

ALTERNATIVE DEFINITIONS OF LONGITUDINAL HOUSEHOLDS IN THE INCOME SURVEY DEVELOPMENT PROGRAM:
IMPLICATIONS FOR ANNUAL STATISTICS

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This paper reports on research to define households and their socioeconomic status over time using data from the 1979 Research Panel of the Income Survey Development Program (ISDP). The research examines alternative definitions of longitudinal households and measures of annual poverty status under each definition, in order to shed empirical light on problems of presenting annual statistics for part-year households and related problems of longitudinal measurement. (See NOTES (1) and (2).)

Background. Measures of annual income and poverty status for persons and households have long derived from the repeated cross-section March Current Population Surveys (CPS), which ask for income totals for each person for the preceding calendar year and aggregate personal income into household economic measures based on the groupings of persons observed at the time of the interview. The new Survey of Income and Program Participation (SIPP) and its predecessors, the 1978 and 1979 ISDP Research Panels, were designed to improve available income statistics by: (1) obtaining more detailed information on sources of income (over 55 income types in the SIPP); (2) obtaining more complete and accurate reporting of income through frequent interviews with short recall periods; (3) obtaining part-year income data to permit important policy analysis in such areas as the adequacy and target efficiency of income support programs (the SIPP obtains monthly data on most income sources); and, finally, (4) obtaining monthly income and household composition data that make possible improved annual income and poverty statistics that take into account intra-year changes in household and family composition.

On the last point, which is the subject of this paper, measures of total annual available income and poverty status can be tabulated for persons, but the measures themselves cannot be defined on a person basis. The income available to many persons is not simply their "own" receipts, but receipts earned or otherwise acquired by other members of the household or family. Similarly, standards of need recognize economies of scale for larger families. But a problem arises in that family and household composition is not static for all the population during the year. Persons are born and die, move into and out of the household for reasons of marriage, separation, divorce, going off to and returning home from school, and so on, and these changes must somehow be associated with income flows in developing measures such as annual poverty status.

The Current Population Survey simply ignores changes in household composition over the income measurement period in constructing annual income and poverty statistics--a very unsatisfactory procedure, but one that has been accepted in the absence of nationally representative data that would permit doing anything else. In the CPS, income is measured over the preceding calendar year for members of each sample household who were present in March of the following year, although not all of these members may have been part of the household during the income accounting period and some members present earlier in the year may have left before the interview. Moreover, income of members of sample households

who died before the interview, were institutionalized, or moved abroad is excluded entirely.

Limited empirical evidence suggests that the CPS procedure distorts to some extent annual estimates of families and persons in poverty because of the different accounting periods used for family composition versus family income, although no work has been done that would indicate whether measures of change in poverty rates from year-to-year are also affected. Scardamalia (1978), using longitudinal data from the Seattle and Denver Income Maintenance Experiments, estimated a higher annual poverty rate based on a CPS measure compared with a measure that aggregated monthly family income and poverty thresholds to determine each sample person's poverty status for the year. Czajka and Citro (1982) obtained similar although less striking results using data from the first two waves of the 1979 ISDP Research Panel, comparing the poverty rates for the first three months based on the second wave's household composition and the first wave's. Although it is perfectly possible for household composition changes to offset such that the CPS annual poverty rates and household income distributions are unbiased in the aggregate, at present, demographic trends toward formation of more and smaller households through divorce, adult children leaving home, and so on appear to be resulting in more cases where households are misclassified as poor using the CPS measure than the other way around.

The SIPP for the first time provides a large nationally representative sample that will permit associating income with family and household units during the course of a year. (One caveat to note is that the SIPP does not measure household composition change during the months covered by the first interview. This is also largely true of the ISDP.) Given intra-year changes in family composition as well as income, the question is still how to define economic units in the context of an annual accounting period. In a nutshell, when is it appropriate to recognize change in family composition from the point of view of measuring annual family income and when is it not? For example, it may be that analysts would agree that the birth of a second child to a husband-wife family is not enough of a change to warrant recognition of a new family, whereas gaining or losing a spouse is. There is likely to be less agreement on treatment of changes between these two extremes.

