2] Morris H. Hansen, William N. Hurwitz, and Leon Pritzker, "The Accuracy of Census Results," *American Sociological Review*, XVIII (1953), 416–17, 421–22.

gories that have formerly been used. All branches of the study of population composition press for more refined categories: Education is needed in terms of single grades and seperately for public and private schools. Family and household status is needed in full detail to show the relationship of every member to every other. Marital status must separate persons who are married into three groups—living together, separated for reasons of estrangement, and separated for other reasons. Migration researchers press hard for a more detailed classification of type of area of origin. Labor-force experts press for refinements of the classification of reasons for not being in the labor force or for being unemployed. Along all fronts the research calls for the making of finer distinctions and the use of more complex and lengthy systems of classification. The limit to this refinement is not lack of ingenuity of the researchers or the unwillingness of census designers to oblige. Instead, it usually is a frank assessment that as yet census procedures are not sufficiently precise to make fine discriminations of the type desired.

2. *Multiple-variable cross-classifications.*—Each census is coming to be more elaborate than the preceding because of the increased amount of cross-tabulations. Some of these involve the cross-tabulation of one detailed characteristic by another (as detailed occupation by detailed industry). Others may involve the cross-tabulation of as many as six or seven variables simultaneously. Demographers have come to regard the *Special Reports*, tabulated after the "regular" reports, as the rich ore of the census. For the testing of hypotheses of the type now being studied, it is not at all unusual to need a tabulation such as the following: women by children ever born, by age, color, education, migration status, occupation of husband, urban-rural residence, region of birth, and region of present residence. Since such tabulations are made from a sample, the average cell density becomes very small for certain critical categories, and it is highly important that the cases found in each cell be measured with a minimum of error. For example, if the number of categories in the above examples were $7 \times 11 \times 10 \times 2 \times 6 \times 3 \times 3 \times 4 \times 4$, there would be an average of only 2.4 cases per cell in the 5 percent sample used for such tabulations in 1960, and the average density in the cells for nonwhite, rural-farm, the migrants, those with unusually high or low education, and the childless would be much below this.

3. *Studies of small areas.*—The areas of micro-demography, micro-economics, and micro-sociology are expanding rapidly; research is focusing increasingly upon adopting small spatial units of population as units of observation and analysis. Demands for data for small individual communities, for townships, census tracts, and city blocks are increasing, both in variety of data wanted and the amount of detailed categories and cross-classification of data. The programs to fight poverty, to rebuild slums, and to aid depressed areas are augmenting this development, because such programs require exact information about local problems and situations. The need is not only for reliable population and reliable economic information for small areas, but to unite several varieties of information in order to deal with these problems in all of their aspects.

4. *Studies where the dependent variable is a residual.*—Many phenomena cannot be measured directly but can be studied indirectly by eliminating all other plausible factors and identifying "what is left" as the topic of analysis. A well-known example is the estimation of net migration by the survival ratio method, wherein the natural increase is subtracted from total growth in order to permit the assumption that the residual is an estimate of net migration.[3] An equally important class of problems is the exploration of all classes of

[3] Horace C. Hamilton and F. M. Henderson, "Use of the Survival Rate Method in Measuring Net Migration," *Journal of the American Statistical Association*, XXXIX (1944), 197–206.

differentials, such as differentials in fertility, mortality, nuptiality, or migration by race, educational attainment, socio-economic status, and so forth. The measurement of intercensal change itself is a residual—the difference between two censuses. Hence, *many, if not most, variables in demography are not derived directly from census data but are residuals or differences between two or more census counts.* As was pointed out by Dr. Leon Truesdell several years ago,[4] all the errors of coverage and classification made by a census are also included in such residuals. Therefore, a residual is measured much less accurately than the trait itself. In fact, errors of 50 or 100 percent in the measurement of residuals are not at all uncommon, especially when the residuals being measured are comparatively small.[5] Inasmuch as the study of differences, change, and net residuals comprise a very large part of demographic research, this is perhaps the single strongest argument for high precision in the basic data.

5. *Studies of small groups with special combinations of characteristics.*—Many research hypotheses refer only to a small segment of the population (perhaps widely dispersed in space) that has some unique trait. Quite often, for "critical tests" of an hypothesis it is only a small group with an extraordinary combination of traits that can provide the data. For example, we may ask the question, "Which is more influential in promoting school attendance, the level of education of the father or the level of education of the mother?" In this example we need data on the school attendance of children 14–17 years of age by sex, educational attainment of father, educational attainment of mother, family income, urban-rural residence, and perhaps nativity and region of birth. For such studies, only highly detailed and accurate data can provide valid information about such special groups. The "crucial data" in such a table would be the cells for mothers with college education married to husbands with only a grade school education and for well-educated men married to poorly educated women. It is highly important that such data arise from events as they exist in the population, not contaminated by errors occurring during the process of enumeration and tabulation.

The number of such special subgroups which have particular interest is large and increasing. Some examples follow:

1. Women who have borne an extraordinarily large number of children or those who are childless or with only one child, though married for several years.
2. Child marriages: children 15–17 years of age who have married—or unusually late marriages: age at first marriage 35 years or older.
3. Early motherhood—girls 15–18 who have borne children.
4. Misfits in the labor force—persons with prolonged unemployment, extraordinarily low pay or high education for given occupations, or part-time workers.
5. Men 25–49 years of age who are not in the labor force.
6. Small ethnic groups—American Indians Chinese, Japanese, Filipinos, foreign-born Negroes, and so forth.
7. Employed women living with husband and with numerous children of school age in the home.
8. Women in occupations usually held only by men.
9. College graduates with low incomes, in low-skill occupations.
10. Uneducated persons with high incomes, high-skill occupations.
11. Persons who journey extraordinarily great distances to work.
12. Persons past age 30 who are still in school.
13. Persons aged 14–19 who are employed full time or persons of this age who are not in school and not in the labor force.
14. Households in which the head is an employed mother with small children.

[4] Leon E. Truesdell, "Residual Relationships and Velocity of Change in the Field of Statistical Forecasting," *Journal of the American Statistical Association*, XXXIII (June, 1938).

[5] Daniel O. Price, "Examination of Two Sources of Error in the Estimation of Net Migration," *Journal of the American Statistical Association*, L (1955), 689–700.

15. Migrants who have made extraordinarily long or unusual journeys.
16. Persons who have been married two or more times.
17. Widows of less than 40 years of age.
18. Children who are retarded or accelerated in school.
19. Elderly persons of low income living alone.
20. Lodgers in the homes of others.
21. Homes in which there is a grandchild but no child of the head.

Much of the research that is needed for the making of policy decisions about these problems requires valid data for such groupings. Because there is no alternative source, more and more reliance is being placed upon the census to provide such information, at least once per decade.

6. *Studies of the incidence of events in the absence of registration data.*—By appropriate demographic techniques it is possible to estimate the rates at which events are occurring in a population from census data. The articles by Mertens and by Grabill-Cho in the present issue of *Demography* are pioneering methodological statements in this tradition. By using two or more consecutive censuses, it is sometimes possible to calculate a wide variety of rates by such procedures, as fertility, mortality, nuptiality, social mobility, marital dissolution, retirement, raises in pay, promotion in school, intermarriage of ethnic groups, and others. The validity of all such measures is greatly affected by the quality of the data, for they constitute a special class of residuals. Although in many cases the data can be smoothed and graduated to correct obvious errors, only precise data can successfully duplicate the results that would be given by a registration system. As Grabill-Cho point out in their article, this line of study permits the calculation of rates for special subgroupings of the population (income, ethnicity, etc.) for which no registration system anywhere can provide information. This line of research is therefore not one confined only to "underdeveloped countries": it is destined to become a very large and important segment of routine demographic analysis.

7. *Studies of cohort changes over time.*—As the number of successive censuses becomes greater and as the comparability of data from census to census improves, more and more refined cohort studies will be undertaken, covering a wider variety of topics. Cohort analysis is no longer confined to fertility studies of a very general nature. Instead, we have cohort studies of migration, education, marriage, labor mobility, income, home ownership, and so forth.[6] Such studies require not only highly precise data with respect to age (single years) in order to preserve the integrity of the cohorts but also exact data on other characteristics in order to calculate comparative rates of change in the various cohorts.

