

ITEM RESPONSE RATES: ONE INDICATOR OF HOW WELL WE MEASURE INCOME

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I. Introduction

Wages are one of the best-measured income sources in household surveys. For example, total wage and salary income in the March Current Population Survey (CPS) ranged between 96 and 102 percent of a benchmark based on the National Income and Product Accounts between 1990 and 1996 (Roemer 2000).¹ Income from Social Security and railroad retirement, and from private pensions, was nearly as well measured in the CPS over this period, accounting for between 88 and 92 percent, and 93 and 103 percent, of their respective benchmarks (Roemer 2000).² Other income items, however, fall short, sometimes substantially, of their benchmarks. For example, interest income was 84 percent, and dividends were 60 percent, of their respective 1996 benchmarks.³

CPS income statistics reflect both the amounts directly reported by respondents and adjustments the

Census Bureau makes for individuals who do not report the amount of income (as well as weighting and adjustments for nonresponse to the CPS as a whole). Response rates for the CPS as a whole (unit response rates) are above 90 percent, and generally are higher than for other large household surveys.⁴ However, unit response rates have been declining for the CPS (U.S. Census Bureau 2002). Declining unit response rates potentially affect data quality if nonresponse leads to bias because units that respond differ from those that do not.⁵ In addition, people who respond to a survey are more reluctant to report on some topics than on others, leading to item nonresponse. For example, item response rates for income are generally lower than for many other kinds of questions (e.g. Roemer 2000, Moore *et al.* 2002). Declining response rates for income items may also affect data quality if there is bias because units that respond to income items differ from those that do not.⁶

Response rates for income items would therefore provide information about one facet of the quality of the CPS income statistics.⁷ However, standard definitions of item response rates have been lacking. Prior research (Atrostic *et al.* 2001) showed that consistent definitions of unit response rates could be developed and calculated from data already available to statistical agencies. Consistent definitions allow users to make appropriate comparisons across surveys and over time.

Disclaimer: This paper reports the results of research and analysis undertaken by Census Bureau staff. It has undergone a Census Bureau review more limited in scope than that given to official Census Bureau publications. This report is released to inform interested parties of ongoing research and to encourage discussion of work in progress. We have benefited from comments by our colleagues, but all errors are the authors' own.

¹ The fit between aggregate wages in the CPS and an external benchmark is one of many criteria that are used to assess data quality (U.S. Census Bureau 2002). There are many possible benchmarks for the CPS income data. Roemer (2000) provides detailed documentation on the benchmark used in that analysis.
² Wage and salary income have exceeded the benchmark since 1994. Roemer (2000) suggests that changes in the CPS sample design and instrument (including a switch from a paper instrument to computer-assisted interviewing) are "strong explanatory candidates," although the exact cause remains unclear.
³ Coder and Scoon-Rogers (1996) report roughly similar results for 1984 – 1990. Moore, Stinson, and Welniak, drawing on Coder and Scoon-Rogers, note that the conclusion typically drawn from the earlier data is that individuals underreport their income. However, they find that other factors, including nonresponse as well as errors in reporting income sources and amounts, play a role in the underestimates. Roemer notes that comparing survey aggregates with external benchmarks may be an overly simplistic measure of data quality because there is evidence of both under- and over-reporting of income amounts, and analyzes each income source.

⁴ While trends in response rates are clear, the reasons for them are less clear, and are continuing research topics (e.g., Groves and Couper 1998; Atrostic, Bates, Gurt, and Silberstein 2001).
⁵ Comparing reported data and data from administrative sources could provide insights on the potential for, and extent of, bias (e.g., Rubin 1983; and Lillard, Smith, and Welch 1986, Roemer 2000).
⁶ Improvements to CPS income imputation and post-collection processing may contribute to the better fit between CPS income statistics and aggregate benchmarks. But a full assessment of that success would note whether those processes also address the potential for nonresponse bias.
⁷ Item nonresponse is only of many sources of potential error in income measures. Moore, Stinson, and Welniak 2000 carefully review the literature on response error in income data, and possible sources of error, including reporting error and cognitive factors. Roemer 2000 provides detailed review and analysis of the size of and possible sources of measurement error in the CPS.

