

Changes in Nonresponse to Income Questions

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Abstract

Nonresponse, both unit and item, is a pressing issue in survey methodology; it has a great impact on making inference to the target population and on survey costs. This paper focuses on item nonresponse to income questions, because income data, collected in almost every survey, has been associated with a large amount of missing data. We will examine changes in nonresponse to the income questions in the Survey of Consumer Attitudes (SCA). SCA is a monthly RDD study; it asks respondents first to report their income in dollar amounts with an open-ended question. For those who do not provide an answer, they are followed up with a closed-ended question with income brackets. We will take a historical approach in studying 20 years of SCA data (from June 1986 to December 2005) and examine the trend of nonresponse to the income questions in SCA over time. Analyses indicate that income item nonresponse has decreased over time, and the decline is related to the unit nonresponse rate, the refusal and refusal conversion rates, and nonresponse to other items in the survey. We interpret these findings through both sample composition and respondent motivation. The results suggest that for questions on household income, there exists a trade-off between unit and item nonresponse.

Keywords: Item Nonresponse, Unit Nonresponse, Income, Panel Survey

1. Introduction

Nonresponse is a significant problem for survey researchers and a key concern for survey methodologists. Nonresponse threatens sample representativeness, limits the ability to make inference about the target population, and runs the risk of incurring nonresponse bias if sample respondents are consistently different from sample nonrespondents with regard to the key analysis variables (Groves, 1989; Lessler & Kalsbeek, 1992). The underlying causes of nonresponse, however, are not fully understood. To optimally design surveys, more information is needed on the characteristics and processes that cause one person to reply to a survey request or answer a survey question, and another person to refuse. The phenomena of nonresponse encompass nonresponse at both the unit and the item level. At the unit level, household surveys have been experiencing a falling response rate over the past few decades (Atrostic, Bates,

Burt, & Silberstein, 2001; Curtin, Singer, & Presser, 2005; de Heer, 1999; Hox & de Leeuw, 1994). Even though some studies find no correlation between response rates and nonresponse error (Curtin, Presser, & Singer, 2000; Keeter, Miller, Kohut, Groves, and Presser, 2000; Merkle & Edelman, 2002), other studies either postulate in theory or demonstrate empirically a link between response propensity and nonresponse error (Groves, Cialdini, & Couper, 1992; Groves, Presser, & Dipko, 2004; Groves, Singer, & Corning, 2000). Understanding the link between nonresponse and survey error is important, since efforts to reduce unit nonresponse, including incentives, extra calling, or extended field periods, have proved to be too costly to prevent continued declines.

Item nonresponse is an additional risk to inference, compounding unit nonresponse. In the worst case, item nonresponse might produce nonignorable missing data – a missing data pattern correlated with the values of the variable of interest (Little & Rubin, 1987). In contrast, ignorable item missing data is a situation where data are missing completely at random; therefore, nonresponse bias is not a critical concern. However, when the item missing data is not ignorable, serious nonresponse bias could occur and standard imputation procedures might not work well to repair the nonresponse problem (cf. Little & Rubin, 1987).

One survey item that tends to attract a high item nonresponse rate is income. The survey literature shows that the typical item nonresponse to income questions is around 20-40% (Moore, Stinson, & Welniak, 1999; Juster & Smith, 1997). Table 1 displays the item nonresponse rate to income questions in some household surveys conducted in the United States. The item nonresponse rate is a function of question characteristics, interviewer characteristics, and design features, such as mode of data collection, whether the survey is cross-sectional or longitudinal, and so on.) and comparison between any two numbers can not be taken literally. It is still quite apparent from the table that the prevalence of item nonresponse to income questions is generally high across surveys and across time, ranging from 14% to 35%. If an analyst employs a complete cases analysis involving income with these missing data rates, they may have to omit up to one third of the data, markedly reducing the sample size and the statistical power. Such a high nonresponse rate earns income a reputation for being a difficult and sensitive question to ask.

