The Interaction between Item, Questionnaire and Unit Nonresponse in the German SOEP

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Abstract

This study investigates respondents' behavior on financial items with respect to item nonresponse, questionnaire nonresponse, and panel attrition. We define questionnaire nonresponse as a new category of respondents' behavior. Using financial items from the household questionnaires of the German Socio-Economic Panel (SOEP), we test whether item nonresponse is positively correlated with questionnaire and unit nonresponse, and if questionnaire nonresponse is a predictor for subsequent panel attrition. Second, we test whether these two nonresponse mechanisms may affect studies on item nonresponse due to endogenous sample selection.

In contrast to other studies, we find no evidence for the existence of a cooperation continuum but for a reverse type thereof.

JEL Classifications: C81, I32, C42

1. Introduction: The Nonresponse Problem

The phenomena of unit nonresponse or panel attrition (UNR) and item nonresponse (INR) have been widely studied in the survey literature. Nevertheless, the literature on the interaction of both phenomena is still scarce. This study attempts to fill this gap.

We first examine whether *panel attrition, questionnaire nonresponse,* i.e. respondents selective response to single questionnaires of a multi-questionnaire survey, and *item nonresponse* are positively correlated or driven by a similar decision process. If so, panel attrition may cause endogenous sample selection with respect to item nonresponse. Hence, studies on determinants of

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item nonresponse using panel data are likely to be biased. Detecting such bias is our second research aim.

This article makes a variety of contributions to the literature: It examines a broad set of financial, i.e. income and wealth, items from the German Socio-Economic Panel (SOEP). We show that the existing theory of a latent cooperation continuum may not hold in general. Besides panel attrition, we examine for the first time respondents' behavior with respect to a separate wealth questionnaire in a multi-questionnaire survey, which we name "questionnaire nonresponse" (QNR). In addition, we provide some evidence that sample selection may lead to biased results in item nonresponse analyses.

The paper is organized as follows. To explain nonresponse interaction, the theory of a latent cooperation continuum is reviewed briefly and previous findings of such studies are summarized in Section 2. The research hypotheses, the empirical strategy and our data are described in Section 3. Section 4 presents and discusses our empirical findings, while the last section summarizes and concludes.

2. Theoretical Issues of Nonresponse

Types of nonresponse in panel data

Unit nonresponse (UNR) or panel attrition describes the drop-out of a household or person from the respondents group. *Item nonresponse (INR)* is an interview participant's refusal to answer a specific question. *Questionnaire nonresponse (QNR)* may only occur in surveys which consist of several separate questionnaires. The respondent or household takes part in the interview, but completely refuses to fill in a whole special-topic questionnaire. This type of nonresponse has – to our knowledge – not yet been analyzed in the nonresponse literature.

Relationship of Item and Unit Nonresponse

The literature provides scanty evidence on the relationship between item and unit nonresponse. It is frequently hypothesized that both types of nonresponse result from the same decision process, which is driven by the interest, motivation, and ability of the respondent (cf., Loosveldt et al. 2002, 546). Some panel studies observe the joint decline of item and unit nonresponse rates over time (cf., e.g., van den Eeden 2002). This may be explained by the self-selection of respondents and supports the aforementioned hypothesis.

Burton et al. (1999) formalized this idea by placing potential survey respondents on a latent cooperation continuum[2] of positive correlations of item and

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[2] The cooperation continuum spans the categories from "will always take part and answer any question" over "hard to persuade and will refuse a lot" to "will never take part".

unit nonresponse probabilities: people with a high willingness to participate are also likely to respond, and vice versa. In the course of time, respondents may move along this continuum. Together with Burton et al. (1999), empirical evidence for this hypothesis is provided by Loosveldt et al. (2002) who found that item nonresponse on difficult questions in the first panel wave significantly raises the refusal probability in the second wave of the Belgian General Election Study. Schräpler (2003a) finds a small but significant negative correlation between refusing the gross income statement and participation in the next wave of the SOEP over the first twelve years, and Frick & Grabka (2005) also find a positive correlation between item nonresponse in an aggregated measure of "total income" and subsequent attrition from SOEP.

Empirical evidence not supporting the cooperation continuum hypothesis above is provided by Dolton et al. (1998), who found that the item nonresponse rate and interview duration do not have explanatory power for panel attrition, not even in the first wave of the panel. Van den Eeden (2002) concedes that item nonresponse as a proxy for motivation has only extremely low explanatory power in a regression of unit nonresponse.