Researchers at the Census Bureau and other institutions have given considerable thought to the question of defining households and families on a longitudinal basis (see McMillen and Herriot, 1984, for a review of the literature). Considerations involved in choice of definition include: (1) research applicability, (2) ease of computation, and (3) feasibility of estimation. With regard to the suitability of various longitudinal definitions for annual measures of income and poverty status, researchers and policy analysts have expressed views about the implications of one or another definition. For example, views have been expressed that a definition that emphasizes continuity and produces a smaller number of longer-lived households will tend to result in a lower poverty rate compared with a definition that recognizes many kinds of change and produces a larger number of shorter-

lived households. (Implicit in this view is a model of household change to the effect that households undergoing rapid compositional change are also undergoing economic swings in and out of poverty.) Examples can readily be constructed that both support and contradict this view.

Opinions have also been expressed on a related issue of how to present longitudinal household statistics once a definition is chosen. Given that any longitudinal household definition will result in part-year households, there is the question of how to present statistics for these. One approach is simply to tabulate full-year and part-year households separately. However, this has the drawback that the sum of the two distributions will provide a count greater than the count obtained on a cross-section basis at any point for the year and that each part-year household will count for as much in the combined distribution as each full-year household. Another approach is to tabulate full-year and part-year households together, but time-weight the latter, that is, count part-year households for only the fraction of the year each existed. This approach will produce an estimate that is close to cross-section estimates of the number of households, but the estimate based on time-weighting will represent "household years" rather than households per se and may, consequently, take some getting used to.

Obviously, the question of tabulations interrelates with the choice of definition. Those definitions that emphasize continuity have the attraction of not producing as many part-year households and thereby simplifying the tabulations. But, continuity for continuity's sake may well mask important differences between households that truly do not change composition and those that are defined as continuous but in fact had one or more changes. Throughout discussions of this issue, it has been clear that even very sophisticated and knowledgeable researchers were struggling to grapple with the implications of annual statistics based on changing composition. An important reason for their difficulty was the absence of actual numbers demonstrating the impact of alternative longitudinal household definitions. Data for a full year from the SIPP are not yet available and the 1979 ISDP Research Panel data have not yet been fully analyzed. (A study of turnover in the Food Stamp Program is the only analysis completed to date involving longitudinal households constructed from the full ISDP. See Carr et al., 1984.)

Research and Data Processing Approach. We set out to develop data sets from the 1979 ISDP that would permit constructing annual income and poverty measures under alternative definitions of longitudinal households. We did not intend to use the entire ISDP sample of about 7,500 households, because of known data problems that we feared would prevent timely completion of useful measures. Our plan, instead, was to use small samples that could be manipulated more readily to generate a range of comparative tabulations. We recognized that small sample size would be a problem for evaluating the results, but we felt it important to adopt a strategy that promised results on a more timely basis than would be possible with the full ISDP. We did not intend, in any case, to produce population estimates; our primary purpose was to generate comparable income and poverty measures under alternative longitudinal household definitions that could begin to shed empirical light on the implications of choice of definition.

We had available at the Census Bureau a database,

called ISDPPROD, loaded in the SIR (Scientific Information Retrieval) Data Base Management System, containing information from all six waves of the ISDP for the area frame sample of households (see Ycas and Linger, 1981, for a description of the ISDP). The database could be accessed directly or accessed by creating extract files for analysis by SPSS; however, it lacked data on household composition by month and aggregate income for persons by month. We obtained files from Mathematica Policy Research containing monthly household composition and monthly personal income and loaded these into ISDPPROD. (The Mathematica files reflected the results of extensive editing of data on arrival and departure dates of persons and household composition at each interview. See Doyle and Citro, 1984.)

From the merged database, we first developed a small test sample of about 160 original sample households designated for interview at the first wave. More precisely, we drew a test sample of "PSUSERIAL groups," that is, we selected not only the members of the original sample households but also all other persons who subsequently moved into a household with any of the original sample members, as identified by the same PSUSERIAL (primary sampling unit and serial) number.