Table 1: Prevalence of Item Nonresponse to Income Questions by Survey (all government-sponsored)

Survey	Income Nonresp Rate	Mode of Data Collection	Income Definition
Atrostic & Kalenkoski (2002) March 1990 Current Population Survey (CPS)	18.4%	In-person & Phone	Ask amount; Multiple income types
Moore et al.(1999) March 1996 CPS	26.2%	In-person & Phone	Ask amount; Multiple income types
Atrostic & Kalenkoski (2002) March 2000 CPS	27.2%	In-person & Phone	Ask amount; Multiple income types
Dixon (2005) CPS (2002-2003)	14.2%	In-person & Phone	Ask amount; Multiple income types
Dixon (2005) Consumer Expenditure Quarterly Survey (CEQ) (2002-2003)	19.9%	In-person	Ask amount, bracket follow-up
McGrath (2005) CEQ 2003	35.0%, 19.0%**	In-person	Ask amount, bracket follow-up
Olson et al. (1999) National Immunization Survey (NIS) Quarter 4/97-1/98	14.2%	Phone	Ask amount, bracket follow-up
Olson et al. (1999) NIS Quarter 2/98-3/98	17.1%, 13.8%**	Phone	Ask amount, bracket follow-up
Battaglia et al. (2002) NIS 2000	27.8%	Phone	Ask amount, bracket follow-up

Note: * Item nonresponse rate to the initial open-ended income question.

** Item nonresponse rate after the pre-coded or bracket question.

2. Potential Causes of Item Missing Data

What is it about income that makes it vulnerable to such a consistently high item nonresponse? According to Beatty and Herrmann's (2002) item nonresponse model, three factors contribute to item nonresponse in surveys — how much people know about the topic, their judgment of the adequacy of what they know relative to the level of exactness or accuracy the question seems to require, and their willingness to report. The first two factors are cognitive while the third is motivational. When it comes to income questions, respondents may not report their income because they do not know their total family income, when they have a rough idea but believe that the question asks for an exact dollar amount, or when they simply do not want to provide their income information. Juster & Smith (1997) provides similar speculations on mechanisms of item nonresponse to income information.

One method thought to help respondents cope with the first two cognitive problems is the unfolding bracket technique (Heeringa, Hill, & Howell, 1993; Juster & Smith, 1997). This technique ask item nonrespondents (or, in some cases, all respondents) a series of bracketing questions (“Was the amount more or less than \$50,000?”, “More or less than \$100,000?”) that allows the researchers to collect partial information about income from respondents who are unwilling or unable to provide an exact amount. Heeringa, Hill, and Howell (1993) and Juster and Smith (1997) both report that this strategy effectively reduced the amount of missing financial data by 50 percent or more.

The unfolding bracket technique was only successful at obtaining substantive responses for most of the “Don’t Know” responses to the initial income question but not for as many “Refusals” (Juster & Smith, 1997). It seemed that this technique is more successful with the cognitive causes of income nonresponse, but less effective with the motivational cause. This is because respondents’ unwillingness to provide income information is partially driven by the sensitivity of the income question itself. Tourangeau, Rips, & Rasinski (2000) describes three meanings of “sensitivity;” one of them is the intrusiveness of survey questions. That is, questions are sensitive because they are seen as an invasion of privacy. Questions asking about income may fall into this category; respondents may feel that such questions are simply none of the researcher’s business. Questions in this category risk offending all respondents, regardless of their status on the variable in question.

To summarize the literature, the consensus is that income questions are subject to high item nonresponse, that both cognitive and motivational factors contribute to the high nonresponse rate, and that the unfolding bracket

technique is able to reduce the nonresponse to a significant extent. However, to our best knowledge, most of the studies on income nonresponse take a static, snapshot view by examining what happens with income questions at one time point of one survey. Therefore, what is lacking in the literature is a dynamic, historical view on income nonresponse. For instance, it is not clear how missing data rates to questions on household income have changed over time. It is also unclear whether respondents' unwillingness to provide answers to questions on household income (item nonresponse) is related to their willingness to participate in surveys (unit nonresponse).

To fill out this gap in literature, this paper examines the trend of item nonresponse to income questions in one survey over a period of 20 years. Specifically, the research questions we propose to address are: 1) Does item nonresponse to income questions increase or decrease over time; 2) Is income nonresponse driven mostly by cognitive factors or motivational factors; and, finally, what is the relationship between item and unit nonresponse.

3. The Data

We used for analysis the Survey of Consumer Attitudes (SCA) conducted by the University of Michigan Survey Research Center. The SCA started out as an area-probability in-person survey in the mid 1940s, and was converted to a random digit dial telephone survey in the mid 1970s. The survey is conducted monthly, and is based on a rotating panel design. We restrict our analysis to the newly drawn representative samples which is consistent with published work on SCA (e.g., Curtin, Presser, & Singer, 2000; Curtin, Presser, & Singer, 2005; Singer, Van Hoewyk, & Maher, 2000).