With respect to our findings below, we introduce the idea that cooperation behavior can in principle also be the reverse: People may have a high probability to take part in an interview because they know that they are unlikely to provide certain answers, and vice versa. We label this phenomenon "reverse cooperation continuum", i.e. a negative correlation of the unobserved *a priori* probabilities of unit and item nonresponse[3].

Besides the cooperation continuum we take into account other possible determinants of nonresponse that may result from the characteristics of the respondent and the interviewer as well as from the interview situation and which are extensively discussed in the nonresponse literature[4].

3. Empirical Approach

Our first research hypothesis is that the theory of a latent cooperation continuum holds and that item and unit nonresponse are positively correlated. Item nonresponse should be a precursor of panel attrition, and in the year before drop-out attriters should have higher INR-propensities than stayers. Therefore, we test whether the INR rate for attriters is significantly higher than the INR rate for stayers, using a simple t-test. Our item nonresponse rate is calculated using the INR information on 12 income-related items from the

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[3] A more thorough discussion of rationales for reverse cooperation can be found in Serfling (2004).

[4] See, e.g., Schräpler (2003b) and the sources cited there for a careful discussion of nonresponse mechanisms.

household questionnaire which typically suffer from INR[5]. Since not all income items in a questionnaire are applicable to each respondent, the number of relevant questions varies across respondents[6]. Second, therefore, we apply the same test procedure on the question level, hoping to identify those items for which nonresponse is positively correlated with subsequent attrition. In a third step, we regress the unit nonresponse indicator on last year's item nonresponse rate, using a logit approach, and test for sign and significance of its marginal effect. We use a broad set of potential determinants of panel attrition behavior, in order to reduce the heterogeneity in our data and to control for other possible determinants of nonresponse.

Our second hypothesis applies the cooperation continuum logic to the case of questionnaire nonresponse. We hypothesize that QNR is an intermediate category between INR and UNR, indicating a cooperation level lower than INR but higher than UNR. Therefore, INR should be a precursor of QNR, and QNR itself should be a precursor of subsequent UNR. We test this hypothesis using the test procedure described above.

Our third hypothesis is that unit- and questionnaire nonresponse may lead to endogenous selected samples, which may cause biased estimates in INR-regressions. We apply a Heckman-type bivariate probit selection model (see van den Veen and van den Praag 1981). This model consists of two estimation equations: (1) the INR specification equation[7]:

$$(1) \qquad\qquad INR_{i,t} = \begin{cases} 1 & \text{if } y^*_{i,t} < 0 \\ 0 & \text{otherwise} \end{cases}$$

$$\text{with: } y^*_{i,t} = \alpha + X_{i,t}\,\beta + \mu_{i,t}$$

and (2) a selection equation[8]:

$$(2) \qquad\qquad UR_{i,t} = (\gamma + Z_{i,t-1}\delta + \eta_{i,t} \geq 0)$$

which determines whether the individual is observed at time t (unit responded: $UR_{i,t} = 1$). The regressors $Z = (X, W)'$ of the selection equation consist of the regressors of the specification equation X and additional regressors W which have explanatory power for unit nonresponse without affecting item non-

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[5] The items are presented along with the results in Table 1.

[6] Nevertheless, the person-specific INR rate is standardized to the number of applicable questions.

[7] With α being the constant, $X_{i,t}$ are the explanatory variables for individual i in period t, β is the vector of regression coefficients and $\mu_{i,t}$ the error term of the specification equation.

[8] Here, γ is the constant, δ the coefficient vector and $\eta_{i,t}$ is the error term of the selection model.

response and thus being instruments for panel attrition. Furthermore, it is assumed that the error terms μ and η are bivariately standard normally distributed with correlation ρ. A self-selection bias exists if the error terms are correlated ($\rho \neq 0$). The significance of ρ is tested using a likelihood ratio test.

Data and Sampling

In this study we are mainly interested in questions of income and wealth, since these are relevant for many economic research questions and typically affected by nonresponse. Hence, we use data from the 1988 wave as well as from the previous and following survey waves of the SOEP household questionnaires. In the 1988 panel wave, the special topical module covered wealth, and was designed as a separate household questionnaire. To circumvent language problems, we restrict our sample to German households from the representative subsample of the native German population (SOEP sample "A") who participated in the 1987 survey. This sample includes 3,394 households in 1987 and is reduced to 3,308 participating households in 1989 due to panel attrition, including losses due to death, emigration, and household dissolution. Second, we restrict our sample to face-to-face interviews since this mode is used in the majority of cases (68 to 77 percent) and permits us to control for interviewer effects while omitting mode effects[9]. Finally, the sample had to be restricted to observations where the same person answered the household questionnaire in two subsequent waves[10]. Due to all these restrictions, the number of analyzable households declines by about one-third. Additionally we use data from the supplemental interviewer dataset to measure interviewer and interaction effects. The unit nonresponse indicator (UNR) is coded 1 if the participating household dropped out after the wave considered. The questionnaire nonresponse indicator (QNR) is coded 1 for households that completed the 1988 household questionnaire but refused to fill in the wealth questionnaire in that same year. Item nonresponse (INR) is coded 1 if an answer to an applicable item was denied[11]. For the analysis of item nonresponse in the wealth questionnaire, we constructed three wealth categories: "property", "savings" and "total household wealth", which consist of up to four items each in the wealth questionnaire[12].