8. *Studies where the tabulations are based on small samples.*—Unfortunately, a great amount of the census tabulations that are of greatest research interest is based on comparatively small samples (have low average cell density). The average cell density in the special reports tabulations of the United States Census has been surprisingly small in all censuses for which they have been performed—1940, 1950, and 1960. The fact that most population characteristics now are collected for only a 25 percent sample introduces rather great relative sampling variability into data for city blocks and census tracts, with consequently greater need that the data be more precise. The inferences that can be drawn from such tabulations are greatly influenced by the amount and pattern of error in the data. The greater the precision the greater the reliability of the findings based upon small samples.

9. *Studies where the variable is not measured directly but is inferred indirectly.*—Demographers and economists are highly adept at devising special indexes to measure indirectly variables for which data were not explicitly collected by the census.

[6] For example, see Hope T. Eldridge, "A Cohort Approach to the Analysis of Migration Differentials," *Demography*, I (1964), 212–20.

For example, by taking the percentage of children of grammar school age attending private schools and expressing it as a percentage of all children of these ages in school, it is purportly possible to identify areas of concentration of population of Roman Catholic faith. Combinations of items from housing censuses have been used to identify "slum," "blighted areas," and "upper class neighborhoods." Data on living arrangements have been combined with other items to identify Skid Rows, "rooming house areas," "areas of social disorganization," and so forth in the city. The intensity of racial segregation and of segregation of residence on the basis of occupation and income has been measured by such indirect means. Census data are used to estimate the "economic base" of a community—the types and amounts of goods it exports or exchanges with other communities as its function in the national division of labor —and the number of persons engaged in such work. Similarly, the economic dependency of a community upon the rest of the economy has been measured by the same procedure. Census data play a central role in the construction of the components of national accounts, and census data are used in the derivation of the equations that express the flows of commodities in input-output analysis. The refinement of economic and demographic models depends to no small degree upon refinement of the basic data from which these numerous indirectly inferred variables are estimated.

10. *Studies of phenomena where judgment or evaluation is required.*—In the data collection enterprise there is a move to rely upon the field worker to make judgments and evaluations that otherwise would be difficult to quantify. A well-known example is the evaluation of housing as "dilapidated," "deteriorated," or "sound." When armed with comparatively simple instructions and uniform training, interviewers can collect with usable validity data for a variety of pathological or unusual conditions that may be of interest but available only though observation.

Together these ten types of research situations emphasize the need for precision in population data. Moreover, these suggest that the need for precision is increasing rapidly, so that merely by staying the same, censuses of the future will become progressively less adequate.

The electronic computer has enabled researchers to pose highly sophisticated and highly complex questions—and for very small populations delimited either in terms of combinations of traits or of residence in a particular area. Because they lack data from other sources, they turn to the census for information.

It is possible to react to this need in two ways. One could assert, "The census was never intended for such purposes and researchers have no right to expect such high precision." Alternatively, it is possible to accept this need as a census goal in the spirit of the Hansen-Hurwitz-Pritzker quotation given above. The "losses" that are being suffered and will be suffered increasingly from insufficient precision, as mentioned in this quotation, are difficult to assess, but estimates suggest that they are tremendous. To reduce them to tolerable limits, the nation could well be justified in tripling or quadrupling the budget for the decennial census and adopting procedures far more elaborate and costly than any heretofore envisaged, if by doing so it could accomplish the level of precision needed both for scientific and public welfare purposes. If this philosophy prevails, then the needs of research, not past performance, will set the goals for future censuses and define their nature. Procedures for collecting the tabulating data will then be established in the light of efforts to attain those goals.

IV. ADVANTAGES OF CANVASSER ENUMERATION: THE FUNCTIONS OF THE ENUMERATOR

Before considering empirical evidence it may not be inappropriate to review the functions which an interviewer (in

theory) is supposed to perform if he or she is doing a good job. It is possible to identify at least ten such functions.

1. *Minimize refusal and noncompliance.*—A certain percentage of respondents is hostile to the idea of being interviewed, while an even larger percentage is adamant or negligent. It is widely believed by "survey researchers" that both groups would not comply with the request for information if the interviewer did not intercede to explain the purpose of the survey and by personal contact facilitate getting the information—or that if they did comply the response would be minimal. Most questionnaires mailed to the general population have only a return of 30–50 percent because of this phenomenon. Although the census has a legal status which a private survey lacks, it has long been presupposed that an interviewer's presence would have a beneficial effect upon the full compliance of a substantial percentage of the population. At the time of the census the interivewer is a personification of the national government, and his very presence (if he is a person worthy of respect) is a genial but nevertheless legal summons to furnish information. Long-term census employees who have worked in the field have many anecdotes to illustrate the point that, with his portfolio under his arm, the census taker is Uncle Sam himself to the unwilling as well as the willing respondents.

2. *Enforce honesty and minimize falsification.*—Many persons dislike to report their age, their marital status, their income, or to admit that they have little education or a poor job. Others may want to understate or hide their socio-economic status. The fact that an interviewer is present to observe the approximate age, to gauge the approximate income level from the location, size, and furnishings of the dwelling unit, has been thought to be a curb to misrepresentation. It has been supposed that the official nature of his visit, backed by the census law, gives the census interview a testimony-taking flavor that would minimize falsification.

3. *Explain concepts, clarify misunderstandings, and answer questions.*—Many of the concepts used by the Census are quite complex. A significant share of the respondents may get confused about the objectives of some questions and give responses that are irrelevant or at best only partly correct. Each of the recent censuses has had a 100-page *Enumerator's Reference Manual,* cataloguing the many unusual types of situations that arise and giving instructions on how each situation is to be handled in order to minimize bias in the data. A householder respondent has only a very brief instruction at most to guide him, and if he falls into one of the very numerous ambiguous situations, he must guess his way out of it as best he can or omit it altogether and thereby create bias. Many a babysitter or other part-time worker could honestly wonder whether she or he is unemployed or not in the labor force; others may fail to grasp the distinction between occupation and industry. Traveling salesmen, circus troupes, and inmates of institutions will have complex questions about their mobility status, The high school graduate may report attendance at a business college, beautician school, or apprenticeship as a part of "years of schooling completed." In reporting children ever born, many women will report only legitimate children or children by the present marriage, and the childless married woman may simply ignore the question. Should family income include the earnings of a nephew paying board and room or a tuition scholarship to college won by a child? The interviewer who has been carefully coached on these definitions and their fine points should be prepared to explain what they mean, define terms, and answer questions. The more ambitious in scope a census becomes, the more its concepts become complex, with need for clarification.

4. *Detect inconsistencies, incomplete responses, and unintentional errors, and, by probing, correct them on the spot.*—Many erroneous answers are given innocently, either from a low level of intelligence,

faulty memory, temporary confusion, or giving a stereotyped response that really does not answer the question. An alert interviewer is expected to perform an editorial function as he records; incongruities and apparent impossibilities or improbabilities get his attention and he makes inquiries about them. The correct age of an elderly grandmother may be revised downward by comparison with the age of the respondent; forgotten dates necessary to record migration status accurately may be recalled with interviewer assistance, and so forth. In theory, at least, the interviewer is prepared to raise the performance of such persons to an acceptably high level by means of patient explanation and probing. The statistics of the prevalance of persons of borderline intelligence, extreme neurosis, and low level of initiative to perform tasks which are onerous but which carry no reward suggest that a low level of performance may be expected by a highly unrepresentative but not small fraction of householders. If this editorial function is performed in an office, it is too late to do much by way of detecting and correcting the work of incompetents. Contacting a person by telephone to ask him to clarify an apparent inconsistency requires much more initiative and may be much more challenging than a simple friendly query from an on-the-spot interviewer. To the extent that there is a tendency for office personnel to falsify the returns *ex post facto* by "writing in what the respondent obviously meant," errors from staff editing may be quite substantial with householder enumeration.

5. *Prevent nonresponse to particular items.*—When people do not wish to supply a particular item of information on a self-enumeration form but do not wish to be uncooperative together, they simply may omit answering the single items to which they object. With householder enumeration there is little to prevent this. When perfectly usable schedules with minor omissions arrive at the census office, the Census is given a most uncomfortable choice. Shall the person be called on the telephone and asked to supply it? If he has no telephone, should an interviewer go to his residence and obtain it? Or should it be supplied by machine guessing, allocating a characteristic on the basis of the characteristics of other persons who have similar traits? With a well designed enumeration form and good enumerators, this situation should be minimized.