The new cases in each monthly survey are random digit dial samples from the coterminous United States, drawn until 1993 using Mitofsky-Waksberg procedures and since then using list-assisted procedures. From each household, one respondent has been randomly selected from among all household residents aged 18 or older. About 300 new interviews are now conducted each month. No formal changes have ever been made to call scheduling. Except for the constraint imposed by the month-long interviewing period, no limit is placed on the number of calls, and attempts are made to convert virtually all initial refusals. For information on the historical trend of unit response rates, see Curtin, Presser & Singer (2000, 2005).

The income questions are part of the SCA's core questions. Respondents are first asked to report their family total income in dollar amount; for those who do

not provide a response, they are followed up with a closed-ended question with income brackets.¹ The exact question wordings for the open-ended question and the bracket question used in the January 2005 survey are displayed in Exhibit 1. The anchor for the opening closed-ended questions (e.g., \$50,000) has been changed a few times to reflect the median household family income over time.

4. Results

We examined SCA monthly survey from June 1986 (when SCA switched to an open-ended income question followed by a bracket question) to December 2005. For aggregate level analysis, we used two item nonresponse rates. The first item nonresponse rate or "open nonresponse rate" referred to the percentage of respondents who did not answer the open-ended income question while the second rate or "final nonresponse rate" is the percentage of respondents who responded to neither the open-ended nor the bracketed income questions. These are the respondents who remained a nonresponder after the bracket question, and the final nonresponse rate variable can be thought of as the total item nonresponse rate for the income question.

Univariate Description. Table 2 displays the univariate distributions of the two item nonresponse rates computed for each monthly survey (n=235). Consistent with the literature, the income nonresponse ranged from 7% to 33% for the open-ended item. The bracket question trimmed down the item nonresponse to a range of 3% to 20%, producing an average reduction of 56% in item nonresponse to the open-ended income question. The average reduction is comparable to the literature on unfolding brackets technique (Heeringa, Hill, & Howell, 1993; Juster & Smith, 1997). Compared to nonresponse rates reported in Table 1, the SCA has somewhat lower item nonresponse rates than government-sponsored or other large-scale household surveys.

¹ This question format began in June, 1986 and due to our primary hypotheses, we are only looking at data that use this question format. Prior to June, 1986 income was asked as a closed-ended question with a list of precoded response categories. Our initial analyses, including data back to 1978, showed us that the income nonresponse pattern looks similar prior to June, 1986 as it does after June, 1986. Those data are not presented here.

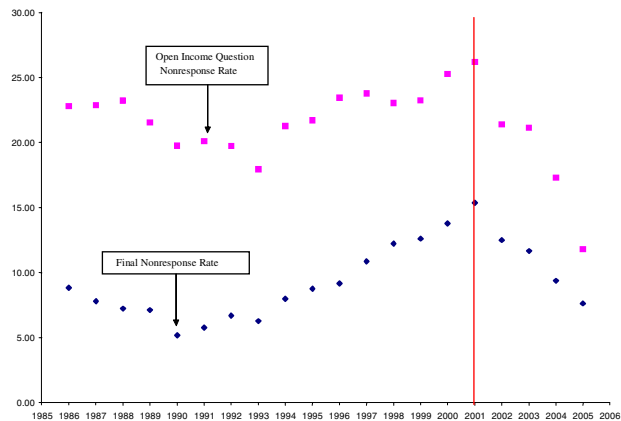
Table 2. Univariate Distribution of Nonresponse Rates to Income Questions in SCA

	Standard				
	Mean	Median	Deviation	Min	Max
Nonresponse rate to open-ended question (open_nr_rate)	21.4%	21.6%	4.1%	6.4%	33.1%
Final nonresponse rate after bracket question (final_nr_rate)	9.4%	8.8%	3.4%	2.4%	19.6%

Trend Analysis at the Aggregate Level. We plotted the two item nonresponse rates by year of the interview (see Figure 1) to examine the trend of income item nonresponse over 20 years. For both definitions of income nonresponse, small declines were recorded in the 1980s, followed by much larger increases in the 1990s up until 2001, after which the item nonresponse rates have declined sharply. Furthermore, it seemed that the initial item nonresponse to the open-ended question dropped faster than the final nonresponse after the bracket question. The downward trend after 2001 is quite intriguing, especially given that unit nonresponse rates have been increasing on the SCA (e.g., Curtin, Presser, & Singer, 2005).