Meaningful analysis is not possible with this test sample, but it proved invaluable for developing and debugging our SIR and SPSS programs to construct longitudinal households under alternative definitions and associated tabulations. One point to note is that the design of ISDPPROD did not prove optimal for ready selection of PSUSERIAL group samples; a design that accorded precedence to a control record for each group would have greatly speeded up the process of selection.

We next took two independent random samples of about 10 and 8 percent of the PSUSERIAL groups from ISDPPROD--the combined 18 percent sample would give us reasonably good cell sizes and the two separate samples would permit assessment of the robustness of our results. We carefully reviewed each PSUSERIAL group and, as we expected and as was true for our test sample, encountered a high proportion of problem cases. Table 1 provides a distribution of the cases that we dropped from the combined 18 percent sample by reason for deletion. In total, we had to drop 27 percent of the cases. Most PSUSERIAL groups that we deleted--over 90 percent of the total--had one or more interview waves missing. We did not have the resources to undertake the formidable task of attempting to impute missing wave data for these cases. Note that PSUSERIAL groups where the original household split into two or more households were deleted if even only one constituent household had a missing wave. It was the case that PSUSERIAL groups deleted on the grounds of missing one or more waves often had other kinds of data problems as well. About 2 percent of all deleted cases were deleted primarily because of switches in the reference person (or householder) from one interview to the next that would have caused problems for many definitions that key off the reference person. Most frequently, these switches involved husbands and wives. Other deleted cases had apparently erroneous changes in relationship to reference person or family type. One case had sex missing for the reference person.

Finally, several cases were deleted because, based on the concepts and methodology for longitudinal household weighting currently being developed at the

Census Bureau, they would be assigned a zero weight for longitudinal analysis purposes. An example is a situation where an original sample member who is unmarried at Wave I subsequently marries a new sample person who has children. It seems highly likely that the new spouse had been maintaining a multiple person family household prior to the marriage and hence that the new spouse's weight should be used for the new married couple household (the SIPP will collect information on household composition for the previous month for all new sample members, permitting a definitive determination). However, the new spouse as a new sample member has a zero longitudinal weight. (See NOTES (3).)

On both the initial test database and the 10 and 8 percent samples, we used SIR and SPSS to construct alternative longitudinal household definitions and to tabulate for each various monthly and annual composition and income statistics. Our experience in using SIR for these efforts was favorable in the sense that SIR could in fact handle the ISDP data. However, we experienced many problems that gave us even more reason to work initially with a small sample that we could thoroughly handcheck. It took many trials to determine how the SIR system processed the ISDPPROD record structure to produce the output that we wanted. We also determined that it was far easier in SIR to construct longitudinal household definitions that keyed off a single person in contrast to definitions that required looking at multiple household members.

Our conclusions from this experience are two-fold. On the positive side, "user-friendly" data base management systems and tabulation packages offer the definite advantage that analysts who are not computer programmers can directly access a complex database such as the ISDP and can experiment with different measures and concepts, instead of having to lock up specifications in advance for a programmer to implement. On the negative side, the analyst must proceed with extreme caution, anticipate large numbers of problems stemming from the interaction of concepts, data, software and hardware systems, and must be prepared to invest considerable effort in handchecking sufficient numbers of cases to be sure that output which appears on the face of it reasonable in fact what was wanted.

Longitudinal Household Definitions and Data Files.

Our goal was to assess the implications for measurement of poverty and income on an annual basis of different ways of defining longitudinal households. Hence, we wanted to experiment with as many different types of definitions as practicable, and particularly to include definitions representing widely-spaced points along a continuum from definitions emphasizing continuity to those emphasizing change.

We constructed longitudinal household definitions on the basis of the ISDP data for each PSUSERIAL group covering a 12-month span. (The 12 months do not represent a fixed calendar period because of the staggered interviewing used in the ISDP: for one-third of the sample, the period is November 1978 through October 1979; for another third, December 1978 through November 1979; and for the last third, January through December 1979.) We began with two definitions that emphasize continuity:

- (1) Reference person definition: A household continues over time if it has the same reference person or householder.
- (2) Principal person definition: A household continues over time if it has the same principal

person. This definition differs from the first in treatment of married couple households for which the reference person may be either the husband or wife as designated by the household but the principal person is always the wife. For all other households, the principal person is the reference person (the person who owns or is renting the house).

