The interaction between unit and item nonresponse in view of the reverse cooperation continuum

Evidence from the German Socioeconomic Panel (GSOEP)

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Abstract

The paper addresses two questions. First, is item nonresponse (INR) a precursor of panel attrition (UNR), as predicted by the theory of a latent cooperation continuum, or is the interrelation of another type? Second, are the results in models of item nonresponse behavior affected by a selectivity bias due to panel attrition?

We test the hypothesis of a latent cooperation continuum with data taken from the German Socio-Economic Panel (GSOEP) - and can not find evidence for it.
In contrast, we hypothesize that the relationship of both nonresponse types may be inverse in principle (the *reverse cooperation continuum*) and both types of cooperation may coexist.
Besides unit nonresponse we analyze questionnaire nonresponse, i.e. participating but refusing a whole questionnaire with specific items in a multi-questionnaire survey.
We find evidence for negative correlation of INR with questionnaire nonresponse. The correlation between item and unit nonresponse is inverse U-shaped which supports the hypothesis of coexistence of both types of cooperation.

Addressing the second question we test whether panel attrition causes endogenous sample selection in regressions of INR by means of a bivariate probit model for selection correction. Additionally we use Monte Carlo simulations to test the influence of alternative assumptions for INR-behavior of attriters. The results show that attrition bias is item-specific. Existence and magnitude of the bias differs with the analyzed subsample.

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1 Introduction: The nonresponse problem

Survey data from household panels form the basis of many empirical studies on income and wealth. Since results of empirical studies will likely be sensitive with regard to the representativeness of the used dataset, it is worth investigating the data collection process with respect to respondents' behavior. Even though the phenomenon of unit nonresponse (UNR) is widely researched and the determinants of item nonresponse (INR) are investigated by a growing number of studies, the interaction of unit and item nonresponse and its problems have been widely neglected. This study attempts to fill this gap.

We examine, whether panel attrition and item nonresponse are correlated or driven by a similar decision process. If so, panel attrition may cause endogenous sample selection with respect to item nonresponse. Selective attrition may cumulate over subsequent panel waves[2]. Hence, studies on determinants of item nonresponse using panel data are likely to be biased. Detecting such bias is our second research aim.

The analysis of the relationship between both types of nonresponse may on the one hand permit the development of techniques to reduce item and unit nonresponse. On the other hand our results may improve researchers' ability to deal with the nonresponse problem in their own analyses.

This paper adds to the literature in various ways: It examines a broad variety of financial questions of the German Socio-Economic Panel (GSOEP). It advances the existing theory of a latent cooperation continuum by setting up and testing the hypothesis of a reverse cooperation continuum. Besides panel attrition, we examine for the first time respondents' behavior with respect to a separate wealth questionnaire in a multi-questionnaire survey, which is named "questionnaire nonresponse" (QNR).

[2] Rendtel (1989) illustrates this effect with an income example: If the attrition rate of households with low income is 10% higher than for others, nearly 30% more of the low income households than other households

The richness of our data permits us to control for effects of socio-demographic characteristics of respondents and interviewers, interactions thereof, and the interview situation. In addition, we provide rough evidence that sample selection may lead to biased results in item nonresponse analyses.

The paper is organized as follows: To explain nonresponse phenomena the cognitive-psychological literature as well as rational choice theory is briefly reviewed. We discuss the theory of a latent cooperation continuum and motivate the hypothesis of reverse cooperation continuum. Previous findings of studies on nonresponse-interrelation are summarized. The empirical strategy of this paper is presented in section three. In the fourth section data and sampling criteria are described. The study proceeds by empirically addressing the two research questions. Univariate descriptive statistics as well as multivariate regressions to provide evidence on the effect of INR on UNR. To identify selective attrition bias, a Heckman-type bivariate probit is used, instrumented with characteristics from last year's interview. To gain additional evidence for cases where the probit could not be estimated, we provide Monte Carlo simulations for different assumptions on item nonresponse behavior of panel attriters. The last section summarizes.

2 Towards a Theory of Nonresponse

Many studies on unit and item nonresponse are descriptive and are criticized for their lack of theory. Although a large and interdisciplinary theoretical effort in psychology and sociology has been made, a unique theory of "survey questioning" still does not exist (cf. Schnell, Hill, Esser 1995). In the following we define the types of nonresponse, review the two prominent theoretical frameworks for the explanation of respondent behavior and the literature addressing the interrelation of unit and item nonresponse. We conclude this section by proposing our research hypotheses.

