SOME PROBLEMS OF NONRESPONSE AND NONRESPONSE ADJUSTMENT
IN THE SURVEY OF INCOME AND PROGRAM PARTICIPATION

Graham Kalton, Survey Research Center, University of Michigan
Daniel Kasprzyk, Department of Health and Human Services
Robert Santos, Survey Research Center, University of Michigan

1. Introduction

The goals of the Survey of Income and Program Participation (SIPP) will be achieved through the collection of detailed intra-year information on household composition, money and in-kind income, assets, liabilities, program eligibility criteria and program participation, labor force participation, taxes, and selected topics of policy interest (Lininger, 1980). The SIPP intends to obtain this information by means of a panel survey of sample individuals who are retained in the panel even when they move to new residences. Since the extensive amount and sensitivity of the data to be collected and the panel aspect of the design could give rise to a greater degree of nonresponse than would be encountered in a simple one-time survey, the issues of nonresponse, nonresponse adjustments, and imputation are of special concern to the SIPP. These issues are being examined by a team from the Survey Research Center at the University of Michigan in conjunction with HHS and the Bureau of the Census.

An indication of the nonresponse levels the SIPP is likely to encounter may be found in the two SIPP prototype national household panels known as the 1978 and 1979 Income Survey Development Program Panels (see Ycas and Lininger, 1980, for descriptions of these ISDP Panels). It should be noted, however, that because of their experimental and developmental nature these panels may experience somewhat higher nonresponse levels than an ongoing survey program.

This report has three purposes: (1) to describe the extent of nonresponse encountered in the 1978 ISDP Panel, focusing primarily on the first two waves (April and July, 1978); (2) to examine the extent of the use of proxy informants in the 1978 ISDP Panel and to provide a preliminary assessment of the quality of proxy reports; and (3) to investigate two potentially useful imputation procedures for certain item nonresponses.

Before presenting the results, some comments on the analyses need to be made. First, the results below should be viewed as preliminary; more detailed analyses are underway. Since the 1978 Panel data were unedited, minor inconsistencies may occur between the results of different analyses. Secondly, all the results are unweighted, i.e. no adjustments have been made to compensate for households' unequal selection probabilities. A major cause of the inequality in selection probabilities is that the Panel was made up of two component samples, a national area probability household sample and a sample drawn from Supplemental Security Income (SSI) files. Many of the analyses presented are restricted to either one or the other of these samples, mostly to the larger area sample.

2. Nonresponse in the 1978 Panel

2.A. Household Nonresponse

Nonresponse occurred at the household level when no data were collected for any household member. One source of this type of nonresponse arose from adults in original sample households changing residences. The sample design called for following all adults in the original sample households, but for cost reasons the fieldwork procedures stipulated that adults moving beyond fifty miles of the Panel's primary sampling units would not be followed. This feature, and other movers who could not be traced, resulted in a 2.5-3.0% loss of households at each successive quarter.

Table 1 summarizes household nonresponse for the five waves of the 1978 Panel among households remaining at their sample addresses or moving within the Panel's sample areas. The table shows, as expected, an increase in nonresponse through the life of the Panel, but at a declining rate. Refusals constitute the main cause of nonresponse at each wave of the Panel.

Table 1: Household Nonresponse in the 1978 Panel

Household:	April 1978 %	July 1978 %	Oct. 1978 %	Jan. 1979 %	April 1979 %
Interviewed	93.5	90.5	88.9	85.4	85.0
Refused	5.0	7.2	8.7	11.8	12.3
No one home, temp. absent, other	1.5	2.2	2.5	2.8	2.7
Total	100.0	100.0	100.0	100.0	100.0
No. of households	(2048)	(2091)	(2126)	(2135)	(2112)

The wave to wave change in nonresponse rates is the net effect of obtaining responses in a later wave from households which failed to provide data in an earlier wave together with the loss of some households cooperating in an earlier wave but not providing data in a later one. In the 1978 Panel, attempts were made to secure responses in a later wave from households which did not respond in an earlier one. The only evidence we have on the effect of these attempts comes from the first two waves of the Panel: of 140 nonresponding households in the April wave, only 28 (20%) provided data for the July wave (of the 103 households refusing in April, 15 responded in July).