In this paper, we develop a process for defining consistent sets of item nonresponse rates. The definitions explicitly account for survey design. As a specific example, we define and calculate income item response rates for several important sources of income in the March Current Population Surveys for 1990 and 2000. While the item response rates we calculate are for income items in a specific survey, the process we describe can be applied broadly to other topics and other household surveys.

II. Item Response Rates: General Definition

Response rates for an item are defined in terms of the group eligible for a set of questions, and whether or not they answer those questions. Definitions of consistent sets of item response rates will vary across surveys because the questions of interest, the group(s) of interest, and the structure of the survey instruments vary. The general process is:

- Specify the item or items of concern;
- Identify the units or groups eligible to be asked the items of concern;
- Identify the path through the survey that determines eligibility for the items of concern;
- Define the numerators and denominators of the response rates in terms of the items and eligibility;
- Present both the definitions and the rates.

Consider item response rates for income items in a household survey. The household is the survey unit, but information about income items is asked for specific persons within the household. Furthermore, all persons may not be eligible for specific income items. For example, current workers do not receive Social Security retirement income (except for a small set of workers who are beyond the age limits of the Social Security earnings test), and so, there would be no questions about how much Social Security income they receive. There are questions both about receipt of a specific form of income, and the amount of income. There may also be related questions about frequency of receipt (e.g., whether wage rates are hourly or weekly). The denominators of meaningful item response rates therefore are likely to vary among income items. For example, “persons eligible to receive Social Security” will not be the same as “persons with wage or salary income.” The numerators will be the number of reported responses for the eligible group. Additional item response rates

could be defined to address other dimensions of nonresponse.

III. Illustrative Example: CPS Income Items

We chose the March supplement to the CPS as an example because the March CPS program has been an important source of income data for over half a century (U.S. Census Bureau 1998). The most well known use of the CPS income data is to determine the U.S. poverty rate.⁸ Other uses of both the published data and the underlying micro data include public and private sector analyses of demographic, economic, and social changes in the U.S. Because the CPS income data are so widely used, they have received many critical reviews (e.g. Coder and Scoon-Rogers 1996; Roemer 2000; Moore *et al.* 2000 for recent reviews; the many citations in these papers’ references; and Rubin 1983; and Lillard, Smith, and Welch 1986 for earlier reviews).

A. CPS Income Item Response Rates

The set of response rates we propose takes account of several aspects of CPS survey design. A series of questions are asked for each income source in the March supplement. The first series determines whether the household member is eligible to receive an income source (for example, questions about current wages will not be asked of persons not in the labor force). For eligible persons, the CPS asks if the person actually received the specific form of income.

For persons who are reported to receive income from a particular source, the amount is then asked. Because our interest lies in how much income information is missing and must be imputed, our item response rates focus on whether or not a specific dollar amount is reported.

We define two item response rates for each source of income. The first rate is defined strictly in terms of information directly reported by respondents. It is the percent of individuals for whom receipt of a particular income source was

⁸ The U.S. Census Bureau conducts the basic CPS and the March supplement. The CPS is a large, continuing household survey that contacted approximately 77,000 households monthly in 1999. The CPS is a panel survey with eight interviews: four monthly interviews for the first four months, and then, after eight months, a second set of four monthly interviews. The first and fifth CPS interviews are usually conducted by personal visit, the others by telephone. The CPS generally collects information about all the members of a household at an address from a single responding household member. For descriptions of the CPS survey design, and for information about its quality, see U.S. Census Bureau (2002).

reported for whom the amount received was also reported:

$$(I_{RR} / Y_R) \times 100 \quad (1)$$

I_{RR} gives the number of these individuals for whom an amount was reported. Y_R indicates the number of persons who were reported to receive income from the specific source. This rate shows how much individuals who are willing to report receiving income from a particular source are also willing to report the amount received. This item response rate is used, for example, in Moore *et al.* 2000.