We then implemented two definitions that emphasize change:

- (3) Family type definition: A household continues over time if it has the same reference person and if it is the same family type where family type may be: husband-wife household, male head family household, female head family household, male head nonfamily household, female head nonfamily household.
- (4) No change in composition: A household continues over time if the membership remains constant, that is, no original household member leaves or new member arrives.

Definition (3) will give different results from either of the first two definitions in a number of situations. For example, definition (3) will recognize dissolution of one household and formation of two new households in the case of a divorce. In contrast, the first definition will, in most cases, continue the husband's household and recognize only one new household, that of the wife, while the second definition will continue the wife's household and recognize only the husband's household as new after the divorce. As another example, definition (3) will always recognize dissolution of one household and formation of a new household where a couple living together subsequently marries. Definition (2) will recognize one continuous household in cases where the woman was the reference person prior to the marriage, as will definition (1) in cases where the same individual continues as the reference person. Finally, definition (4) is at one extreme of the continuum from minimizing to maximizing recognition of change, as this definition recognizes dissolution of one household and formation of one or more new households in the case of any and every kind of change in household membership, whether it be the birth of a child, the loss of a parent, or the arrival of a roomer. Definition (4) was much more difficult to program in SIR than the first three definitions. Note that we did not attempt to implement the CPS definition, because the ISDP, as is also true of the SIPP, does not have complete income data for persons who joined the sample after the first wave.

For each of the four definitions that are currently implemented, we produced an extract file from SIR for tabulation in SPSS. Each file contains a set of fixed-length records, one for each longitudinal household under the particular definition represented, with the following variables: (1) household status by month, 1 for each month in which the household exists, 0 otherwise; (2), household size by month; (3) total household income by month (these totals represent underestimates in many cases because of missing data); (4) household poverty threshold by month (constructed by assigning the U.S. Office of Management and Budget weighted average thresholds by household size categories for 1978, 1979, and 1980 to July of each of those years, dividing by 12, and interpolating linearly for the intervening months); (5) family type by month; and (6) demographic characteristics for the household head.

The records also contain the base weight for Wave

I, the weight representing essentially the inverse of the sampling fraction. The ISDP sample was drawn to overrepresent high and low income groups and the weights vary widely. We decided ultimately not to use the weights, because they greatly exaggerated the effects of movement among tabulation cells of a handful of cases in our small samples.

Results. We have initial results of tabulating the extract files for our first four longitudinal household definitions. Only a few key results are shown here (see NOTES for information regarding availability of additional tabulations from the author). Considering first total household counts (see Table 2), the number of households on a cross-section basis tabulated from the combined 18 percent ISDP sample (unweighted) grew from 1,030 in month 1 to 1,066 in month 12, for an increase of 3.5 percent.

Each longitudinal household definition generated yet larger numbers of households. Definition (1), which recognizes households as continuing so long as the reference person remains the same, and definition (2), which continues households so long as the principal person remains the same, both generated 1,078 longitudinal households or 5 percent more than the month 1 cross-section count. Definition (3), which continues households only so long as both the reference person and the family type remain the same, generated 1,123 households, or 9 percent above the starting count. Finally, definition (4), which continues households only so long as every member remains and no new members arrive, generated 1,302 households or more than 126 percent above the month 1 count. Finally, applying time weights to the longitudinal households under each definition, that is, fractional weights for part-year households that existed only part of the year, the count of household years is 1,044.5, or 1.4 percent above the starting month 1 count.

In terms of duration, close to 95 percent of longitudinal households under the first two definitions existed for the entire year and the average duration for the total was over eleven and one-half months (see Table 3). Definition (3) resulted in somewhat fewer full-year households and definition (4) resulted in the smallest number, although still a sizeable proportion--about two-thirds of the total. Looking more closely at the part-year households generated by each definition, the predominant form of intra-year composition change under the first two definitions involved the formation of new households as offshoots of continuing households, for example, adult children leaving the nest. Under definition (3), these kinds of changes occurred as well, but, in addition, some households with the same reference or principal person changed type (for example, from husband-wife to nonfamily household or vice versa), resulting in a higher proportion of dissolved households. Definition (4) produced the highest proportion of dissolved households and also of households that both came into being and went out of existence during the 12-month span. The average duration of part-year households overall--about 5 months--did not differ appreciably among the four definitions. It is important to note that duration for dissolved and newly formed households is observed only within the 12-month period and not for the full spell of their existence.