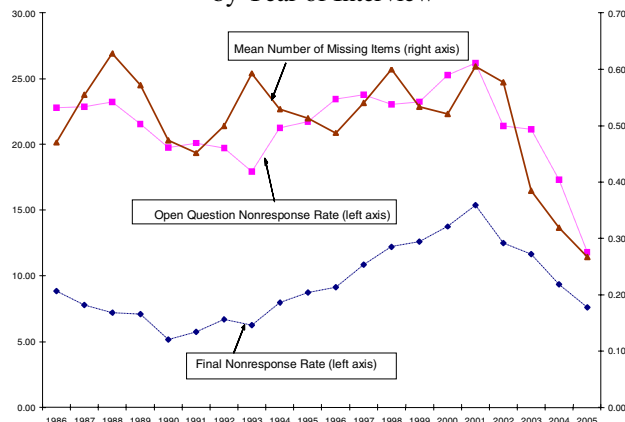
The trends in item nonresponse are not due to design changes, since there has been no change in the survey design over this time period. It is also reasonable to assume that the level of knowledge about family income in the target population remained constant over the years. The only factors that could change over time are the interviewed sample that was recruited and the survey respondents' motivation to respond to survey questions. The interviewed sample may have changed to include more cooperative individuals who were more likely to report their income than in previous years. Respondents' motivation or willingness to report income may have also changed over time.

Figure 1. Plot of Item Nonresponse Rates to Income Questions by Year of Interview



To examine the link between respondents' motivation and income reporting, we counted the total number of items for which each respondent did not provide an answer before he or she was asked the open-ended income question. This index was used as a proxy measure of respondents' overall motivation to answer survey questions. We assume that the lower a respondent's motivation, the higher the number of items with missing data, and the higher the income nonresponse rates. Figure 2 presents the plot of income item nonresponse rates and the mean number of items with missing data. It is apparent from Figure 2 that, the more questions that have missing data, the higher the item nonresponse rate to the income questions. The zero-order correlation between the mean number of missing items and the item nonresponse rate to the open-ended income question is .70 (and the correlation between the same motivation index and final income nonresponse is .20). Thus, a lower motivation is linked with a higher item nonresponse rate.

Figure 2. Plot of Income Item Nonresponse Rates, Mean Number of Items With Missing Data, by Year of Interview



It is important to note that all of the questions included in our proxy measure are administered prior to the income question in the SCA. Since privacy concerns are also a likely driving force behind respondent's motivation to not report income, this finding implies that an important component of our proxy measure for respondent motivation may involve privacy concerns rather than an unwillingness to undertake the effort required to answer the questions.

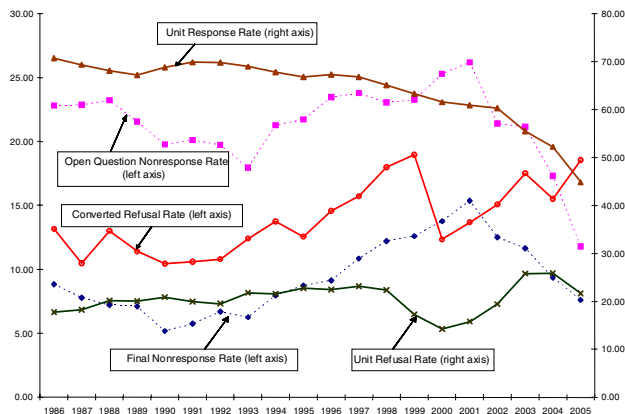
The other major hypothesis involved the relationship between item and unit nonresponse. Figure 3 shows the relationship over time of item nonresponse rates, the unit response rates, the unit refusal rates, and the refusal conversion rate by year of interview. The plot indicates a negative relation between the income nonresponse rates and the unit refusal rate. For instance, when the unit refusal rate was decreasing from 1995 to 2001, the final item nonresponse rate corresponding to the same time period was on the rise. However, from 2001 onwards, the unit refusal rate increased but the final item nonresponse rate dropped.