An examination of household nonresponse rates for various subgroups identified some variations. These may be found in Table 2 for four waves of the Panel (the rates for the October 1978 wave are unavailable at this time); like Table 1, this table relates to households remaining at their sample addresses or moving within the Panel's sample areas. The table illustrates that at every wave nonresponse rates are lower for the SSI sample than for the area sample, and that they are higher for those living within the standard metropolitan statistical areas (SMSA's) than for those living outside these areas. The last part of the table shows that the nonresponse rate for white households is higher than that for non-white households during the first two waves of the

Panel, but this situation is reversed in the last two waves.

Table 2:   Household Nonresponse Rates in the
           1978 Panel for Selected Subgroups*

Subgroups	April 1978	July 1978	Jan. 1979	April 1979
Area sample	7.2% (1656)	10.7% (1696)	15.8% (1708)	16.9% (1713)
SSI sample	5.3% (400)	6.2% (405)	9.4% (406)	9.3% (407)
SMSA	8.0% (1401)	11.4% (1425)	16.6% (1432)	17.4% (1433)
Non-SMSA	4.3% (655)	6.5% (676)	10.4% (682)	11.5% (687)
White	7.7% (1719)	10.2% (1752)	13.8% (1740)	14.7% (1746)
Non-white	2.1% (337)	8.0% (349)	18.2% (374)	19.0% (374)

*Figures in brackets are number of households on which percentage is based.

2.B. Person Nonresponse

Person level nonresponse occurred when no data were collected for one or more household members in an otherwise cooperating household. In the 1978 Panel, interviewers collected data for all adults by personal interview if they were present at the time of interview or by proxy interview with a knowledgeable family member if they were absent. Data on 30% of respondents in the April wave of the Panel were provided by proxy informants. In consequence, only about 1.5% to 2% of adults in cooperating households did not respond, either because the person refused to cooperate or because he was absent and no other member of his family felt able to respond on his behalf. The consequences of utilizing proxy informants are taken up in Section 3.

2.C. Item Nonresponse

Item nonresponse occurs when some but not all data are missing for a sample person. Its extent varies considerably between items. Table 3 exhibits item nonresponse rates for several items from the first wave of the Panel.

The table focuses on data items for which amounts of payment or income were to be reported. Thus, Social Security or SSI payments among those receiving such payments had very low nonresponse rates. In contrast, item nonresponse on the amount of savings interest received during the period January to March is substantial, with missing amounts for almost half the persons with savings accounts. The dominant cause of the missing data was the respondent's inability to answer the question. Anticipating a high level of item nonresponse, a supplementary question concerning the amount held in savings accounts was asked of those failing to answer the savings account interest question. The answers to the supplementary questions were to be used as a basis for imputing the missing interest amounts. The table shows that there was a sizeable degree of nonresponse to the supplementary question, with over one-third of the subset of respondents

asked the question failing to provide an answer. Nevertheless, the question was answered by many of those who failed to answer the question on the amount of interest received. Thus, if this question serves as an acceptable proxy for savings account interest, the high nonresponse rate will be considerably reduced. The use of the amount in the account for imputing the interest received is discussed in Section 4.

Other items investigated included data on salaries and wages. For simplicity, most of the results in Table 3 for these items are restricted to the subgroup of individuals paid the same amount each payday. In order to obtain accurate reports of salaries and wages, respondents were encouraged to consult records; however, the table demonstrates that a sizeable proportion were unable to do so. In the case of salaried individuals for whom records were unavailable, respondents were asked for an accurate estimate or a rough guess of the salary. Thus, salaries were obtained for 57.1% of salaried employees from records, for 26.5% as accurate estimates, and for 5.5% as rough guesses, leaving 10.8% for whom no estimate was obtained.