6. *Enumeration by observation.*—Some items of census data require only that the interviewer observe and record, without asking questions. Examples are race and condition of dwelling unit. Before 1960, Negroes scarcely knew that the question on race was being asked, because it was simply observed by the interviewer and recorded. By the householder method they are forced to certify their race in writing. The current drive by civil rights groups to get the race item removed from all data collection forms may be greatly intensified by this forced self-registration of race. It is not improbable that a racist organization will inspire its members either to refuse to answer this question at future censuses or else encourage them to falsify their responses. Self-enumeration lays each series of data vulnerable to refusal to cooperate by one or more groups most unique or deviant from the population average.

7. *Obtain a legible record.*—A very substantial share of the population writes illegibly. The writing instruments used by many households are of very smeary, smudgy, blotty, and scratchy quality. Self-enumeration produces a great quantity of illegible marks on paper, and a poorly written record is typical rather than exceptional. This problem has been serious enough in previous censuses, where interviewers were screened for their ability to write legibly and instructed to do so. Persons who must transcribe self-enumeration records find themselves guessing whether given symbols are 5 or 2, 3 or 8, 7 or 4, and so forth, and whether the state of birth or place of last residence were Mississippi, Michigan, Minnesota, or Wisconsin. Errors of transposition, of making

incorrect and misleading abbreviations, of placing answers in the wrong boxes, and so forth, almost certainly must be higher among the general population than among a corps of trained enumerators who must pass an examination to be hired.

8. *Assure transmission of each question in full.*—An interviewer is instructed to read each question aloud *in full* and to read it in exactly the same way to each respondent. This is done in an effort to assure that every respondent gets the same stimulus. In filling out enumeration forms, many impulsive householders may look only at the caption heading and insert what they think ought to go there, without "reading the fine print" that gives extra information or instructions. Thus, many persons do not get the question presented in full and experience a different stimulus from that given by the interviewer. Moreover, hearing a question read aloud with proper phrasing and intonation may convey clearer comprehension than a quick reading by a person not accustomed to reading and comprehending factual questions of this type.

9. *Build rapport and maintain good public relations during the census.*—At the time of the census a great many public issues get tied to the census. Salesmen pose as enumerators; zealots condemn certain items or otherwise try to benefit from the situation. Even the neighborhood hothead, an irresponsible disc jockey or news commentator, or a radical newspaper or pamphleteer can create substantial mass anti-enumeration unrest and anti-census feeling. The more urban we become the greater are the potentialities for mass media campaigns against the census or particular parts of the census. Canada's recent experience with counting ethnic origin is an example. A friendly, well-mannered interviewer, circulating in each neighborhood, armed with counter arguments given him as a part of his training, is expected to be an antidote to such temporary hysteria. Under a scheme of householder enumeration, rumors can be fabricated and spread with almost no counter-information except that which is put through formal channels, which most rumor-believers may not trust. The census enumerator hopefully is a force for maintaining stability and public calm and trust while the count is on. The fact that enumerators are spread uniformly throughout the entire population means that counter-information is never far from the source of rumor.

10. *Obtain information about hard-to-reach persons.*—Persons who are hard to reach because they are away from home and not receiving mail and are likely not to be enumerated often can be contacted and enumerated at least approximately by contacting neighbors. With a system of mail enumeration, this is more difficult to accomplished. When self-enumeration is combined with sampling, as in the 1960 census, failure to obtain any information about persons in sample households can be a substantial source of bias.

V. THE ADVANTAGES OF HOUSEHOLDER ENUMERATION

There are no less than nine arguments in favor of the householder approach to enumeration which, if valid, are very powerful.

1. *Each person has an opportunity to report for himself*, or at least to have an opportunity to review the information concerning himself before it is forwarded to the census office. The enumerator calling at each house usually must accept the replies of a single informant and cannot wait to have ambiguous answers clarified by a family caucus in the evening. If each person describes his job, reports his own income, birth date, employment status, and so forth, to the person completing the report, it would seem plausible that the total amount of error could be much smaller than under a system whereby the enumerator must accept the answers given by a single adult informant who happens to be home at the time. The enumeration of lodgers and more distant relatives of the head might

be thought to benefit especially from this procedure.

2. *It reduces bias and variance in enumeration.*—It has now been demonstrated beyond any doubt that enumerators do inject a significant amount of bias and variance into census data, and that particular enumerators exhibit particular patterns of error.[7] The article by Powell and Pritzker, in the present volume, presents a carefully reasoned presentation of the theory and some empirical results which demonstrate not only that is is *possible* for this undesired source of difficulty to arise but that in fact it *does* occur. Similar results have been measured in the Canadian census.[8] This research indicates that this bias and variance are contributed by a comparatively small group of interviewers; the majority do work that is reliable, but a small minority creates problems by systematically mishandling particular questions. Although there is a tendency for persons who mishandle one question also to mishandle others, unfortunately the tendency is only a general one.[9] Although substantial reductions in errors could be made by a policy of early detection and discharge of error-prone enumerators, as of right now it appears that this could only alleviate but not wholly resolve the problem. *It is firmly established that under the programs of recruitment, training, supervision, and quality control of field work thus far employed, data collected by enumerators fail to measure up to the standards of precision outlined in Section II.* (Documentation of this assertion will be given below.) Does householder enumeration materially improve the quality of the data collected by reducing bias and variation? In theory, allowing each person to "speak for himself" should solve the problem completely, unless errors of householder-reporting outweigh those of enumerator-reporting.

3. *It reduces the amount of time required to take a census.*—By mailing out the forms, everyone can enumerate himself on a single day. In fact, where a *de facto* census is taken, in some nations only the householder system can hope to achieve the ideal of one-day counting. Enumerators require more than one day to complete an assigned enumeration district. Some enumerators fail and their unfinished assignments must be taken over by others. Where insufficient enumerators can be hired some districts must wait until an enumerator has finished his first assignment before work can begin.

4. *It provides time for compiling correct answers.*—The enumerator is paid according to the number of people he enumerates. In order to maximize his pay he must spend a minimum amount of time at each house. He is in no mood to encourage a wife to locate last year's tax return in order to report income more accurately or otherwise to consume time in compiling precise answers. Errors that otherwise would occur because of haste, carelessness, or lack of immediate access to the correct information are reduced.

5. *It is cheaper.*—If every household head would report accurately and completely for all members of his dwelling unit, there would unmistakably be a great saving in interviewing costs. The major costs of the field work in previous censuses has been the salaries of enumerators and supervisors. If this cost could be eliminated, it would be a major economy.

6. *It simplifies field work.*—At first thought one might presume that householder enumeration would greatly reduce the complexity of the field work. It would be necessary only to mail out the forms, collect them, and mail them to the census office. If this proved to be true, it would eliminate the process of recruiting, training, and supervising large numbers of enumerators, and the large census offices

[7] See references below to Stock and Hochstim (1951); Gray (1956); Gales and Kendall (1957); Hanson and Marks (1958); Eckler and Hurwitz (1958); Kish and Slater (1960); Hansen, Hurwitz, and Bershad (1960); Kish (1962); and Fellegi (1964).

[8] See reference to Fellegi (1964).

[9] See article by Powell and Pritzker in the present volume.

that must be opened up and then dismantled after the enumeration.

7. *It requires less-skilled personnel.*—To be effective, enumerators must be superior persons—in terms of education, integrity, drive, and perseverance. It is possible that under self-enumeration the job can be done with a few highly talented people with administrative skills and a corps of persons of very modest experience and ability.

8. *It preserves confidentiality.*—Canvassers are recruited from the local area and often are known to the persons whom they are enumerating. There may be more reluctance or resentment at having to report income or other private information to such a person than reporting it on a form that is mailed to a central office.

9. *It creates greater public interest and sense of responsibility for the success of the census.*—The fact that each household shares a part of the responsibility for the census creates greater public awareness and interest and sense of involvement.

VI. VIEWS OF DEMOGRAPHERS BEFORE 1960 VIS-À-VIS HOUSEHOLDER ENUMERATION

Discussions of the respective merits of the two systems of collecting data are not new. Before 1960 the problem had been reviewed by experts on both sides of the Atlantic, and from it had emerged a concensus which may be summed up in the following principle:

For speed and acceptable precision in taking a simple census among a literate and favorably disposed population, use the householder method; for high quality data where the concepts are more complex, the list of questions is long, the population is of low education or is indifferent or negative, use the canvasser approach.

Three illustrations of this view follow:

The advantages of the householder method are that there is ample time to fill in the details of the schedule and also that there is a smaller chance of missing members of the household who are temporarily absent. However, since the burden of completing the return falls upon the household, the questions asked must necessarily be simple and few in number. Even so, many errors in reporting may be made due to misunderstanding of the questions on the part of the respondent, to a lack of interest, and to a dilatory attitude.