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[9] Even if face-to-face is the standard interview mode in SOEP, we have to concede that respondents with lower willingness to cooperate may have opted for paper and pencil interviews.

[10] It is assumed that continuity of the head of household is uncorrelated with response behaviour.

[11] In the wealth questionnaire of 1988 the option to answer "don't know" was provided. We treat this category as a valid response.

[12] For a more careful discussion on the problems of using wealth items instead, see Serfling (2004).

4. Empirical Analysis of Nonresponse Interaction

Item nonresponse as a precursor of panel attrition

Row 1 of Table 1 gives the difference between the item nonresponse rates of subsequent attriters and stayers in 1987 (column 1) and 1988 (column 2), respectively. The *t*-test results show that the null hypothesis (the difference in the mean INR rates for stayers and attriters is zero) cannot be rejected. Looking at the question-specific INR rate, only for two items in 1987 are differences significantly different from zero and thus confirm our hypothesis: e.g. the nonresponse rate on the special welfare benefits item was 50 percentage points higher for subsequent attriters than for stayers. The same holds for maintenance expenditures on property, even though with a smaller difference and at a lower significance level. In 1988, none of the item-specific INR rates were significantly different for attriters and stayers (column 2). In the wealth questionnaire, item nonresponse among subsequent attriters was 40.9 percentage points higher for the item "stocks and bonds" and 1.4 percentage points for "total household wealth". So far, we have found no clear evidence supporting the first hypothesis of a cooperation continuum.

With respect to the correlation between INR and QNR it is obvious that it points in the opposite direction than hypothesized: The person-specific item nonresponse rate for questionnaire nonrespondents is 3 percentage points lower than for questionnaire respondents (Table 1, column 3, row 1). Only those refusing to answer the net household income question seem to be more likely to opt for QNR.

Against the results presented above, it may be argued that unit nonresponse is also affected by other determinants than the INR propensity. We therefore reduce the heterogeneity in attrition behavior by controlling for respondent, interviewer and situation characteristics, as well as their interactions, and additionally for the duration of the conducted interview. The marginal effects of the logit regressions are presented in Table 2.

To verify our cooperation continuum hypothesis, we have to check whether the INR rate is significant positively correlated with UNR, when controlling for the above-mentioned covariates. In columns 1 and 2, the INR rate of the interviews in 1987 and 1988 is negatively correlated with subsequent UNR, which is contradictory to our hypothesis. We concede that the coefficient, and thus the marginal effect, is not precisely estimated, such that the null hypothesis of INR rate and UNR being uncorrelated cannot be rejected. However, this does not support the cooperation continuum hypothesis either, since it predicts a positive correlation. In the UNR model specification of column 2, we have also used the QNR indicator as explanatory variable to test our second hypothesis. Even if the effect of questionnaire nonresponse is estimated to be positive, we cannot reject the hypothesis that QNR in 1988 and UNR after 1988