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would have quitted the panel until wave 4. It is evident that such an selectivity process is non-ignorable and

2.1 Types of nonresponse in panel data

We define three types of nonresponse for the following study: Unit Nonresponse (UNR) describes the drop-out of a household or person from the respondents group[3]. Item Nonresponse (INR) describes the fact that a respondent is taking part in the interview, but refuses to answer a specific question Questionnaire Nonresponse (QNR) occurs in surveys which consist of several separate questionnaires. The respondent or household takes part in the interview, but refuses to fill in a whole special topics questionnaire. This type of nonresponse has - to our knowledge - not been analyzed by the nonresponse literature, since it could only occur in surveys with different mono-thematic questionnaires. We hypothesize that QNR is an intermediate category between item and unit nonresponse.

2.2 Determinants of nonresponse

The cognitive model of respondent behavior extends prior psychological models of thought processes (cf. Lachman et al. 1979) and structures the question-answering process, by defining the tasks a respondent has to do before providing an answer[4] (cf. Sudman et al. 1996). Rational choice theory assumes that a respondent evaluates his response alternatives and accounts for the expected costs and benefits of his possible actions. Then he opts for the alternative with the highest subjective expected utility (cf. Esser 1986).

By broadening the definitions of costs and benefits, the cognitive model can be integrated into rational choice framework, if we assume that people with cognitive difficulties will have larger expenses to answer a given question(naire), or that items / questionnaires with high cognitive effort will involve higher costs for respondents with given cognitive ability. This mechanism may have relevance for item, questionnaire and unit nonresponse[5].

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leads to biased results of income estimations.

[3] In contrast to initial unit nonresponse it is prerequisite that the respondent has participated in at least one interview. This is also called "panel attrition" in the survey literature.

[4] After having heard or read a question the respondent must interpret it, recognize the issue addressed, putting the meaning of the question in the context of the interview, gather the information needed to give an appropriate answer, taking subjective motives like self representation or social desirability into account and modify the "true" answer and communicate the so derived information to the interviewer.

Even if most of the hypothesized determinants are unobservable, the nonresponse literature has shown that nonresponse can be partly explained by observable proxies such as the interview situation characteristics, the personal characteristics of respondents and interviewers, as well as the interactions thereof (see e.g. Groves 1989).

2.3 Relationship of Item and Unit Nonresponse

2.3.1 Cooperation Continuum

In the literature evidence on the relationship between item and unit nonresponse is scarce. It is often hypothesized that both types of nonresponse result from the same decision process, which is driven by interest, motivation and ability of the respondent (cf. Loosveldt et al. 2002: pp. 546). Some panel studies observe the joint decline of item and unit nonresponse rates over time (see e.g. Van den Eeden 2002). This finding may be explained by self-selection of respondents: over time only the motivated respondents stay in the group of panel participants and they have low item nonresponse propensities.

Burton et al. (1999) formulated the idea that potential survey respondents can be placed on, and move along, a cooperation continuum[6] of item and unit nonresponse probabilities correlations. The authors support the conclusion that people with high willingness to participate are also likely to respond - and vice versa - with empirical evidence from the British Household Panel Study (BHPS): respondents with no missing data on key variables were also very likely to complete a full interview in the next wave. Panel attriters had higher item nonresponse in the prewave. Intermittent respondents, i.e. respondents who suspended at least one previous interview, had higher item nonresponse than regular panel participants. Additionally, the conversion of initial attriters led to higher item nonresponse rates of these persons.

[6] 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".

Summing up, the theory of the cooperation continuum suggests a positive correlation of unobservable *a priori* probabilities of INR and UNR, which is depicted in Figure 1. Empirical evidence for this is provided by several studies: Loosveldt et al. (2002) find, 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 (2003b) finds a small but significant negative correlation between refusing the gross income statement and participation in the next wave of German Socio-Economic Panel (GSOEP) over the first twelve years.

2.3.2 Reverse cooperation continuum

On the other hand, there also exists empirical evidence not supporting the cooperation continuum hypothesis. Dolton et al. (1998) found that 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) tests whether both UNR and INR result from the lack of respondents' motivation with data from the first seven waves of the Longitudinal Aging Study of Amsterdam (LASA). The item nonresponse rate as predictor for motivation has only extremely low explanatory power in a regression of unit nonresponse, and so the hypothesis must be rejected.