The method of direct interview has the advantage that the enumerators can be trained to secure more accurate reporting, more elaborate questions can be asked, and the results will be fairly uniform in quality.[10]

While endorsing the householder approach as used in England and Wales, because it permits rapid enumeration as of a given date, Peter Cox observes:

It might be thought that more and more information about the population of a country could be gained simply by adding to the number of questions asked on the census schedule. It is generally considered, however, that if this process is pursued far enough a point will be reached where public indifference or inability fully to understand what is required can give rise to such a degree of inaccuracy that doubt is thrown on the validity of the results of the whole enumeration. The limit to the number of questions to be asked was considered by the authorities in England and Wales to have been approached in 1911, since when little or no increase has been made in the complexity of the schedule of that country. If canvassers are used it should be possible to explain the more difficult questions and so help to improve the accuracy of the answers.[11]

Essentially the same position is reached by Wolfenden:

It is stated on pp. 13–14 of the "General Report of the Census of England and Wales, 1911" that "the transfer to the householder of the duty of record can be regarded as advantageous, if at all, only provided that the scope of the census inquiry is to be severely restricted," because "the census schedule is an elaborate and in the nature of things a difficult form to fill in, and the average householder is a person without much clerical or literary training, and quite unaccustomed to the formidable form with which he is confronted." . . . "The 'canvasser' method, however, not-

[10] Mortimer Spiegelman, *Introduction to Demography* (Chicago: Society of Actuaries, 1955), pp. 10–11.

[11] Peter R. Cox, *Demography* (London: Cambridge University Press, 1959), p. 25.

withstanding its higher cost and its dependence on the efficiency of the enumerators, is justified by the more elaborate enquiries which can be made when the information, as in that system, is obtained directly by officials who are familiar with the requirements of the schedule, and by the fact that it secures more reliable information from colored and foreign-born populations among whom the percentage of illiteracy is genuinely high.[12]

The principle stated above seems to have been accepted around the world. As reported by the United Nations, censuses taken between 1945–54 used the canvasser method uniformly where literacy was low.[13] In Africa, South America, and Asia the canvasser method has been employed almost exclusively. It has also been employed in part in Europe by Denmark, France, and Norway. (In France, if the householder expressed the wish to complete the questionnaires himself, he was permitted to do so. In Norway and Denmark the canvasser method was used in rural areas only and the householder method was used in urban areas.)

All the remaining nations of Europe used the householder approach. Among the family of nations, the United States is clearly in an anomalous position—it has a highly literate and generally favorably disposed population, yet it has the longest and most complex census questionnaire, with much evidence that in future years the scope and complexity will increase even more. It also outstrips all other nations in having a corps of professional demographers ever demanding greater detail and precision as outlined above. What course should it follow?

Admittedly, most of the judgments held before 1960 were arrived at on the basis of general observation and experience rather than on the basis of formal research investigations. What light can be thrown on this problem by the comprehensive evaluation studies of the 1950 and 1960 censuses of the United States?

[12] Hugh J. Wolfenden, *Population Statistics and Their Compilation* (Chicago: University of Chicago Press, 1954), pp. 12–13.

[13] United Nations, *op. cit.*, pp. 34–35.

VII. EVIDENCE FROM THE POST-ENUMERATION EVALUATION OF UNITED STATES CENSUSES

The amount of material available for analysis in this area is very large, and the picture that is built up may well reflect the bias of the analyst. The present article was prepared with the explicit advance understanding that, if it so chose, the United States Bureau of the Census would append its own evaluation and reaction to the selection and interpretation made by the author. The Census was also invited to summarize its own evaluation of its experience with self-enumeration and its future potential. Unfortunately, direct answers are not available for many of the questions asked, and it is necessary to reason indirectly, using the principle that the 1950 census was a canvasser census and the 1960 census was primarily a householder census. Such comparisons are of course, biased against the canvasser approach, because many administrative and procedural refinements not directly related to either approach were added to the 1960 census as a result of experience with the 1950 census. Nevertheless, if caution is used much can be learned by this line of reasoning.

A. COVERAGE

The 1960 census had as one of its objectives the improvement of coverage. Of the several measures taken to improve coverage, two involved householder enumeration directly or indirectly—the advance census report and two-stage enumeration.

Advance census reports.—"An advance census report was mailed to households on a nationwide basis so that written information for household members would be available when the enumerator called. This advance report contained instructions as to who was to be included; and, since it was available prior to the enumerator's visit, it permitted the members

of the household to develop a correct list of persons to be enumerated in the housing unit. It also served to focus attention on questions related to coverage during the interview conducted by the enumerator. Not all householders filled out the advance report; but many did, and the net effect of the whole procedure was to add to the enumeration situation another factor calculated to increase the completeness of enumeration above that achieved in previous censuses."

Two-stage enumeration.—"In areas covering approximately 82 percent of the total 1960 population, the 1960 census was conducted in two stages. In the first stage, the enumerator visited each household in his enumeration district and collected the relatively small amount of information—name, household relationship, sex, race, birth date, and marital status—which along with some limited housing information, was obtained on a complete-count basis. He left a sample schedule with additional questions at every fourth household, with the request that it be filled out and mailed to the census office. This procedure meant that the first-stage enumerator needed training only on the relatively few 100 percent items; and, therefore, relatively more emphasis could be placed on coverage in his training. Likewise, in the actual canvass, more attention could be given to coverage and the canvass could be completed more rapidly."[14]

To the extent that householders did fill out the advance census reports and enumerators accepted them without repeating the entire enumeration process for households that had filled out the forms, there was householder determination of the persons to be included or excluded.

The evidence available from the experience suggest two hypotheses: (*a*) The net overall gains in coverage with householder participation in enumeration in 1960 as contrasted with canvasser enumeration in 1950 were negligible and (*b*) the proportion of persons within each household who were erroneously included or erroneously omitted did not decrease and possibly may have increased substantially.

Evidence on the first point is furnished by Taeuber and Hansen.[15] They report that the program of coverage improvement yielded an improvement of 277,000 persons with an estimated 3,438,000 persons left unenumerated by the 1960 procedure. Thus, only 7.5 percent of the coverage problem appears to have been solved, leaving 92.5 percent untouched. The advance census reports must share this small gain with the use of listing books, improved control and checking of coverage, the two-stage procedure, and heavy emphasis on improving coverage given during training of enumerators.

Evidence concerning the second hypothesis is ambiguous. The post-enumeration survey following the 1950 and the 1960 censuses yielded estimates of percentage error as shown in the accompanying tabulation.[16] These data make the 1950 canvasser census look much better than the 1960 householder census. In presenting these figures, Taeuber and Hansen cast doubt on the estimates for 1950 and attribute the poorer showing of the 1960 census to a more effective reenumeration procedure used in 1960.[17]

	1960	1950
Omissions of persons	3.0	2.3
In missed living quarters	1.6	1.6
In enumerated living quarters	1.4	0.6
Erroneous inclusions of persons	1.3	0.9
Net undercoverage of persons	1.7	1.4

[14] U.S. Bureau of the Census, *U.S. Census of Population, 1960: Introduction to Number of Inhabitants, United States Summary* (Final Report, PC 1-1A; Washington, D.C.: U.S. Government Printing Office, 1961), p. xi.

[15] Conrad Taeuber and Morris H. Hansen, "A Preliminary Evaluation of the 1960 Censuses of Population and Housing," *Demography*, I (1964), 2.

[16] *Ibid.*, p. 4.

[17] *Ibid.*, pp. 4–5.

(The specific changes that would account for these differences are not cited.) The alternative hypothesis—*that these are exactly the results that would materialize if householders interpreted the coverage rules less adequately than do enumerators*—should not be completely rejected without further evidence.

B. NONRESPONSE

A major difference between the 1960 and the 1950 and the earlier censuses was a substantially higher rate of nonresponse in 1960—for almost all characteristics. Table 1, reported by Taeuber and Hansen, illustrates the change. Two hypotheses may explain this change: (1) The 1960 census instructed enumerators who were collecting data to obtain information only from an acceptable respondent in the household, and, if three call-backs failed to produce the needed information, to close it out as a nonresponse. In contrast, in 1950 and earlier censuses enumerators were permitted to make inquiries from neighbors. This tended to produce a higher percentage of nonresponse in 1960. (2) The "self-enumeration" procedure (the second stage of the two-stage enumeration) resulted in a very substantial percentage of forms being mailed in with nonresponse to one or more items. Special corps of follow-up workers, using telephones and making field revisits, were needed to shrink this nonresponse to tolerable levels. The level finally achieved represented the best that could be done with the budget and personnel available within the allotted time.