Table 1

**Differences in Current Item Nonresponse Rates
for Subsequent Attriters and Stayers**

Item	(1) INR 1987, UNR 1988			(2) INR 1988, UNR 1989		(3) NR 1988, QNR 1988		
	Mean diff.	t	# of cases	Mean diff.	t	Mean diff.	t	# of cases
person-specific INR rate in Household Questionnaire	−0.008	−0.5	2459	0.012	0.8	0.030	2.8***	2353
Item specific: Household Questionnaire								
Welfare benefits[1]	0.002	0.3	2252	0.002	0.3*	0.006	0.3	2126
General welfare benefits[2]	0.016	0.2	61	0.096	0.5	0.094	–	54
Special welfare benefits[2]	−0.500	−7.6***	61	0.096	0.5	0.094	–	54
Child benefits[1]	0.006	0.5	1439	0.003	0.3	0.003	0.3	1391
Child benefits[2]	0.004	0.1	813	0.003	0.1	0.003	0.3	735
Rental or lease incomes[1]	0.007	0.5	2252	0.003	0.3	0.003	0.4	2126
Rental or lease incomes[2]	0.012	0.2	255	0.022	–	0.023	0.4	273
Maintenance exp. on property[2][3]	−0.425	−2.2**	255	0.136	–	0.140	1.1	273
Annuity and interest payments[2][3]	−0.188	−0.6	255	0.331	–	−0.047	−0.3	273
Interest payments[2][3]	−0.148	−0.4	255	0.368	–	−0.009	−0.1	273
Interest and dividend income[3]	−0.074	−1.0	1674	−0.013	−0.2	0.066	1.3	1615
Monthly household net income[2]	0.033	1.1	2252	−0.004	−0.1	−0.142	−6.7***	2126
Item specific: Wealth Questionnaire								
Ownership of occupied flat or home: rateable value				0.012	0.4			902
Ownership of occupied flat or home: market value				0.005	0.2			902
Property				–	–			268
Farm				0.184	–			50
Equity in a business				−0.265	−0.9			134
Savings account				0.034	1.0			1770
Home loan savings certificates (*Bausparvertrag*)				−0.027	0.2			817
Stocks and bonds				−0.409	−1.7*			562
Life Insurance: Originally insured amount				0.011	0.4			1124
Life Insurance: Current monthly payment				0.029	0.6			1124
Household debt				0.013	0.3			640
Total household wealth				−0.014	0.7*			2072
Inheritances since 1960				0.064	0.4			331

Notes: Possible answers:[1] yes / no; [2] amount; [3] last year (retrospective question).
Significance levels: * 10%, ** 5%, *** 1%.

Source: Authors' calculations based on SOEP waves 1987 and 1988.

Table 2

Determinants of Unit and Questionnaire Nonresponse
(marginal effects of logit regression)

Explanatory variables:	(1) Participation in 1987, UNR in 1988		(2) Participation in 1988, UNR in 1989		(3) QNR in wealth questionnaire in 1988	
	ME	t	ME	t	ME	t
Item nonresponse rate	−0.067	−0.39	−0.674	−1.41	−1.284	−2.84***
QNR in 1988			0.112	0.64		
Sex						
R female I male	0.060	0.98	−0.172	−1.92**	0.084	1.77*
R male I female	0.107	1.51	0.002	0.03	0.096	2.00**
R female I female	0.048	0.71	−0.099	−1.10	0.099	1.88*
Age						
R age	0.000	0.17	0.002	0.50	0.003	0.99
age difference: R − I	0.001	0.84	0.001	0.39	0.000	0.00
Employment status						
R part time employed	−0.002	−0.02	0.067	0.35	−0.025	−0.35
R not employed	0.021	0.34	0.170	1.37	−0.090	−1.99**
I part time employed	−0.016	−0.36	0.040	0.39	−0.055	−0.78
I not employed	−0.049	−0.95	−0.054	−0.57	−0.098	−1.79*
same employment status	0.026	0.57	0.121	1.59	−0.026	−0.63
Schooling						
R medium level schooling	−0.056	−1.36	−0.069	−0.8	−0.087	−1.20
R high schooling	−0.065	−1.45	−0.198	−1.68*	0.063	1.44
I medium level schooling	0.018	0.35	−0.035	−0.41	0.059	1.08
I high schooling	−0.029	−0.52	−0.087	−0.80	−0.017	−0.26
same schooling	−0.026	−0.53	−0.108	−1.21	0.097	2.06**
Situation Effects						
Change of I	0.007	0.12	−0.103	−0.85	−0.062	−0.76
R public sector employee	−0.052	−0.77	0.221	2.18**	−0.139	−1.66*
Self administered survey	−0.027	−0.35	−0.192	−1.19	0.011	0.23
HH in small town	−0.004	−0.10	−0.061	−0.88	0.024	0.55
R's household size	−0.080	−3.04***	−0.119	−3.18***	0.037	2.31**
Number of I contacts	−0.021	−1.37	0.038	1.86*	0.023	1.80*
R living in high-rise buildings	−0.013	−0.33	0.127	1.79*	0.056	1.22
R living in residential area	−0.054	−1.51	0.111	1.32	0.010	0.24
interview duration (min.)	0.002	0.89	0.002	0.52	−0.002	−0.89
Constant (coefficient)	−2.591	−1.44	−4.932	−2.86**	−5.871	−4.49***
No. of obs.	2172		2107		2107	
Pseudo R^2	0.17		0.16		0.10	
Log Likelihood	−130.6		−138.9		−228.04	
LR-Test (df)	55.30 (25)		53.6 (26)		53.5 (25)	
$P > \text{chi}^2$	0.00		0.00		0.00	

Notes: Significance levels: * 10%, ** 5%, *** 1%.
I: interviewer; R: respondent; HH: household; ME: marginal effects.
It should be noted that explanatory variables for the model presented in column 3 are taken from the same year 1988, while those for columns 1 and 2 are taken from the base year.