Clearly, the households in the sample experienced a number of changes in composition during the space of a year, with greater or lesser recognition of these changes by the various definitions. The question is whether different longitudinal household concepts have

an effect on annual statistics, specifically poverty status. Using the count of time-weighted households as the base (see Table 4), it turns out that the percentage poor is virtually identical for all four definitions--ranging from 25.2 percent for definitions (1) and (2) to 25.4 percent for definition (3) and 25.5 percent for definition (4). Using the simple total of full-year and part-year households, without applying fractional weights to the latter, as the base, the poverty rates are also very similar across the four definitions. (Note that these percentages are not in any way comparable with the CPS, given that they are based on unweighted ISDP data. Poverty status is measured for each household by aggregating, over the months of its existence, monthly incomes and monthly poverty thresholds and dividing the first by the second sum.) How do we explain these findings?

Under definitions (1) and (2), part-year households exhibit lower poverty rates than do full-year households, but there are so few part-year households that the full-year rates dominate the time-weighted figures. Under definition (3), the poverty rates for both full-year and part-year households are very similar at about 25 percent. Finally, under definition (4), full-year households have a somewhat higher poverty rate than under any other definition and part-year households a lower rate than under definition (3), with the result, once more, that the time-weighted total rate for definition (4) differs very little from the rates for the other three definitions. In sum, the choice of definition does not appear to matter for the overall proportion of households in poverty on an annual basis.

Categorizing longitudinal households by initial family type (that is, by the family type in the first month of each household's existence), the poverty rates for each category, again based on time-weighted household counts, are remarkably similar across the four definitions (see Table 5). The rates for the two largest categories--husband-wife households and female head nonfamily households representing about 57 and 22 percent of the total--differ by only two-tenths of a percentage point and seven-tenths of a percentage point, respectively, across definitions. Somewhat higher poverty rates for single female head family households and male head nonfamily households (representing about 11 and 10 percent of the total) are observed for definitions (3) and (4) compared with definitions (1) and (2); however, sample sizes are small for these groups. Sample sizes for single male head family households--only 1 percent of total households--are too small to permit any conclusions about differences in poverty rates for different definitions.

We also examined the impact of alternative longitudinal household definitions on another dimension of poverty, namely the proportion of each household's existence spent in poverty month-by-month. Full-year households on average spent about 30 percent of the year (three and a half months) in poverty. Those full-year households that were in poverty overall measured on an annual basis (that is, on the basis of comparing the sum of their monthly incomes with the sum of their monthly poverty thresholds) spent over 85 percent of the year or 10 months in poverty (on the basis of determining their poverty status for each month); about half of them were poor for all 12 months. Those full-year households that were not poor overall on an annual basis nevertheless were poor on average about 9 percent of the year or 1 month; about three-fourths of them were never in poverty for any

month. These results are very interesting as they relate to the question of income flows and economic well-being during the year. However, for our purposes, the outstanding finding is that time spent in poverty during the year is virtually the same for full-year households under all four definitions.

The results for part-year households (where the percentage of time in poverty is measured for the time period of each household's existence) are very similar for definition (3) and definition (4) to the full-year household results. Greater differences are evident comparing part-year with full-year households for the first two definitions, but the sample sizes for the part-year households, particularly those in poverty overall, are quite small.

Further Research. Our initial results indicate that choice of longitudinal household definition, while undoubtedly important for many analytic purposes, does not appear to have an impact on annual measures of poverty either for total households or for initial family type categories. Tabulations, not shown, from the 10 and 8 percent samples analyzed separately, similarly evidence very few differences among the four definitions, indicating that our results have a measure of robustness. Clearly, we have only scratched the surface of the research that should be carried out on this issue. A first priority is to look at

additional income statistics from our ISDP files for each definition. It may be that choice of definition does not affect the annual poverty rate but does affect the shape of the income distribution.