The second set of rates applies to a larger group of people. In addition to individuals who report receiving a particular source of income, its base includes individuals for whom receipt was imputed. The numerator includes those in the denominator for whom an amount was reported:

$$((I_{RR} + I_{IR}) / (Y_R + Y_I)) \times 100 \quad (2)$$

I_{IR} is the number of persons for whom an income amount is reported, either directly or through imputation. Y_I indicates the number of persons for whom there was no answer to the question about receipt but who were eligible (or imputed to be eligible) to receive income from this source.

The U.S. Census Bureau imputes receipt of a specific source of income if it believes someone is likely to have received it (given other responses or demographic characteristics) and there was either no response at all to the March Supplement, or no response to the particular question about receiving income from this source. One minus rate (2) captures the degree of missing information due to income item nonresponse.

B. Related Set of Income Quality Measures

The share of income from each source that is imputed is another indicator of the quality of income data. A high share of imputed income may not be of great concern for sources of income that are not prevalent in the population, because their shares of total income are relatively small.⁹ However, if specific income sources become more prevalent and account for larger shares of total income, decreasing response rates for these items will result in larger amounts of total income being imputed. The shares of income imputed from each source are given by:

⁹ A high share of imputed income may be of concern, however, for income sources important to specific population subgroups.

$$\frac{\text{Dollar amount of income imputed}}{\text{Total dollar amount reported or imputed}} \times 100 \quad (3)$$

Marked increases in the share of income that is imputed may result if the imputation process improves on what otherwise might be guesses by respondents. However, if the increases do not improve the fit with benchmarks, they may suggest the need to review the current imputation procedures and the survey processes designed to improve or maintain response rates.¹⁰

IV. Response Rates for Sources of Income: March 1990 and March 2000 CPS

We calculate our proposed income item response rates for the March 1990 and March 2000 CPS. Item response rates for these years may not be typical. Results in Harris-Kojetin and Tucker (1998) suggest that the CPS response rates in March 1990 and March 2000 may be above the time trend because of the effect of the Decennial Census of Population, collected in April of those years. However, moving the starting point of our analysis backwards more than one year is difficult because the CPS income imputation algorithm was modified substantially in 1989 (U.S. Census Bureau 1998). Although the response rates in these two years may be above trend, comparisons between them will show general trends in income item response rates.

A. Income Item Response Rates

Response rates fell between March 1990 and March 2000 for all income items. Response rates for both years, calculated using definition (2), are shown in Table 1.¹¹

Response rates for some items fell relatively modestly. For example, the response rate for total wage and salary earnings fell by 8.8 percentage points, that for earnings on the job held longest in the preceding year also fell by 8.8 percentage points, and that for Social Security income fell by 9.9 percentage points. However, response rates for several other income sources fell markedly. For example, response rates for interest and dividend income each fell by 22 percentage points. Response rates for the combined

¹⁰ The Census Bureau periodically revises its survey processes. U.S. Census Bureau (1998) gives a history of the March CPS supplement, ranging from survey instrument design to data collection and data processing, including imputation.

¹¹ Rates were also calculated using definition (1). These rates are similar to those using definition (2) and are not shown here.

category of interest and dividend income fell by 24.8 percentage points.¹²

More striking than the percentage point declines in item response rates are their actual levels. The response rate for the value of total wage and salary earnings is less than 75 percent. This response rate fell from 81.6 percent to 72.8 percent between March 1990 and March 2000. However, this drop pales in comparison to the decreases in some other income item response rates. Response rates for total own business earnings fell from 72.3 percent to 59.8 percent. The response rate for interest and dividend income together is now less than 50 percent: it fell from 70.3 percent to 45.5 percent over the period.