Contrary to the theory of the cooperation continuum we would like to introduce the idea that the correlation of INR and UNR probabilities can in principle also be reverse (see Figure 1): people may have a high probability to take part in an interview but are unlikely to provide answers if they participate 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.

In this framework, respondents are only willing to take part in the interview, because they know that they are not willing to answer. This behavior may be rational in the sense of a cost-benefit calculus: In many panel survey studies participation is appreciated with a small gift,

which will be provided at the end of the interview, independent of how many questions were answered. So it may be possible to take part in the interview to get the gift and to use item nonresponse as a strategy to minimize subjective expected costs of answering questions (low P(UNR) with high P(INR), see the bold faced line in Figure 1). On the upper part of the reverse cooperation continuum people are very conscientious and willing to answer every question posed, but since they don't know if they are able to provide an exact answer to every question they are likely to refuse participation (high P(UNR) with low P(INR))[7]. In the framework of the reverse cooperation continuum refusals should have lower item nonresponse rates in the year before dropping out than in the framework of the cooperation continuum.

2.3.3 Simultaneity of both cooperation types

If both types of respondents, cooperators and reverse cooperators, appear in a panel sample, the INR-propensity as a predictor of UNR will reflect two opposing mechanisms. In a linear model its coefficient may be zero or insignificant, as in the studies cited above. Since it is not very likely to observe respondents with high a priori unit nonresponse probability in a panel study, only the lower part of the lines in Figure 1 is likely to be observable. This inverse U-shaped pattern of the interactions between unit and item nonresponse can empirically be approximated by an second order polynomial of the INR propensity in a model of UNR (see Figure 1).

2.4 Hypotheses

To investigate the relationship between item nonresponse and unit nonresponse probabilities, we formulate four hypotheses which we test below:

First, item nonresponse is a precursor of panel attrition, and in the year before drop-out attriters have higher INR-rates than stayers, as predicted by the theory of the cooperation

[7] This low INR-probability stays unobserved if the respondent decides (with utmost probability) to refuse the interview.

continuum. Second, respondents behave according to the reverse cooperation continuum, and attriters have lower item nonresponse rates in the year before unit nonresponse, than stayers. Third, both types of respondents exist in the panel: one "cooperation continuum type" and one "reverse cooperation continuum type". Either effects of INR on UNR are cancelled, or the effect of one type predominates. Fourth, with respect to our second research question, we hypothesize that UNR and QNR bias the results of INR-analyses due to self-selection of panel participants.

3 Empirical Approach

To address the first and second hypothesis, a three-step descriptive approach is chosen: First, we look at differences in the item nonresponse propensities in period t-1 for stayers and attriters of period t. To obtain a measure of the INR-propensity we apply the item nonresponse rate for income-related items which typically suffer from INR. Since not all income items in a questionnaire are applicable to each respondent, i.e. a pensioner does not have to answer the "wage" question, we computed the person-specific item non-repsonse rate as the share of refused questions out of the number of questions applicable to that person. Using a simple t-test, we test for equality in means of this INR-rate for stayers and attriters.

Since the number of questions varies across respondents this may bias the outcomes of the above analysis. So, we ask in a second step whether the relation of item and unit nonresponse varies across questions and look at questions-specific INR-rates. Again, we apply t-tests for the equality in mean item nonresponse rates for each income and wealth question for stayers and attriters.

In a third step, we regress a unit nonresponse indicator on last year's item nonresponse rate and test for sign and significance of its coefficient. We use several sets of potential determinants of panel attrition behavior, to reduce the heterogeneity in our data. Based on rational choice theory, we assume that an individual attrits from the sample if the expected

costs of participation exceed the expected utility. The dichotomous outcome of the UNR-indicator is estimated using a logit approach. To test our third hypothesis, we regress UNR on the INR-rate and its square. Hypothesizing an inverse U-shaped relationship between INR and UNR, we expect the linear effect to be positive with a negative quadratic effect. To test the fourth hypothesis, the influence of sample selection on the results of an INR-analysis, we use a bivariate probit selection model which is illustrated next.