In the case of individuals paid hourly, the unavailability of records was treated by obtaining data on the person's regular hourly rate of pay and usual number of hours worked. Table 3 shows nonresponse for these items to be much lower than that for wages as obtained from records. The use of these two variables for imputing wages is discussed in Section 4.

A comparison of item nonresponse rates for various subgroups points to some differences; however, because of the small subgroup bases, no definitive conclusions can be drawn without more detailed analyses. The present findings suggest that there may be a greater proportion of missing data for non-whites than for whites. For instance, the following results were obtained from the April 1978 wave of the area sample: for those paid the same amount each payday by their first employer, 61.2% of non-whites did not provide the amount from records (n = 152) compared with 45.7% of whites (n = 812); and for those paid hourly, the regular hourly rate of pay was missing for 15.8% of non-whites (n = 177) compared with 8.7% for whites (n = 967). Two examples of other subgroup differences are: for those paid hourly, the regular hourly rate of pay was missing for 15.4% of those aged 45 or over (n = 306) compared with 7.8% for those under 45 (n = 835); and the quarterly interest on savings accounts was missing for 52.8% of females with such accounts (n = 615) compared with 43.1% of males (n = 707). For each of these examples comparable results were obtained from July wave analyses.

3. Use and Quality of Proxy Reports

As noted earlier, proxy informants were widely used in the 1978 Panel to provide data for persons not present at the time of interview. While the use of proxies may have contributed to the high person level response rate in cooperating households, it may also have affected the quality of the data collected. For some items proxy informants may provide answers as accurate as self reporters, but for other items they may be poorer reporters; that is, they may be unable to answer certain questions, leading to item nonresponse, and they may answer other questions less accurately.

Table 3: Item Nonresponse Rates in the April Wave of the 1978 Panel for Some Amount Items among Persons Known to have Non-zero Amounts

	Refused %	Don't know or other nonresponse %	Total %	(No. of persons)
For those receiving program support:				
Social Security payment in January (area sample)	1.6	3.1	4.7	(553)
Federal SSI in January (SSI sample)	1.3	0.7	2.0	(300)
For those with savings accounts (area sample):				
Interest on savings accounts, January-March	2.6	45.0	47.6	(1,329)
Amount in savings accounts at end of March[1]	11.5	27.0	38.5	(636)
For those paid salaries receiving the same amount each payday (first employer only) (area sample):				
Amount of paycheck from records	3.2	39.7[2]	42.9	(472)
Amount of paycheck from records or estimated	5.7	5.1	10.8	(472)
For those paid hourly (area sample):				
Amount of paycheck from records (for those receiving the same amount each payday – first employer only)	0.6	51.5[2]	52.1	(466)
Regular hourly rate of pay as of March 31 (all jobs)	1.7	8.0	9.7	(1,144)
Number of hours per week usually worked at this job during January-March	---	0.3	0.3	(1,144)

[1]This item was asked only of those with savings accounts who failed to report the amount of interest received for January to March.

[2]This percentage includes those who did not have records available.

Table 4: Item Nonresponse Rates for Self Reports and Proxy Informants in the April Wave of the 1978 Panel, among Persons to Whom the Question Applies (Area Sample)

	Self reports %	Proxy reports %
Interest on savings accounts January-March:		
Refused	3.0	1.5
Don't know and other nonresponse	42.1	53.5
Total	45.1	55.0
	(995)	(333)
Regular hourly rate of pay, for those paid hourly (all employers):		
Refused	2.1	1.2
Don't know and other nonresponse	2.9	16.6
Total	5.0	17.8
	(716)	(427)
Amount of paycheck from first employer, for those paid hourly and paid the same amount each payday	43.4	64.6
	(274)	(192)
Amount of salary at March 31 for all salaried workers, from records or estimated, for those paid same amount each payday:		
Response from records	65.8	42.4
Accurate estimate	22.6	33.5
Rough guess	2.7	10.6
Refused	6.0	5.3
Don't know and other nonresponse	3.0	8.3
Total	100.0	100.0
	(301)	(170)

Firm conclusions on the effects of using proxy informants can be drawn only from a properly designed experiment, in which persons absent at the initial interview are randomly assigned either to be followed up for an interview or to have their answers provided by a proxy informant. No experiment of this type was conducted with the 1978 Panel. The only evidence on the effects of proxy interviews comes from comparing the results obtained from self reports with those obtained from proxy informants. Since persons for whom proxy informants were used were a self-selected subgroup of the total sample, these comparisons should be interpreted with caution. Nevertheless, they are suggestive of the possible effects of using proxies.