There is clear evidence that *both* these explanations are valid. On the one hand, the number of households known to be occupied, but for which no enumeration was made, was larger in 1960 than in 1950; this is proof that the closeout procedure tended to boost nonresponse statistics. On the other hand, there is substantial evidence that householder enumeration itself created an increase in nonresponse rates: (1) A comparison of nonresponse rates in selected cities of the 18 percent of the population enumerated by the householder method, made by Shryock and Greene, indicated a higher rate of nonresponse in the "self-enumeration" areas.[18] (2) Examination of householder returns when first received in the mail showed that a significant proportion lacked information on multiple items to the extent that they would have been considered clearly deficient if performed by an enumerator. (3) The rate of nonresponse reported in 1960 is much higher for some items than for others. If the difficulty were due solely to the problem

[18] Cited in *ibid.*, p. 6.

Table 1.—PERCENT OF NONRESPONSE (NA's) FOR SELECTED CHARACTERISTICS: 1960 AND 1950

SELECTED CHARACTERISTICS	PERCENT NONRESPONSE	
	1960	1950
Age	1.7*	0.2
State of birth	2.7	1.0
School enrollment (persons 5–34 years old)	8.3	5.9†
Highest grade completed (persons 25 and over)	4.9	4.6
Employment status (persons 14 and over)	3.1	1.0
Occupation (employed persons)	4.9	1.3
Children ever born (to women ever married)	6.0	9.0
Income (persons 14 and over)	6.2	6.7

* Year or decade of age not reported. The 1.7 figure is based on Stage I or 100-percent enumeration. In Stage II, the corresponding nonresponse figure was 1.0 percent.

† Enrollment data available only for persons 5–29 years old in 1950.

Source: Conrad Taeuber and Morris H. Hansen, "A Preliminary Evaluation of the 1960 Census of Population and Housing," *Demography*, I (1964), 6.

of obtaining a qualified informant, the nonresponse rate would tend to be of the same general magnitude for all characteristics, unless the householder enumeration procedure had already created a willful tendency to omit responses to particular items. (4) The rate of nonresponse is especially high among populations of low socio-economic status, low education, living in slum areas, in foreign language communities, and so forth. Persons with these characteristics would be expected to have difficulty in filling out the forms properly and in having sufficient knowledge of the purpose and importance of the census to be motivated to comply. For example, Shryock and Greene found that occupation was not reported for 4.4 percent of the nonwhite population in cities enumerated by direct enumeration, but, in a corresponding sample of cities with self-enumeration, 10.1 percent of the nonwhite employed persons failed to report their occupation.

Taken together, these shreds of evidence indicate that the householder approach yields a higher rate of nonresponse, especially for complex items such as occupation, education, income, and so forth, that would be obtained by enumerators.

The exact extent of the increase in nonresponse due to householder enumeration is difficult to estimate. When allowance is made for the effects of improvement in questions and general enumeration procedures of 1960 and even if the more stringent closeout rules are allowed to share in the responsibility for the increase in nonresponse, it is difficult to avoid the conclusion that the increase was sizable—perhaps as much as 50 percent in nonresponse rates for the more complex census items and 100 percent for the nonwhite population. This is only a very crude and impressionistic estimate.

Given that "householder enumeration" does increase the nonresponse rate, is this *necessarily bad? Many times it is* preferable to accept a nonresponse in lieu of bad information. The usual procedure in such cases is to make an imputation, either directly or by assuming the NA's are distributed like the knowns. For several items in the 1960 census, imputation for nonresponses was done by computer, attributing characteristics that were consistent with the other facts known for the individual. Whether this procedure is preferable to accepting information provided by neighbors is highly debatable and should not lightly be assume to be so. The computer-imputation procedure merely substitutes an average value for each unknown. The unknowns, in a disproportionately large share of cases, tend to be deviant in some way. In the self-enumeration procedure the very fact that the information was omitted (either intentionally or by oversight) and then subsequently could not be obtained readily because of lack of a telephone or persistent failure to be found at home creates the presumption that the nonresponse items accumulated by the householder approach may be deviant cases in a disproportionately large percentage of instances and as a consequence would be very inadequately represented by computer imputation. In fact, the approach may well have the tendency to "chop off the tails" of the distributions for most characteristics, especially at the lower end of the socio-economic scale, and produce a bias for overstating the welfare of the population. It is quite possible that information on occupation, educational attainment, employment status, and so forth, provided for such extraordinary people by their neighbors, may be superior to imputation by the computer. This is a problem for research and one that is of crucial importance before making a decision concerning the comparative precision that is obtained by the two methods of enumeration.

Another hypothesis that should be mentioned here, but for which no data are available to the writer's knowledge, may *be stated as follows: "The extra work re*quired to obtain missing information on mailed-in census returns invites false enumeration in a context where quality con-

trol checks are difficult to impose. For example, instead of making a third telephone call after two "no answer" attempts or of assigning a householder report for reinterview, it may be found easier simply to write in an "educated guess" in the field office. Enumerators who are assigned to clean up problem cases may do much more of their interviewing at home than is suspected, unless strict quality controls are established. It is more difficult to establish quality control over such operations than is the case with canvasser enumeration.

C. ERRORS OF CLASSIFICATION

Did householder enumeration succeed in reducing the very substantial rate of misclassification that characterized the 1950 (and presumably earlier) censuses? The evidence available suggests that for several characteristics the rates of misclassification were somewhat lower in the 1960 census than in 1950.[19] The extent to which householder enumeration was responsible for this is debatable. In some cases the improvement seems to have resulted primarily from improvement in the formulation of the questions and layout of the schedule to increase clarity and to facilitate correct recording. Also, in some cases, at least a part of the improvement appears to be linked to the higher rate of nonresponses in 1960; by refusing to accept approximations by neighbors, the errors of classification in the group for which information was obtained tended to have fewer errors. (See example of education, below.) Thus, instead of a complete overall gain there may have been an exchange of one type of deficiency for another, with the total overall effect not known.

The data to be presented below run counter to the thesis that there was an improvement in classification between 1950 and 1960. Instead they appear to justify the following hypothesis: "The reduction in misclassification in the 1960 householder census, in comparison with the 1950 canvasser census, is disappointingly small. In fact, on balance it appears that the effect of householder enumeration may have been to *increase* misclassification."

A particular difficulty arises in testing this hypothesis because of differences of opinion concerning the appropriate measurement of misclassification that should be used. The rate of misclassification may by measured in several different ways, and the various alternatives do not all give the same verdict. A measure which is believed to be at least as adequate as any other in assessing the overall quality of census data for making statistical inferences (and possibly the best) is the proportion of population found to be in a given category at the post-censal follow-up re-enumeration that was *not* classified in that particular category by the census.[20] In other words, it is the proportion of each post-enumeration category that falls "off the diagonal" but in the same row when the results of the post-enumeration survey are cross-classified (in rows) against the matching census returns (in columns). A preferable measure would be one that summarizes the *magnitudes* of the deviations from the diagonal.[21] The measure $b/a + b$ proposed here is useful because it indicates the proportion of observations upon which a given statistic is based that are erroneous, and which in cross-tabulations may be interacting in

[19] L. Pritzker and R. H. Hanson, "Measurement Errors in the 1960 Census of Population," *Proceedings of the Social Statistics Section* (American Statistical Association, 1962), pp. 80–90. See also Charles B. Nam, "Some Comparisons of Office of Education and Census Bureau Statistics on Education," *Proceedings of the Social Statistic Section* (American Statistical Association, 1962), pp. 258–69; Taeuber and Hansen, *op. cit.*, p. 12.

[20] In the familiar schematic representation of the census used in all the introductions to the ER 60 Reports (see References) this measure is b divided by $a + b$ or 1.00 minus the Census "percent in CES class identically reported."

[21] This alternative was advanced and its possibilities illustrated by Donald J. Bogue and Edmund M. Murphy in "The Effect of Classification Errors upon Statistical Inference: A Case Analysis with Census Data," *Demography*, I (1964), 42–56.