Secondly, and very importantly, we hope to transfer our work to the first three waves of the SIPP survey. We anticipate fewer data problems with the SIPP and therefore may be in a position to carry out the analysis on a much larger scale without a corresponding increase in processing time required. In addition to the definitions previously implemented on the ISDP, our intention is to implement the definition that the Census Bureau is currently considering for use with the SIPP. Developed principally by Don Hernandez and Roger Herriot, this definition combines elements of the family type definition and of a definition that says a household is the same if a majority of the household members at time t represent a majority of the membership at time t + 1. (The latter is a reciprocal majority definition used in analysis of the National Medical Care Utilization and Expenditure Survey.) If our initial findings from the ISDP also hold for the SIPP, then the Census Bureau will be able to turn its attention to other considerations besides the possible implications for poverty rates in choosing a longitudinal household definition.

TABLE 1. Original Households (PSUSERIAL Groups)
Deleted from 18% ISDP Sample

	<u>Total</u>	<u>Percent</u>
Total	1,410	100.0
Deleted	380	27.0
Missing 1 or More Waves	336	23.8
Reference Person Switch	24	1.7
Demographic Errors	14	1.0
Zero Longitudinal Weight	6	0.4
Remaining in Sample	1,030	73.0

TABLE 2. Household Counts, 18% ISDP Sample

<u>Cross-section</u>	<u>Number</u>	<u>% Month 1</u>
Month 1	1,030	100.0
Month 12	1,066	103.5
<u>Longitudinal</u>		
1: Same Reference Person	1,078	104.7
2: Same Principal Person	1,078	104.7
3: Same Family Type	1,123	109.0
4: Same Household Members	1,302	126.4
<u>Time-Weighted</u>		
(Household-years)	1,044.5	101.4

TABLE 3. Full-year Versus Part-year Households,
18% ISDP Sample

Definition:	1	2	3	4
Total Households	1078	1078	1123	1302
Ave. Duration (mos.)	11.6	11.6	11.2	9.6
Full-year	1021	1020	984	871
Percent of Total	94.7	94.6	87.6	66.9
Part-year	57	58	139	431
Percent of Total	5.3	5.4	12.4	33.1
Ave. Duration (mos.)	5.0	5.0	5.2	4.8
Percent Dissolved	15.8	17.2	33.1	36.9
Percent Newly Formed	78.9	77.6	59.0	45.2
% Formed and Dissolved	5.3	5.2	7.9	17.9

TABLE 4. Percent Poor of Full-Year, Part-Year, Total and
Time-Weighted Longitudinal Households, 18% ISDP
(Unweighted, not comparable with CPS)

Percent Poor	Definition:	1	2	3	4
Time-Weighted Total		25.2	25.2	25.4	25.5
Total (Unweighted)		25.0	24.8	25.4	24.6
Full-Year		25.5	25.5	25.5	26.5
Part-Year		17.5	12.1	24.5	20.6

TABLE 5. Percent Poor of Time-Weighted Longitudinal
Households by Initial Family Type, 18% ISDP
(Unweighted, not comparable with CPS)

Percent Poor	Definitions:	1	2	3	4
Total (Time-Weighted)		25.2	25.2	25.4	25.5
Husband-Wife		11.5	11.5	11.3	11.4
Single Male Head Family		28.0	26.8	22.2	23.1
Single Female Head Family		36.6	35.7	39.5	39.1
Male Head Nonfamily		25.7	26.5	27.3	27.7
Female Head Nonfamily		54.2	54.9	54.4	54.2

NOTES: (1) The author wants to thank Robert F. Phillips, ASA Census Research Associate, for outstanding work in developing the data sets and tabulations used for the analysis.

(2) Additional tabulations from the ISDP of poverty status and initial family type under each longitudinal household definition for 10, 8 and 18 percent samples may be obtained by writing the author care of ASA/Census Research Fellowship Program, Statistical Research Division, U.S. Bureau of the Census, Washington, D.C. 20233.

(3) Households formed by the marriage of a sample and nonsample person should have been assigned weights of one-half rather than one. This correction lowers slightly the total longitudinal household count under each definition, but does not affect the comparisons.

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