Table 4 provides a comparison for several items of the extent of item nonresponse for self and proxy reports. The results show a uniformly higher rate of item nonresponse when the data were collected from proxy informants, usually deriving from a slightly lower refusal rate but a substantially higher rate of 'don't knows'. It is conceivable that if the persons whose data were provided by proxy informants had been interviewed for themselves, they would have generated somewhat higher item nonresponse rates than the self reporters. It seems unlikely, however, that this effect would fully account for the differences observed in the table. The results suggest that the use of proxy informants does contribute to an increased level of item nonresponse.

Two approaches are available to aid in the assessment of the quality of proxy reports: (1) the extent of the use of records by proxy informants, and (2) a comparison of the stability of responses to the same item on two waves of the Panel when both are self reports and when one is a self report and the other is a proxy report. Using the former approach, the last item in Table 4 indicates that a higher proportion of salaries reported by self respondents was obtained from records, the proxy informants relying more heavily on estimates. With the latter approach, a greater stability in the responses for an item on two waves when both are self reports than when one is a self report and the other is a proxy report suggests variability between self and proxy reports. To investigate this issue, product-moment correlations between responses on the April and July waves for self reports on both occasions and for a self report on one and proxy on the other were calculated for three items. In each case the self/proxy correlation is based on a small sample size (given in parentheses) and hence is subject to sizeable sampling error. The first item was the monthly income obtained from records for persons in the area sample who were paid the same amount each payday. In this case, since records were consulted, it is not surprising that the self/proxy correlation of 0.86 (n = 39) is similar to the self/self correlation of 0.90 (n = 146). The second item was the Federal SSI payment for the first month of the quarter (i.e. January for the April wave and April for the July wave) for recipients in the SSI sample. The correlations for both self/self and self/proxy reports were high, 0.94 (n = 222) and 0.99 (n = 22) respectively, with no indication of a variation between self and proxy reports. The final item, interest on savings accounts for the quarter for area sample

persons with such accounts, produced much lower correlations for both response patterns, and here the self/proxy correlation was appreciably lower: the self/self correlation was 0.61 (n = 283) while the self/proxy one was only 0.34 (n = 41). While this very limited evidence suggests that the quality of self and proxy reports may differ for some items, it should again be pointed out that this could be a result of the self-selection of the groups being compared.

4. Two Potential Imputation Procedures

As experience with the 1978 Panel demonstrates, the SIPP will incur a fair amount of missing data. After every effort has been made to minimize nonresponse at both the unit and item levels, an appreciable amount will remain and be concentrated in certain population subgroups. This situation calls for the application of methods to reduce the extent of nonresponse bias in the survey estimates.

Two imputation procedures for item nonresponse have been investigated. The first procedure imputes a value from responses to highly related items for the same wave. For certain items where considerable nonresponse was expected, alternative, closely related information was obtained. Two examples stand out: (1) when interest from a savings account was not reported, a question was asked about the amount of savings in the account, and (2) the earnings of those paid hourly were obtained from paycheck records where possible, and information was also collected on their regular hourly rates of pay and usual number of hours worked.

This procedure is useful if reasonable response rates are obtained for the alternative questions among those not responding to the original ones, and if a close relationship exists between the information collected from the original and alternative questions. Evidence on the first point is given in Table 5 for the area sample. The table shows that about three out of five of those failing to provide answers to the savings interest question did answer the question on the amount in the savings accounts. The position on earnings for those paid the same amount each payday was even better: about 5 out of 6 of those failing to provide earnings from records (i.e. paycheck amount and frequency of payment) did answer the two questions on hourly rate of pay and usual number of hours worked. There remains a significant proportion of persons for whom information was unavailable from either source both for savings and earnings; however, if the alternative information can be used to provide accurate estimates, the missing data problems for these two items would be substantially reduced.