Table 2.—PERCENT OF CENSUS RESPONDENTS NOT IN SAME CLASSIFICATION IN COMPARISON WITH POST-ENUMERATION SURVEY: 1960 AND 1950

Characteristic	Percent not in same class as Post Enumeration survey		
	1960	1950	Change [a] 1950-60
Occupation			
Total	20.98	17.00	3.98
Professional, technical and kindred workers	12.13	11.05	1.08
Farmers and farm managers	13.91	7.55	6.36
Managers, officials and proprietors exc. farm	32.84	19.95	12.89
Mgr., off., prop. (n.e.c.) salaried	32.83		
Other	45.51		
Clerical and kindred workers	22.62	17.63	4.99
Clerical and kindred workers (n.e.c.)	37.92		
Other	29.14		
Sales workers	16.93	15.15	1.78
Salesmen and sales clerks (n.e.c.)	22.09		
Other	13.58		
Craftsmen, foremen, and kindred workers	20.37	17.36	3.01
Operatives and kindred workers	20.23	17.47	2.76
Operatives and kindred workers (n.e.c.)	36.57		
Other	22.06		
Private household workers	36.37	17.24	19.13
Service workers, exc. private household	13.32	12.84	0.48
Farm laborers and foremen	24.49	24.37	0.12
Laborers, exc. farm and mine	39.59	29.46	10.13
Laborers (n.e.c.) - manufacturing	42.75		
Other	40.52		
Total personal income, males			
Total	41.30	41.62	-0.32
$1-$499 or loss	45.77	37.95	7.82
$500-$999	45.37	42.39	2.98
$1,000-$1,499	54.10	46.22	7.88
$1,500-$1,999	53.51	46.75	6.76
$2,000-$2,499	60.61	45.21	15.40
$2,500-$2,999	59.84	41.60	18.24
$3,000-$3,499	53.34	32.40	20.94
$3,500-$3,999	54.16	39.48	14.68
$4,000-$4,499	45.77	42.00	3.77
$4,500-$5,000	40.90	46.94	-6.04
$5,000-$5,999	32.89	38.42	-5.53
$6,000-$6,999	37.65	56.85	-19.20
$7,000-$9,999	22.23	44.66	-22.43
$10,000 or over	16.59	35.23	-18.64
Educational attainment			
Total	25.78	37.09	-11.31
Elementary, total (not in the same specific class)	31.48	40.06	-8.58
1-2 years	59.62	54.58	+5.04
3-4 years	35.83	40.36	-4.53
5-6 years	33.14	43.84	-10.70
7 years	38.74	55.33	-16.59
8 years	23.79	30.25	-6.46

Table 2—*Continued*

Educational attainment cont'd.			
High school, total (not in the same specific class)	23.56	35.64	-12.08
1 year	34.80	50.68	-15.88
2 years	35.88	53.27	-17.39
3 years	41.39	56.48	-15.09
4 years	14.39	20.39	- 6.00
College, total (not in the same specific class)	19.09	30.53	-11.44
1 year	29.80	49.90	-20.10
2 years	27.40	41.18	-13.78
3 years	35.60	49.95	-14.35
4 years or more	5.48	13.03	- 7.55

[a] Minus sign denotes an improvement in 1960 Census as compared to 1950.

unknown ways with similar errors in other variables to vitiate the inferences that would be arrived at by cross-classifying without error two or more variables simultaneously.

Table 2 reports such data for both 1960 and 1950 for three of the more complex census concepts: occupation, income, and education.

Occupation.—Errors of classification of occupation clearly seem to be more serious in 1960 than in 1950, as measured by the indexes of Table 2. This is indeed a surprise, because it was believed that one of the major gains to be made from householder enumeration was permitting the breadwinners to report their work activities for themselves instead of permitting their spouses to report to the enumerator for them while they were away at work. The increase in misclassification appears to have affected all occupational groups but was especially serious among manager, laborers, and private household workers. The overall increase between 1950 and 1960 in proportion of misclassification, as measured by this index, was 20 percent. It must be kept in mind that these data refer to the broad *major* occupational categories, in which one entry in five was estimated to have been an error. *That the rate would be very much higher for the* 297 *detailed occupational categories is certain.* No evaluation of quality of data for these detailed categories has been attempted. The statistics for the broad categories hint that, if this were to be done, it would show that for many detailed occupation categories the data are worthless.

Income.—With respect to income, the change in misclassification between 1950 and 1960 was mixed. Errors of classification were much greater in 1960 than in 1950 at the *lower* end of the income scale but correspondingly less at the *upper* end of the income scale, with little overall change. This would be consistent with the hypothesis that wealthy people dislike to report their income to an enumerator and poor people (with less education) tend not to comprehend the concepts if required to report for themselves without help. It is generally believed that the system of questions devised for asking income in 1960 was superior to that of 1950 and that a part of the improvement at the upper end of the scale must be attributed to this. Also, at the time of the 1950 census there had been a rebellion against the income question, led by influential politicians, openly encouraging citizens to refuse to report their incomes. The appeals of this group were primarily to the wealthy. The fact that resistance of this type was much reduced in 1960 may also help account for the 1950–60 improvement at the upper income ranges. Taking all of these factors into consideration, we conclude that the 1960 census

data on income appear to be inferior to those for 1950 for studying the prevalence and correlates of poverty and that perhaps householder enumeration increased misclassification at the lower end of the scale. (It should be noted here that we are dealing with *gross* errors of classification, because it is such errors that can potentially affect inferences concerning relationships and differences. It is true that 1960 *net* errors in income appear to be smaller than in 1950.)[22]

Education.—Statistics for education in 1960 appear to be clearly subject to less error in 1960 than in 1950,[23] but it is doubtful whether householder enumeration can be credited with much of the gain. First, there was a major improvement in the educational level of the population during the decade; a substantial proportion of the very poorly educated (elderly) population died and was replaced by a generation of much more adequately educated persons. This alone would have tended to improve the quality of reporting. In addition there was a major change in office procedure between 1950 and 1960 in the handling of this item that would have the effect of reducing errors of classification. This is explained by the census as follows:

> In 1950, persons for whom highest grade attended was reported but for whom no report was made on finishing the grade were assumed not to have finished the grade if they were at the compulsory school ages but to have finished the grade if they were not at those ages. In 1960, nonresponse on both highest grade attended and completion of grade were eliminated by the procedure described in the section on "editing of unacceptable data."[24] [This is a procedure of editing by computer and imputing a value.]

[22] See Herman P. Miller, "New Evidence Regarding Errors in Income Size Distributions" (processed paper presented at annual convention of the American Statistical Association, 1962).

[23] See Charles B. Nam, *op. cit.*, pp. 258–69.

[24] U.S. Bureau of the Census, *U.S. Census Population, 1960: Detailed Characteristics, U.S. Summary* (Final Report PC (1)), p. xv.

In other words, the 1950 procedure accepted without question the response of the individual and treated all errors in such a way that there would be an upward bias in classification, whereas the 1960 procedure subjected the responses to an edit that would remove a certain fraction of more conspicuous errors and eliminate at least some if not all of the upward bias. Had this same procedure been followed in 1950, errors of classification would have been fewer. In addition, formulation and layout of the 1960 questions were greatly improved over 1950. When allowance is made for these factors, the improvements in classification which almost certainly may be traced to these other procedures, little remains that could be claimed for self-enumeration. Moreover, a careful examination of Table 2 reveals *that most of the reported improvements occurred at the upper educational levels, and at the lowest levels there was less than average improvement.* These results would be consistent with the hypothesis that a general overall improvement was achieved by the other programs, while self-enumeration caused a deterioration in quality among the less educated segments of the population.

All of the data pertaining to classification errors examined thus far hint at an hypothesis suggested in the quotations above from Cox, Spiegelman, and Wolfenden:

> Populations lower in the socio-economic scale are much less able to participate in a householder enumeration than are persons higher in the scale, and errors of classification rising from use of the householder approach would tend to show a much wider differential by socio-economic status than corresponding errors of data collected by enumerators.