Applying standard estimation methods to non-randomly selected samples leads to biased coefficients if the expectation of the error term is nonzero and dependent on a selectivity process that is correlated with the regressors of interest. Heckman (1979) introduces a two-stage estimator that allows to consistently estimate behavioral functions based on nonrandomly drawn samples with a least squares method, imposing distributional assumptions on the error term structure. This approach was applied to dichotomous dependent variables by Van den Veen and Van Praag (1981). They introduced a bivariate probit estimator to obtain unbiased coefficient estimates for selective samples. This bivariate probit model consists of two estimation equations. First, a specification equation with the function of interest, here: the probability of item nonresponse. Second, a selection equation, which determines the probability of observing an observation's outcome in the specification equation. The structural threshold for the dichotomous outcome can be written:

$$INR_{i,t} = \begin{cases} 1 \text{ if } y_{i,t}^* < 0 \\ 0 \text{ otherwise} \end{cases} \qquad (3.2.1)$$

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

where α is 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.

Item nonresponse ($INR_{i,t}$=1) of respondent i at time t occurs if the unobserved subjective expected utility of answering a question ($y_{i,t}^*$) is negative. The opposite applies to the selection equation, which shortly can be written as:

$$UR_{i,t} = (\gamma + Z_{i,t-1}\,\delta + \eta_{i,t} \geq 0) \qquad (3.2.2)$$

where γ is the constant, δ the coefficient vector and $\eta_{i,t}$ is the error term of the selection model. This equation determines whether the individual is observed at time t (unit responded: $UR_{i,t}=1$) or dropped out of the sample (unit nonresponse: $UR_{i,t}=0$). Following the rational choice framework, the respondent will stay in the sample if the unobserved subjective utility is positive or zero and drop out if it is negative.

The regressors of the selection equation Z=(X,W)' consist of the regressors of the specification equation X and additional regressors W which have explanatory power for unit nonresponse without affecting item nonresponse 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.

$$\begin{pmatrix} \mu_t \\ \eta_t \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right) \qquad (3.2.3)$$

As Heckman (1979) has shown, 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, after the maximum-likelihood estimation of the bivariate probit model.

To investigate the magnitude of the attrition bias we finally compare our estimation results for the determinants of item nonresponse derived from the bivariate probit approach with those obtained when ignoring panel attrition.

Since in some cases the likelihood function did not converge - possibly due to the small number of cases - we simulate INR outcomes for attriters and compare the results of estimations with the simulated data with estimations ignoring panel attrition to obtain a rough measure of the possible impact of attrition on INR-results.

First, we estimate the INR equation (3.2.1) in a "worst case" and a "best case" scenario by univariate probit, and test if the coefficient vectors differ from an estimation ignoring panel attrition. In the "best case" scenario, all attriters are assumed to have responded to the relevant

item in the following wave: $P(INR_{i,t} \mid UNR_{i,t}=1) = 0$. For the "worst case" we assume that all attriters did not respond to an item: $P(INR_{i,t} \mid UNR_{i,t}=1) = 1$. Using a Hausman-test, it is tested whether the obtained parameter vectors are equal to the parameter vector of a regression ignoring panel attriters. Rejection of both tests could be interpreted as strong evidence for the biasing effect of INR behavior of attriters on the results of the INR regression.

Second, we use Monte-Carlo simulations where the dichotomous outcome of INR for attriters is drawn from a Bernoulli distribution, where INR=1 occurs with probability p and INR=0 with (1-p). For this INR-probability we use the weighted (w) individually realized INR-rate from previous wave:

$$p = P(INR_{i,t} \mid UNR_{i,t}=1) = w * \text{INR-rate}_{i,t-1} \qquad (3.2.4)$$

In three scenarios we choose different weights for w = 0.5, 1, and 2, to check for the sensitivity of the results with respect to the underlying INR-assumption for the attriters. For each scenario, observations for attriters were simulated and the INR-model was estimated 100 times. Using a Hausman-Test, we test whether the coefficient vector for the data including simulated INR-outcomes for the attriters is equal to the coefficient vector of the estimation ignoring attriters. The number of rejected Hausman-Tests at the 5% level of significance are counted. If this number is small or close to zero, we conclude that there exists no biasing effect of panel attrition.