Little evidence is available to quantify how well responses to the alternative questions can predict those to the original questions. Twenty-five persons in the April wave of the 1978 Panel (both area and SSI samples) were incorrectly asked and then answered both questions on savings account interest and the amount in the savings accounts. The correlation between the amount of interest and the amount in the accounts was 0.63 for these persons. In the case of the paycheck item, there were 162 persons in the area sample paid hourly, and paid the same amount each payday, for whom earnings could be estimated from both

Table 5: Availability of Information on Amount in Savings Account for Imputing Savings Interest, and of Regular Hourly Rate of Pay and Usual Hours Worked per Week for Imputing Wages for Those Paid Hourly the Same Amount Each Payday (April 1978 Wave, Area Sample).

	Savings Interest %	Amount of Paycheck %
Response obtained to original item*	52.4	46.5
Response not obtained to original item, but information available from alternative item(s)	28.2	45.5
Responses not obtained to either original or alternative items	19.4	8.0
Total	100.0	100.0
(Number in receipt of such payment)	(1329)	(402)

*i.e., amount of savings interest for savings item, and amount of paycheck from records, together with frequency of pay, for paycheck item.

Table 6: Patterns of Response for the April and July Waves of the 1978 Panel for Three Items: (a) Amount of Federal SSI Received in January (April Wave) and April (July Wave), Among SSI Recipients in the SSI Sample; (b) Amount of Interest Received from Savings Accounts in January-March (April Wave) and April-June (July Wave), for Area Sample Respondents with Savings Accounts; (c) Earnings from Paycheck Records for All Those in the Area Sample Paid the Same Amount Each Payday, April and July.

April Wave	July Wave	(a) SSI payment %	(b) Savings interest %	(c) Earnings %
Response	Response	94.7	39.4	39.8
Response	Nonresponse	3.9	16.0	16.5
Nonresponse	Response	1.1	16.8	13.0
Nonresponse	Nonresponse	0.4	27.8	30.8
Total		100.0	100.0	100.0
(No. receiving payment)		(283)	(934)	(601)

records (Y) and the hourly rate of pay and usual number of hours worked per week (X). The correlation between these two estimates was 0.83, and the regression equation was Y = -55.4 + 1.05X, with an intercept not significantly different from zero, and a slope not significantly different from 1. While there remains room for improvement, it appears from this evidence that the alternative questions may provide a reasonable basis for imputing for missing data on these two items.

The second imputation procedure investigated uses the panel feature of the survey design to impute for a person's missing response to an item in one wave from his response to the same item in another wave. Such cross-wave imputation can in principle be applied in either direction, using data available for April to impute missing data for July or vice versa. Table 6 summarizes the patterns of response for three items across the April and July waves of the 1978 ISDP Panel among persons in households which cooperated in both waves. With the first item, January SSI payments for the SSI sample, there were very few missing data cases in April (1.5%), and almost three-quarters of them had data available in July; of the 4.3% of missing data cases in July, 3.9% had data available in April. The other two items, savings interest and earnings, have similar response patterns: each wave had around 45% of missing data, with about two-thirds of it being common to both waves. In consequence, for these items only about a third of the persons with missing data on one wave have data available on the other wave for possible use in imputation.

An indication of the strength of the relationship between the amounts reported for the two waves is provided by the correlations between these amounts for those responding on both

occasions: for the Federal SSI payments, r = 0.95 (n = 268); for savings account interest, r = 0.67 (n = 368); and for earnings, r = 0.89 (n = 223). The high correlations for SSI payments and for earnings suggest that if a response is available from an adjacent wave, that response may serve as a firm basis for imputation. While the correlation for savings interest is lower, the use of a response from another wave in the imputation scheme may still be valuable.