Evidence with which to test this hypothesis directly is not available. However, Tables 3 and 4, showing indexes of misclassification for several census traits separately for the white and nonwhite population, reveal differences that are in the direction of supporting the hypothesis. For each variable, errors of classification

for the nonwhite population are much greater than for the white. Unfortunately, comparable data are not available to permit a determination whether the differential was less in 1950. It is clear, however, that among the nonwhite population householder enumeration in 1960 permitted errors of very substantial magnitude to occur. It is not at all uncommon to find categories in which errors of classification outnumber correct entries. As has been discussed elsewhere, the fact that these errors tend to cancel each other is no argument that they do not affect research.[25]

D. SUMMARY OF EVIDENCE FROM UNITED STATES EXPERIENCE

Taken together, the evidence cited above tends toward the conclusion that

[25] Bogue and Murphy, *op. cit.*

Table 3.—ESTIMATED PERCENT OF CENSUS RESPONDENTS NOT IN SAME CLASSIFICATION IN COMPARISON WITH POST-ENUMERATION SURVEY FOR SELECTED SOCIAL AND ECONOMIC CHARACTERISTICS, BY SEX AND COLOR, 1960

Characteristic	White		Nonwhite	
	Male	Female	Male	Female
Relationship to household head [a/]				
Head	0.92	7.77	2.55	4.89
Primary family head	1.16	16.71	3.13	12.19
Primary individual	5.73	3.66	16.97	5.42
Child	1.64	1.15	4.54	0.58
Other relative	16.37	12.71	32.61	19.50
Nonrelative	19.31	25.33	35.21	16.67
Marital status				
Married	1.23	1.46	6.08	3.12
Excluding separated	0.60	0.90	1.97	1.94
Separated	56.55	34.20	62.89	22.94
Widowed	12.68	7.11	20.50	12.94
Divorced	36.38	17.88	50.00	27.23
Single	1.92	1.22	2.11	2.82
Employment status				
Employed in agriculture	23.94	57.03	29.13	69.12
Wage and salary workers	35.46	56.20	42.24	66.67
Self employed workers	25.99	52.28	38.25	79.17
Unpaid family workers	63.78	69.24	61.82	50.00
Employed in nonagricultural industry	4.46	10.35	9.42	19.88
Wage and salary workers	6.18	9.45	9.28	19.18
Self employed workers	22.01	48.92	35.14	46.67
Unpaid family workers	....	56.92	....	00.00
Unemployed	46.13	69.24	59.22	67.35
Not in labor force	9.66	5.55	10.20	12.40
Occupation				
Professional, technical and kindred workers	12.23	7.36	9.29	32.00
Farmers and farm managers	12.51	68.19	29.48	00.00
Managers, officials and proprietors exc. farm	32.55	49.57	47.96	34.05
Clerical and kindred workers	21.70	7.05	34.24	9.22
Sales workers	16.37	15.95	64.29	34.79
Craftsmen, foremen, and kindred workers	19.84	38.62	36.07	00.00
Operatives and kindred workers	18.81	8.32	32.53	9.10
Private household workers	48.00	6.86	00.00	7.54
Service workers, exc. private household	12.45	15.50	16.83	8.64
Farm laborers and foremen	22.02	25.74	31.03	35.90
Laborers, exc. farm and mine	38.92	88.24	41.70	65.22

[a/] Reported for total and nonwhite population only.

Source: U.S. Bureau of the Census. "Accuracy of Data on Population Characteristics as Measured by CPS-Census Match." Evaluation and Research Program of the U.S. Census of Population and Housing, Series ER 60, No. 5.

neither the householder approach nor the canvasser approach to enumeration is succeeding in producing data of the precision needed and expected by modern demographic research, and both are falling short by a wide margin of the standards outlined in Section I.

Our review of the evidence from the United States experience led to the following opinions concerning the apparent effect of self-enumeration:

a) Coverage was not improved and possibly was worsened by larger gross errors caused by an increase in omissions balanced by double enumeration.
b) Nonresponse was increased.
c) Errors of classification were not less and perhaps were greater, especially among low socio-economic groups.

Contrary to what many hoped, the introduction of householder enumeration did not seem to lead to a significant improvement in the precision of population statistics. The best that can be said is that quality remained about the same, with perhaps some rather serious deterioration for data for Negroes and other lower status groups. It is even possible that entrusting the enumeration to householders led to an overall decline in the self-enumeration census of 1960, in comparison with the canvasser census of 1950, but that this deterioration was offset and partially hidden by other improvements, such as better question design, machine editing, and correction of obvious errors of recording, and improved quality control.

Table 4.—ESTIMATED PERCENT OF CENSUS RESPONDENTS NOT IN SAME CLASSIFICATION IN COMPARISON WITH POST-ENUMERATION SURVEY FOR SELECTED ECONOMIC CHARACTERISTICS, BY SEX AND COLOR, 1960

	White		Nonwhite	
	Male	Female	Male	Female
Industry:				
Agriculture, forestry, and fisheries	7.04	15.24	14.24	00.00
Mining	21.50	57.70	00.00	....
Construction	18.98	35.08	28.91	....
Manufacturing	8.12	7.08	18.55	4.09
Durable goods	10.23	10.31	22.08	14.29
Nondurable goods	12.81	9.26	20.92	6.43
Transport., Commun. & other pub. util	9.11	6.74	12.45	24.14
Transportation	9.02	9.18	9.56	30.44
Commun., Utilities, & San. serv	9.87	5.60	30.16	00.00
Wholesale and retail trade	18.16	9.74	21.28	7.53
Wholesale trade	40.90	37.64	44.63	56.25
Retail trade	18.95	10.05	20.68	3.81
Finance, insurance, and real estate	12.90	6.36	00.00	00.00
Business and repair services	36.33	31.23	21.32	50.00
Personal services	14.82	10.81	24.64	10.07
Private household	68.27	9.65	75.00	7.42
Other	7.17	17.36	15.43	30.51
Entertainment and recreation services	13.34	7.06	13.80	00.00
Professional and related services	9.20	4.42	18.70	6.66
Public administration	6.60	5.06	6.56	00.00
Income:				
$1 to $499 or loss	37.31	16.99	32.92	27.64
$500 to $999	36.40	28.83	52.28	36.37
$1,000 to $1,999	44.01	29.57	44.31	42.00
$2,000 to $2,999	46.21	29.59	59.35	49.39
$3,000 to $3,999	43.78	32.73	38.05	36.03
$4,000 to $4,999	42.15	29.01	52.64	8.34
$5,000 to $5,999	38.45	39.97	44.92	00.00
$6,000 to $6,999	40.85	38.12	42.38	....
$7,000 to $9,999	26.85	32.37	77.20	....
$10,000 and over	23.81	34.10	00.00	....

VIII. HOW DO ENUMERATION ERRORS ARISE?

Two good interviewers assigned to enumerate a given population should get identical results. They should deliver for their employer all ten of the benefits listed in Section IV above, without introducing error into the results because of their own unique personalities and traits. This ideal is very nearly achieved by sample survey organizations and by the Bureau of the Census for its *Current Population Survey*.[26] But at the time of the decennial census a great deal of variance, attributable solely to the enumerators, manifests itself. Why should this be? There must be highly specific and discoverable explanations for this; it would be illogical to view it simply as some mysterious inherent and irradicable trait of decennial censuses. Once explanations are made, programs to deal more effectively with the problem can be devised.

Also, we must learn why and how the equally large errors of classification arise in householder enumeration errors.

In other words, it would appear that the next phase of study in problems of data quality is to research the enumeration process step-by-step to discover exactly how and why enumerators and householders make their errors and thereby introduce needless variance and bias into the results.

[26] Evidence that the canvasser approach, when carried out under the highest skill and best knowledge, is capable of accomplishing very high levels of precision is demonstrated in at least two highly important studies in this area worthy of very careful study by those interested in this problem. They are U.S. Bureau of the Census, *The Current Population Survey Reinterview Program: Some Notes and Discussion* (Technical Paper No. 6, Washington, D.C.: Government Printing Office, 1963); and Leslie Kish, "Response Variance and Its Estimation," *Journal of the American Statistical Association*, LIX (1964), 1016–41. The Census article shows that by careful selection and training of data-gatherers errors of classification can be reduced to very low levels, and the Kish article suggests that enumerator (interviewer) variance can be greatly reduced even for highly subjective and emotion-laden attitude questions.

It is quite possible that if the conditions that permit enumeration error are identified, the most serious ones can be controlled at a cost that can be afforded.

Perhaps we may begin by hypothesizing that the following "explanations of enumerator failure" are simultaneously at work during any data-gathering operation carried out by canvassers and must be minimized if maximum precision is to be achieved:

1. *Idiosyncratic prejudice.*—Emotional reaction against particular questions or instructions so that they are omitted altogether, are reworded, and are asked in an incomplete, improper, or biasing way, or not asked but an answer is presumed and recorded by the enumerator.[27]

2. *Incompetence.*—Lack of intelligence, education, and work experience necessary to comprehend the study, undergo training, and make necessary decisions in the field.

3. *Carelessness.*—Disinterest, poor morale, lack of concentration.

4. *Laziness.*—Desire to obtain full pay while doing only a part of the work.