B. Share of imputed income

Large proportions of income from each source are imputed in the March CPS, and the proportions of income that are imputed are increasing. We calculate (3), the percentage of total income that is imputed for each income source, in March 1990 and 2000, and report results for several major income categories in Table 2.

In March 2000, the share of major income items that is imputed ranges from 26 to 64 percent.¹³ In that year, 26.8 percent of wage and salary earnings were imputed, up 8.1 percentage points from 18.6 percent in March 1990. The share of total self-employment income that was imputed grew from 29.4 percent in March 1990 to 43.8 percent in March 2000. Similarly, the share of interest and dividend income that was imputed grew from 44.4 percent in March 1990 to 64.1 percent in March 2000. The share of income that is imputed, and its percentage point increase, roughly corresponds to the proportion of reported recipients who do not report an amount received. The increasing proportion of income from key sources that must be imputed underscores the importance of periodically reviewing imputation algorithms and their underlying assumptions. It may be the case that there is no response bias in interest and dividend reporting, or that the degree of bias is the same in 2000 as in 1990, and that the imputation

¹² We define nonresponse rates for dividends and interest separately, and as a single category, following a suggestion by Ed Welniak (2001) that individuals may have trouble distinguishing whether the income they receive is dividends or interest. For example, both income sources could be directly deposited to a respondent's checking account.

¹³ We calculate response rates for a detailed list of 16 income items, similar to the items presented in Roemer 2000, but present statistics only for the most prevalent items to avoid any disclosure concerns. We find the same pattern of decreasing response rates, and decreasing reports of amounts, for these income items.

algorithms adequately correct for that bias. However, such assurances matter when nearly two-thirds of these amounts are imputed.

C. Comparisons with other studies

The response rates we calculate for CPS income items, and the shares of income totals that are imputed, are consistent with the evidence available from other analyses of the CPS and similar surveys. This rough consistency suggests that our findings are not artifacts of our specific definitions or the years of data in our analysis. However, the other studies do not provide enough detail on how their item response rates are calculated for us to draw firmer inferences about the amount of nonresponse to specific income items in household surveys.

Moore *et al.* (2000) report on the percent of persons in the March 1996 CPS for whom income amounts were imputed for each of a dozen illustrative income sources. They calculate that amounts of wage and salary income were imputed for 26.2 percent of persons, similar to the 27.2 percent we find for March 2000 ($27.2 = 100 - 72.8$ (Table 1, column 3)). For dividend income, they report 48.6 percent with imputed amounts; we report 50.4 percent.

Income item response rates defined similarly to those we propose are also being calculated for an experimental panel of the Census Bureau's Survey of Income and Program Participation (SIPP). While the design of the experimental panel and the CPS differ, preliminary panel findings yield useful insights. The income item response rates for wage and salary earnings from the experimental SIPP panel, and for business earnings, are roughly 81 to 85 percent, (Bates 2002). By comparison, the CPS response rate for wage and salary income is about 73 percent in March 2000, and the rate for total own business earnings is about 60 percent.

Loomis and Moore 2002 report response rates to income item amounts in another Census Bureau experiment, the Questionnaire Design Experimental Research Survey (QDERS). They report on two survey designs, person-based and topic-based. In the person-based design, questions on all topics are asked for the first person in the survey unit, then for the second person, etc. This is the same approach as the CPS. For the person-based design, they report income amount response rates. The amount response rate in QDERS for wage and salary income is 80 percent, 73 percent for self-employment income, 68 percent for interest and dividends, and 75 percent for social security income. The response rates we

calculate for the March 2000 CPS are 73 percent for wages, 60 percent for total own business earnings, 45 percent for interest and dividends, and 71 percent for social security income. Response rates in both this study and the March CPS are highest for wages. While both studies show lower response rates for non-wage income items, the item response rates appear to be somewhat lower in the CPS.