5. Nonresponse Adjustments and Imputation

In considering a general nonresponse adjustment and imputation strategy for the SIPP, the variety of analyses for which its data will be used must be taken into account. They will, for instance, be used to provide numerous descriptive estimates for the population, including household, family, and individual income levels, the number of participants in various federal transfer programs and the amount of support received by federal program participants. The data will also be used for analytic work, especially microsimulation modelling of the federal tax and transfer system. Thus, the costs and impacts of new programs or changes to existing programs will be estimated and analyzed.

If the SIPP data were to be used solely to produce basic descriptive measures of average levels, the simple procedure of imputing for an item nonresponse the mean of the imputation class in which the nonresponse occurred might serve well. However, because this procedure distorts distributions, reduces element variances and alters covariances, its application is inappropriate to data which are also to be employed for analytic purposes, many of which depend on a variance-covariance matrix. In view of the variety of analyses to which the SIPP data will

505

be subjected, the nonresponse adjustment procedures adopted for the survey will need to provide good estimates of distributions, variances and covariances as well as of average levels.

Other issues which are relevant to the development of a nonresponse adjustment procedure for the SIPP include the problems of aggregation (imputation of micro-level components to be summed vs. imputation of single aggregate components), weighting (the use of standard imputation procedures with a weighted sample may give rise to sizeable increases in variance), sampling errors (single imputation schemes underestimate the true variance - Rubin, 1979), the risks of using the same donor repeatedly, and outliers (the use of extreme values in imputing numeric values may be undesirable).

Finally, a principal concern for nonresponse adjustments and imputation with the SIPP is the issue of cross-sectional imputation (each wave being taken separately) or cross-wave imputation (several waves being treated as a single combined data set). The former procedure has the practical convenience that it can be carried out as soon as each wave's data are available. However, it fails to use all the data, and may therefore produce imputed values inferior to those that would have been obtained from the combined data set. For instance, as illustrated in the preceding section, a response for an item on one wave may be a good predictor for that item on another wave.

Another disadvantage with the cross-sectional procedure is that records with imputed data may be inconsistent from wave to wave. This feature is particularly damaging for analyses requiring more than one wave of data, as for instance in the case of micro-simulation modelling of the federal tax and transfer system.

Separate wave reweighting adjustments for household nonresponse also cause a problem for cross-wave analyses. The varying pattern of household nonresponse across waves results in respondents being assigned weights which change from wave to wave. The problem is determining what weights to use when several waves· of data are merged for longitudinal analyses. (Since the sample inclusion probabilities of some persons in the 1978 ISDP Panel changed between waves, a factor which also caused a variation in weights, the removal of varying nonresponse adjustments would, however, not entirely eliminate this problem.)

The disadvantages of the cross-sectional approach to nonresponse adjustments and imputation make the cross-wave approach an attractive one. Household nonresponse on one wave could, for example, then be treated as a collection of item nonresponses in the combined data set. However, the full cross-wave approach cannot be applied until all the waves of the panel have been completed and merged tapes produced, a feature which impairs the production of timely adjusted estimates from individual waves. The demand for timely estimates suggests the use of a two-fold strategy, first making preliminary adjustments for immediate individual wave analyses, and then later making final adjustments using data available in other waves. A variant on this scheme might be to generate merged tapes as each wave's data became available, making nonresponse adjustments and imputations for the latest wave using all the data collected to that point; this variant may also be treated as a preliminary one, with the final adjustments for all waves being made from the combined data set.

References

Lininger, C.A. (1980). The Survey of Income and Program Participation: goals, objectives, and prospects. *Proceedings of the Section on Survey Research Methods, American Statistical Association,* 1980.

Rubin, D.B. (1979). Illustrating the use of multiple imputations to handle nonresponse in sample surveys. *Proceedings of the 48th Session of International Statistical Institute,* Manila, December, 1979.

Ycas, M. and Lininger, C.A. (1980). The Income Survey Development Program: a review. *Proceedings of the Section on Survey Research Methods, American Statistical Association,* 1980.