5. *Dishonesty.*—Deliberate falsification or omission in order to minimize effort needed to get full pay.

6. *Inadequate training.*—Failure to comprehend the goals of the items, misunderstandings concerning definitions and instructions, lack of familiarity with the forms, lack of skill in conducting an interview, ignorance concerning record keeping procedures.

7. *Physical incapacity.*—Poor eyesight, palsy, inability to climb stairs, obesity,

[27] An outstanding example of the type of research which is needed in this area is the article by Robert H. Hanson and Eli S. Marks, "Influence of the Interviewer on the Accuracy of Survey Results," *Journal of the American Statistical Association*, LIII (September, 1958), 635–55. Hanson and Marks find evidence that particular interviewers develop a more or less irrational "resistance" to given questions, with a consequent tendency to alter the wording of the question or to omit it altogether. It is the discovery and detailed study of mechanisms such as this that offer hope for eventually achieving greater precision in all social science data.

and other conditions that slow down or hamper enumeration.

8. *Poor mental health.*—Unpleasant disposition, offensive manners or mannerisms, neurotic personality traits, poor interpersonal relations with others.

9. *Poor supervision.*—Vague instructions or assignment, incorrect interpretation of procedures, failure to check first few interviews to assure procedure is understood, infrequent contacts between interviewer and supervisor. Lazy, incompetent, or dishonest supervisors who set a bad example.

10. *Less than desired effectiveness in quality check on each phase of the field work.*—During the data-gathering phase processes may be pyramided on each other with incomplete checks on quality. There may be too much reliance on the honesty, drive, and ability of the average interviewer.

11. *"Human error."*—Oversights, transpositions, recordings in improper place by occasional accident—created by fatigue, haste or inexperience.

12. *Memory failures.*—Lack of planning and foresight, failure to check maps, callback records, and so forth. Failure to apply specific instructions to the situations to which they refer.

If one examines the above list carefully, an important discovery emerges: *The householder is subject to making exactly the same errors, or analogous ones, as the census canvasser.* A person reporting for himself and family can be unintelligent, careless, lazy, cheating, misunderstanding, forgetting, with an idiosyncratic reaction to particular questions, neurotic, misinformed, undertrained, or subject to human error and failures of memory. *Shifting the responsibility for reporting from a corps of selected, trained, and paid enumerators to a cross-section of householders witn no possibility of selecting, only little possibility of training, and who furthermore are asked to work without pay, is trading one set of "employees" for another.* The householder enumeration may be expected to reduce error only if the performance of an average paid canvasser is worse than the performance of an average unpaid householder.

Moreover, the reduction of enumerator variance by eliminating the canvasser may be largely illusory. We could imagine, for instance, that a national census taken by the householder method is really an enumeration by about a dozen or so enumerators, each with his own particular response variance pattern to particular items on the census and each with a varying but huge field assignment. These persons, by name, might be:

Mr. Carefully Competent
Mr. Subnormal Intelligence
Mr. Lick and A Promise
Mr. Ego Inflator
Mr. Little Fib
Mr. Minority Group
Mr. Very Busy
Mr. Smart Alec
Mr. Neurotic Personality
Mr. Illegible Writer
Mr. Low Education
Mr. Error Prone
Mr. Can't Quite Remember
Mr. Computer Imputed

It is not at all impossible that "enumerator variance" associated with each of these types of householder is equal to or greater than that found for individual enumerators. In the selection of canvassers, most of these objectionable types of persons can be eliminated. The fact that response variance for each class of householder extends to the entire national census, instead of being canceled out at the enumeration district level, may result in a far greater effect upon the data than could realistically exist in a canvasser census. All of this is only conjecture, however, Thus far, we know even less about the errors made by householders than we do about the errors made by enumerators.

IX. IMPLICATIONS

Recognition that both the canvasser and householder approaches to data collection as practiced in the past fail to meet the needs of today's highly specific hy-

potheses, mathematical models, and micro-population analysis is an important first step in making the decision whether to use householder or canvasser enumeration in future censuses. It might be argued that the choice should be based upon an estimate of which method offers the greater promise of eventually attaining the desired level of precision, instead of deciding which is least inadequate now.

A second important step is recognition that the difficulties of enumerating the United States population appear to be highly concentrated in the lowest two socio-economic quartiles. Data of acceptable quality can very probably be obtained for the upper one-half by either method using the best practices now known. It might be argued that the choice of householder versus canvasser enumeration should be based upon an estimate of which method offers the greater possibility of obtaining minimum error for the poorest and least educated one-half of the population.

Combining these two points leads to the formulation of the problem in the following terms: Which method, householder or canvasser enumeration, offers the greater promise of eventually obtaining, for the lower socio-economic strata of the United States population (especially poor nonwhite) data that are precise enough to meet the needs of modern demographic research and current social action programs concerning population problems?

Too little is known about the causes of the errors made by householders to do much more than speculate upon what courses of action might be taken to reduce them. Mass instruction via television and cinema immediately prior to the enumeration is one possibility. Experts in communication would warn that those who need instruction most (least educated and poor) would be instructed least by such a procedure. It is possible that the reduction of errors made by householders will prove to be a very much more difficult task than reducing the errors made by canvassers. If true, continued use of householder enumeration simply because it is no worse and involves less elaborate advance organization, may be taking a short-run rather than long-run view.

One avenue of approach that has some plausibility would be to maintain a persistent program of experimenting with the canvasser approach with the goal of ultimately learning how to take a decennial census with essentially the same precision as now achieved by the *Current Population Survey*. It is not difficult to develop a list of hypotheses for trial in such a program. Among them are the following:

1. Experiments with new procedure for enumerating problem areas, such as slums, ethnic ghettos, and so forth, more effectively. This includes programs to recruit enumerators from among the residents of such areas. (Census tract data indicate that an ample supply of persons qualified to be enumerators actually resides in each such problem area.)

2. Abandon the political patronage system of recruiting field personnel, and experiment with building semi-permanent civic organizations to recruit enumerators at the time of the census. "Political referral" in employing census personnel is an anachronism which thus far census bureau technicians apparently have not been permitted to bring under their research searchlight. Despite assertions that this time-honored procedure of filling all field census posts first with candidates recommended by the local political machine (even if such candidates must take entrance tests) does not damage the census, objective experiments in eliminating it should be tried. Some observers believe it has the pernicious effects of discouraging the participation in the census operation of many nonpartisan civic organizations and tends to place marginally competent persons in supervisory and teaching roles at all levels.

3. Experiment with devising improved diagnostic and testing procedures for rejecting error-prone candidates for positions as enumerators.

4. Experiment with devising diagnostic and testing procedures for rejecting inadequately trained candidates after training, before giving them a field assignment.

5. Development of new techniques for making field assignments to minimize the effect of

enumerator variance. This could include reducing the size of the enumerator's assignment and making more assignments per enumerator, not permitting the same person to have two assignments in the same census tract.

6. Experiment with increasing the pay given to enumerators in order to attract more qualified applicants for the posts.

7. Re-evaluate past methods of training, and experiment with new training procedures to overcome enumerator resistance to particular items on the census. Develop tests to detect this reaction among enumerators.

8. Experiment with various systems of quality control in the field, to reduce error at acceptable cost.

9. Experiment with combinations of householder and canvasser collaboration in enumeration.

10. Experiment with various systems for organizing and supervising the work of canvassers.

These, however, are only superficial suggestions with little specific programmatic content. The United States Bureau of the Census already is working at most, if not all, of them. Effective solutions to the problem of data quality will be devised only after much more is known about the processes by which errors are generated: "Who makes them?" "Under what conditions are they made?" "How are they made?" and "What causes or permits them to occur?"

The United States Bureau of the Census has taken the lead in revealing the shortcomings of its own data. A semi-critical paper, by a "semi-discontented customer," such as the present one, is possible only because of this courageous and praiseworthy policy. It might not be unduly speculative to assert that all of the population data—social and economic—collected by all private survey and other research organizations suffers from deficiencies equal to or greater than those revealed by the Census. The problem of how best to collect data is, therefore, one that is shared by many and worthy of a many-faceted research attack. If the many ingenious mathematical models and elegant statistical procedures currently being made available are to realize their full potential contribution, the whole of social science must follow the lead of the Census (suggested by Deming more than two decades ago)[28] in taking the lid off this Pandora's box and facing up to the contents.

[EDITOR'S NOTE.—A comment on this article is being prepared by the United States Bureau of the Census and will appear in the next issue of *Demography*.]

[28] W. E. Deming (see References).

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