4 Data and Sampling

The data in this analysis are taken from three waves of the German Socioeconomic Panel (GSOEP). The GSOEP data are collected annually since 1984 and contain information on household and individual characteristics. Besides the annually repeating questions, a special topics module is regularly added to the survey. In 1988 this special topic module covered household wealth, and was designed as a separate household questionnaire. In this study we

are mainly interested in questions on income and wealth, since they are relevant for many economic research questions and typically affected by nonresponse behavior. Hence, we use data from the 1988 wave as well as from the previous and following survey waves. The household questionnaires are answered by the head of the household[8], while the individual questionnaires are filled in by every member of the household who reached age 16. In 1988 the GSOEP surveyed 4,814 households in West-Germany with 10,023 individuals. The survey is supplemented by an interviewer dataset, so measures for interviewers and interactions between interviewers and respondents are available (see Schräpler and Wagner 2001).

Our sample was selected based on four criteria: First, to circumvent language problems and to avoid cultural differences in response behavior, only German households from the nationally representative subsample "A" were selected. Second, only individuals with German nationality were considered. Third, only households and individuals are used who participated and fulfilled the mentioned criteria in the 1987 survey[9]. The sample includes 6,731 persons in 3,394 households. Figures 2 and 3 show the sample sizes for all three survey years at the individual and household level.

Fourth, while the GSOEP uses a method-mix to gather the desired information, including paper and pencil, face-to-face, and telephone interviews, we restrict our sample to face-to-face interviews. This mode is used in the majority of cases and for an analysis of interviewer effects while omitting mode effects.

[8] The GSOEP administration has no strict definition of the "head of household". The interviewer decides which knowledgeable person of the household appears as "head" and it is attempted to re-interview this person in subsequent waves. For a discussion of the concept "head of household" in the GSOEP see Hanefeld (1987): p. 132-137.

[9] Persons who changed nationality after 1987 to German or reached the age of 16 are omitted.

Finally, for the analysis of response behavior at the household level, the sample had to be restricted to observations where the same person answered the household questionnaire in two subsequent waves. This involves the loss of about one third of household observations[10].

The financial variables of interest are taken from the individual, household, and wealth questionnaires. In the GSOEP every participant is requested to provide his monthly income and its sources. So, there are questions on working and self-employed earnings, benefits, and social transfers. Whether a question is applicable to a respondent or not, is identified by filter questions. Accordingly, the number of questions that are posed to an individual depends on the respondent, and the sample size for each item nonresponse indicator varies by question.

The unit nonresponse indicators (UNR) are coded 1 if the household or individual has participated in the last wave but dropped out in the considered wave. The questionnaire nonresponse indicator (QNR) is coded 1 for households who participated in the 1988 household interview, but refused to fill in the wealth questionnaire. Item nonresponse is coded for households and individuals who participated in the interview but denied to respond to an applicable question[11]. In the household wealth questionnaire of 1988 the option to answer "don't know" was provided. We treat this category as a valid response since we want to measure the attrition bias with respect to the outcome "item nonresponse"[12].

For an analysis of item nonresponse on question level, the information whether a question is applicable to a respondent is crucial to restrict to the correct sample. In 1988 the households' wealth was surveyed for the first time, so there existed no information on the types of wealth a household owns from prior waves. Therefore the applicability of wealth item had to be asked by filter questions of the kind: "Did you or another household member

[10] It is assumed that continuity of the head of household is uncorrelated with response behavior.
[11] It is possible that after lying on filter questions the wrong questions are posed to a respondent. Because of panel care activities of the survey organisation and information cross-check with information of former wave interviews, it is assumed that cheating on questions in the repeating part of the interview can be ignored.

own …? (yes / no)". Unfortunately, 1988's attriters and questionnaire non-responders were not in the position to respond to these filters. So, the information whether a wealth item was applicable to them had to be obtained in a more sophisticated way. In the repeating part of the household questionnaire the amount of wealth related incomes and expenditures was queried, such as dividends and rents or maintenance and mortgage expenditures on property. If an amount was provided, then at least one corresponding wealth category in the special topics questionnaire had to be applicable. The question for total household wealth had to be answered by all respondents. Figure 4 shows the three pooled wealth categories used in this analysis and their corresponding questions in the household and wealth questionnaire.