There also exists a similar negative relation between the unit refusal rate and the initial item nonresponse to the open-ended income question, though to a lesser extent. The relation between income item nonresponse rates and the refusal conversion rate is similar to that between item nonresponse and unit refusal; before 1999, both the item nonresponse and the refusal conversion rates went up. But after 1999, refusal conversion rate first dropped and then went up again after 2001, inversely related to the trend change in item nonresponse. The causal relationship between unit response rate and income item nonresponse rates may reflect a shift in sample composition toward more willing respondents at lower rates which were associated with less item missing data.

Regression models with the item nonresponse rate to the income questions as the dependent variable were used to formally test these links.² Two separate models were constructed for the initial item nonresponse to the open-ended income question and the final item nonresponse. Table 3 displays the unstandardized regression coefficients from the final models. The mean number of items with missing data is shown to be a significant predictor for both types of income nonresponse; when the mean number of missing item increases by one (the actual mean in the samples was .51), the initial income nonresponse rate increases by about 13% and the final nonresponse rate increases about 11%. The significant regression coefficients suggest that income nonresponse rates are driven by respondent motivation more than knowledge problems. Decreasing motivation produces higher income nonresponse.

A time index from 1 to 20 based on the year of the interview is also a significant predictor for income nonresponse rates, but the impact is not large; an increase of one unit in the time index is associated with and less than one-fifth of a percentage point increase in initial income item nonresponse and about two-fifths of a percentage point increase in final income item nonresponse rates. Of course, over the 20 year period, even small changes produce more sizeable changes.

Figure 3. Plot of Income Item Nonresponse Rates, Unit Response Rates, Refusal Rates, And Converted Refusal Rates by Year of Interview



² We started with a fully specified model based on monthly data that included all variables in the final models in addition to eleven dummy variables representing the month of the interview. None of the month dummy variables had a significant main effect. Thus, we removed the month variables and used yearly averages. The final models, as presented in the paper, were the ones with best theoretical explanations and statistical fit.

Table 3. Regression Coefficients from Regression Models at the Aggregate Level

IVs	Regression Coefficients Pr > t		Regression Coefficients Pr > t	
	DV=Nonresponse Rate to Open-ended Question		DV=Final Nonresponse Rate (after bracket question)	
Intercept	1.83	.66	-3.30	0.48
Year of interview	.15	.04	.40	<.0001
Mean number of items with missing data	12.82	<.001	10.35	<.0001
Unit response rate	.20	<.001	.07	<.10
Refusal rate	-.11	<.10	-.21	<.0001
Refusal Conversion Rate	.08	.54	.22	<.01
Model fit	$F(5, 225)=18.92, p<.0001$		$F(5, 225)=54.4, p<.0001$	
R ²	.2960		.5473	

Unit response rate only affects the initial income nonresponse rate; 1% increase in unit response rate leads to .20% increase in item nonresponse rate. The refusal rate and refusal conversion rate, on the other hand, affect the final income nonresponse rate. A 1% increase in refusal rate reduces the final income nonresponse rate by .21%, and a 1% increase in refusal *conversion* rate increases the final income nonresponse rate by .22%. The significant effects of unit response rate, refusal rate, and refusal conversion rate demonstrate that the mix of interviewed sample plays an important role in income nonresponse rates. The monthly sample varies in the proportion of different types of respondents it interviewed and in the level of respondent motivation to answer income questions. Both variations contribute to the trend changes in income item nonresponse, suggesting that our speculations are correct.³

³ We also examined individual propensity to respond to income questions over time. We fit several logistic regression models and selected one that makes most sense theoretically. Consistent with what is found at the

5. Discussion

This paper takes a historical perspective and examines the item nonresponse rate to income questions over time. We found that item nonresponse rates to questions on household income had increased in the 1990s until 2001, when they started to fall. This goes against common expectations for nonresponse trends. Our analysis showed that this post-2001 declines can be explained in part by the increasing refusal rate, inclusion of increased converted refusals in interviewed sample, and a falling unit response rate. Regression models at the aggregate level confirmed that unit response rate is significantly associated with initial income nonresponse and that refusal rate and refusal conversion rate are significant predictors of final income nonresponse, suggesting that the mix of respondents interviewed in each monthly survey has a great impact on the income item nonresponse. In addition, we found that less motivation to answer survey items is linked with increased income nonresponse, suggesting that item nonresponse is driven mostly by motivational factors – including perhaps privacy concerns.