Source: Authors' calculations based on SOEP waves 1987 and 1988.

are uncorrelated. Robustness checks[13] showed that the effects of the INR rate and QNR indicator that were identified remained unaffected with respect to magnitude and significance if only one of them was used in the model specification.

In column 3 of Table 2, the results of a regression of the QNR indicator on our set of possible determinants are presented. Here, the INR rate, derived from the household questionnaire in the same interview, has a highly significant negative effect on questionnaire nonresponse. This is unambiguous evidence against the cooperation continuum and affirms the results from our sample t-tests provided in Table 1 above.

With regard to the effects of control variables, we find only household size having a negative significant effect on unit nonresponse in both years, but having a positive significant effect on questionnaire nonresponse in 1988. The effects of other controls suffer mostly under imprecise estimates and are often insignificant. Nonetheless, our models have significant explanatory power for UNR and QNR as indicated by McFadden's pseudo R^2 statistic and the likelihood ratio test as given at the bottom of Table 2.

Sample selection due to attrition and questionnaire nonresponse

Addressing our third hypothesis, we estimate Heckman-type bivariate probit models for the occurrence of item nonresponse on several financial items and test for correlation in the error terms of the selection and specification equation as described in Section 3[14]. The specification equation describes the potential determinants of item nonresponse. As regressors, we use sex and age of interviewer and respondent as well as interactions thereof, situation effects such as self-administered survey and household size, the employment status and schooling degree of the respondent. The variables "number of interviewer contacts before first successful interview", "household living in a residential area" (in contrast to living in the country or an industrial area) and "type of building the household lives in" (high-rise building or not) are used as instruments for the selection equation, since they have some explanatory power for UNR without affecting INR results.

The results indicate a sample selection bias for the items in the wealth questionnaire, but not for the repeating part of the household questionnaire. When all applicable financial items were pooled, we derived a correlation coefficient ρ of –0.36 (std. err: 0.35) in the 1988 and of 0.02 (std. err: 0.92) in the 1989 household questionnaire. For both coefficients the null hypothesis of being zero could not be rejected at any level of significance. When it comes to the

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[13] These results are not provided here, but available from the author upon request.

[14] These results are not provided here due to space restrictions. For a complete table of results see Serfling (2004): Table 4, p. 26.

item "total wealth of household" in the wealth questionnaire, we derived a positive correlation of 0.85 (std. err.: 0.18), which is significantly different from zero at the 95 percent level of confidence. This indicates endogenous sample selection and therefore biased estimates in INR regressions if panel attrition and questionnaire nonresponse is neglected.

5. Summary and Conclusion

The literature focusing on the interactions among nonresponse types is scarce and partly ambiguous. We introduce the nonresponse category QNR, the refusal of a mono-thematic questionnaire in a multi-questionnaire survey, and assume this to be an intermediate category between INR and UNR. We contribute to the literature by providing empirical evidence for: (1) the correlation of item and unit nonresponse, (2) the correlation of item and questionnaire nonresponse, (3) the correlation of questionnaire and unit nonresponse and (4) sample selection with respect to item nonresponse due to panel attrition and questionnaire nonresponse. First, we tested whether the prediction of the cooperation continuum hypothesis introduced by Burton et al. (1999) holds for the SOEP waves 1987 – 1989.

In summary, we do not find evidence for positive correlations of INR and UNR, INR and QNR, and QNR and UNR. Instead we find slightly negative correlations of the INR rate with subsequent UNR. When it comes to questionnaire nonresponse, we find a significant negative correlation with item nonresponse. This leads to the conclusion that the cooperation continuum can also in principle be reverse. People are willing to fill in the special topics questionnaire because they know they are not going to provide certain answers. These results are derived from univariate statistics as well as from multivariate regressions.

Second, we tried to identify sample selection bias due to panel attrition in the results of INR regressions. We find that the items in the repeating household questionnaire are unaffected by panel attrition. The wealth questionnaire is the subject of two possible biasing sample selection processes: panel attrition and questionnaire nonresponse. Hence, we identify a bias in the estimates of item nonresponse on the total household wealth question.

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