IV. Summary and Preliminary Conclusions

This paper showed how to define item response rates and calculate them straightforwardly from existing survey micro data. We calculated several of these rates for both the March 1990 and March 2000 CPS. Response rates to income items are falling, and the amount of income that is imputed is increasing. About one quarter of wage and salary income is imputed in March 2000, while nearly two-thirds of dividend and interest income is imputed. While the amount of income that is imputed is increasing, some of these CPS income totals differ substantially from external benchmarks. For example, wage and salary income was 102 percent, interest income was 84 percent, and dividend income was 60 percent, of their respective 1996 benchmarks.

Based on these findings, we recommend that household surveys identify key data items and develop and publish item response rates for them. Analyzing such response rates will suggest directions for further research and quality improvement. More specifically, we recommend:

- Calculating and reporting these rates routinely;
- Continuing research to determine causes of nonresponse and identify ways to alter survey design and operations;
- Identifying characteristics of those who do not respond, to assess potential bias;
- Reviewing periodically whether assumptions underlying imputation algorithms continue to hold.

We are extending this research in several directions. First, we are modeling the determinants of income item response to determine whether there is bias, and if the degree of bias changes over the period. The model includes some characteristics of the CPS and Census Bureau survey administration, as well as respondent characteristics, following suggestions in Groves and Couper 1998 and the example of Harris-Kojetin and Tucker 1998.

We are also assessing the effect of nonresponse and imputation on stylized estimates in empirical analyses that use the CPS. Our motivation is Rubin 1983, which found that response rates for income items differed across demographic groups, and those differences biased estimates of rates of return to schooling. Current research using administrative records finds evidence of over- and under-reporting in the CPS (Roemer 2000). We are undertaking analyses similar to those in Rubin 1983, although without use of administrative records, to assess the current degree of nonresponse bias and its impact on inference.

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Table 1: Response Rates for Dollar Amounts, Given Reciprocity, March 1990 and March 2000 CPS, by Source of Income

Income Source	Percent of All Recipients (Reported and Imputed) Who Also Reported An Amount		
	1990	2000	Change
	Percentage points		
Direct Questions			
Earnings from Longest Job ¹	81.2	72.4	-8.8
Other Wage and Salary Earnings	84.1	77.9	-6.2
Other Self Employment Earnings ²	81.3	65.0	-16.3
Interest Income	70.9	48.4	-22.5
Dividend Income	71.8	49.6	-22.2
Social Security	80.7	70.8	-9.9
Aggregates			
Total Wage and Salary Earnings	81.6	72.8	-8.8
Total Own Business Earnings ²	72.3	59.8	-12.5
Interest/Dividend Income	70.3	45.5	-24.8
Other Retirement Income ³	78.8	68.0	-10.8
¹ Includes wage and salary and own business and farm income			
² Does not include own farm earnings			
³ Excludes Social Security and veterans' benefits			

Table 2: Share of Income Imputed, March 1990 and 2000 CPS, by Source of Income

Income Source	Imputed Income as Percent of Total Income		
	1990	2000	Change
	Percentage points		
Direct Questions			
Earnings from Longest Job ¹	19.3	27.5	8.2
Other Wage and Salary Earnings	16.2	21.9	5.7
Other Self Employment Earnings ²	19.6	32.2	12.5
Interest Income	44.5	63.5	19.0
Dividend Income	33.6	54.5	20.9
Social Security	19.4	29.8	10.3
Aggregates			
Total Wage and Salary Earnings	18.6	26.8	8.1
Total Own Business Earnings ²	29.4	43.8	14.3
Interest/Dividend Income	44.4	64.1	19.6
Other Retirement Income ³	20.9	31.6	10.6
¹ Includes wage and salary and own business and farm income			
² Does not include own farm earnings			
³ Excludes Social Security and veterans' benefits			