These findings have important implications for overall survey quality as they suggest a trade-off between unit and item nonresponse. Contrary to common beliefs, the level of item nonresponse to questions which are thought to be sensitive and difficult such as questions on household income may decline with higher unit nonresponse. Income nonresponse rates have been falling since 2001 as unit nonresponse rates have risen on the SCA. Even the open-ended income question produced less item nonresponse in the last 5 years or so. Its downward trend is sharper than that of final income nonresponse rate, suggesting that while the unfolding brackets technique is as effective, there is less need to reduce item nonresponse. Given that the administration of every single survey question takes time and adds costs, survey researchers should continue monitoring the effectiveness of bracket questions and make necessary adjustment. Our analysis showed that the return from having unfolding bracket income questions has diminished.

Our findings also suggest that respondent motivation to answer a survey item is a general characteristic of individual respondents rather than an effect of question

aggregate level, respondents are less likely to respond to the income questions when they have more survey questions with missing data. In addition, we found that older people, females, married respondents, less educated respondents, and non-household head respondents are less likely to report income to either the open-ended or the bracket question, which is also again consistent with existing literature on item nonresponse (de Leeuw, 2001).

content or survey context. We found that individuals who did not report income tended to refuse other non-sensitive questions as well. Furthermore, individuals who were converted from initial refusals were also more likely to not report income when they finally participated.

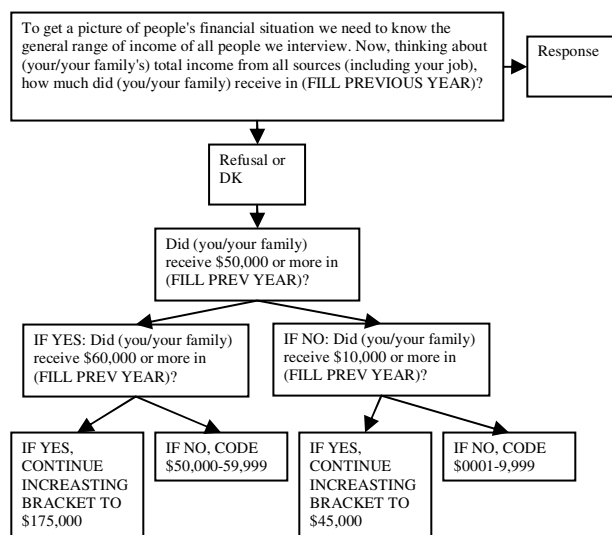
Finally, our findings remind us of the tradeoffs between nonresponse error and measurement error common in survey methodology. Our finding that the increase of unit response rate results in an increase in the initial income item nonresponse suggests that there is a tradeoff between these two facets of survey quality. Similarly, surveys listed in Table 1 generally have a higher unit response rate than the SCA, but they also tend to have a higher item nonresponse rate than the SCA with regard to the income questions. Treating item nonresponse as a manifestation of measurement error, our findings suggest that higher response rate does not necessarily indicate reduced measurement error. Conversely, a lower response rate is not necessarily associated with worse data quality. This is consistent with the findings of Curtin et al., (2000), Keeter et al., (2000), and Merkle & Edelman (2002) on the relation between response rates and data quality.

Our findings also speak to the classical trade-off between survey cost and survey error. The aggregate level regression models showed that the expensive efforts in improving unit response rate, reducing refusal rate, and converting initial refused respondents are not cost effective with respect to income questions, because these costly efforts lead to an increase in item nonresponse (either to the open-ended question or to the bracket question). Therefore, given a limited resource, a survey designer has to consider the impact on all aspects of data quality of spending resource on increasing unit response rate and/or of investing in refusal conversions.

The findings presented here offer another piece of the puzzle of nonresponse. They offer both optimism and caution to survey researchers, showing that low response rates do not necessarily indicate lower quality data, but also that higher response rates do not indicate higher quality data either, at least with respect to item nonresponse to income questions. In addition, the extremely low rates of income nonresponse that we found (as low as 2.4%), and broad fluctuation over time suggest that there is more to understanding nonresponse to sensitive questions. Studies on item nonresponse should not be limited to question items per se. Other design parameters might have an impact too. For instance, survey recruitment protocols affect response rates and refusal rates; as a result, they affect the sample composition and the varying level of motivation among respondents that goes along with that particular composition. These two factors subsequently affect the ultimate response or item nonresponse. Thus, we suggest

that researchers and methodologists continue to explore survey design features that affect item nonresponse.

Exhibit 1. Question wordings and bracketing for the income questions in the SCA



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