Surprisingly, 305 respondents who declared interest and dividend income in the household questionnaire denied to own savings accounts and certificates, stocks, and bonds in the filter questions of wealth questionnaire. Hence, in the original wealth dataset these items were filtered as "not applicable" in these cases. We assume the information from the income questions in households questionnaire to be more reliable, due to panel care activites and cross check with the total income of household. Therefore we recoded the 305 cases to item nonresponses, because we conclude that these respondents tried to omit an answer by cheating. These observations are nearly half of all 614 INR cases on savings, stocks and bonds[13].

5 Empirical analysis of nonresponse interaction

This analysis addresses two main research questions: First, is there evidence, that item nonresponse is a precursor of unit nonresponse and does it have explanatory power for subsequent panel attrition behavior, or is there another type of interaction? Second,

[12] A second possible treatment would have been to omit observations with "don´t know" statements. A robustness check showed that the findings stayed unaffected using this empirical approach.
[13] In contrast to savings, stocks, and bonds, only 7 respondents were cheating on the questions on property.

doesattrition cause endogenous sample selection which biases the coefficients of INR-regressions?

5.1 Item nonresponse as a precursor of panel attrition

As shown in section 2, under the theory of cooperation continuum, panel attrition is preceded by a higher item nonresponse propensity. The t-test results for the test of equality in mean item nonresponse rates for attriters and stayers are presented in Table 1. There is no evidence, that the item nonresponse behavior of panel attriters differs significantly from that of stayers.

Some authors emphasize that item nonresponse on sensitive key variables is a predictor of unit nonresponse in the next wave. One could argue that the insignificance of the difference in overall INR-rates may originate from the fact that too many soft items are included in the calculation of the INR-rate, or that the sensitive items were not applicable in the majority of cases. Thus, we present test-results for question-specific differences in INR-rates of stayers and attriters in Tables 2a-c (for items of the individual, household and wealth questionnaire). Significant differences in response behavior can be reported for 1988 for the gross earnings question at the 1% level of significance. For dropouts, the INR-rate on this item is 8.6 percentage points higher than for stayers. The same could be observed for general unemployment transfers: the 15.6 percentage points difference is significant at the 5% level. In the household questionnaire, INR-rates differ significantly for maintenance expenditures on property, special welfare benefits, and child benefits.

Interestingly, in 1988 none of the differences in mean item-specific nonresponse rates are significant, except for wealth questionnaire items, presented in Table 2c. Here the findings are as expected with large differences of up to 27 percentage points on the items of equity in business, home loan savings, stocks and bonds. For the question on total household wealth, which had to be answered by any household, we find a weakly significant difference of 2 percentage points.

So far, we found no clear evidence supporting the first hypothesis of a cooperation continuum. Significant differences in item nonresponse rates were found only for special items with small numbers of observations.

Against the above presented results it may be argued that unit nonresponse is also affected by other determinants than the INR-propensity. In the third step we therefore reduce the heterogeneity in attrition behavior by controlling for respondent, interviewer and situation characteristics, as well as their interactions. Additionally, the duration of the last interview conducted is used as an explanatory variable. In the first specification, we check whether the INR-rate has significant explanatory power for unit nonresponse, when controlling for these covariates. In a second specification we include the squared INR-rate to test, whether INR-UNR correlation can be described by a second order polynomial. The regression is performed separately for the panel-waves of 1988 and 1989, using a logit estimator. Since values for the explanatory variables are not observed for the year of the dropout, the prewave characteristics are used as explanatory variables. Table 3a reports the marginal effects of the logit regressions for the individual questionnaire in both waves and for both specifications.

In the model specifications presented in columns 1 and 3 of Table 3a, the hypothesis that the effect of prewave's item nonresponse rate is zero cannot be rejected. Our first and second research hypothesis are rejected. Looking at a specification with INR-rate effects (columns 2 and 4) it seems obvious that INR-rate has a non-linear effect on UNR. The two coefficients are of opposite signs, describing a U-shaped (column 4) resp. inverse U-shaped relationship (column 2) between INR and UNR. In 1988's wave, the linear and quadratic effect of the INR-rate are jointly significant at the 10%-level (see Wald-Test result at bottom of Table 3a) The linear and quadratic effects of the INR-rate in the wave of 1989 are found to be insignificant. The precisely estimated inverse U-shaped polynomial for 1988 (column 2) has

its maximum at an INR-rate of 0.48. This supports our third research hypothesis of the coexistence of two types of respondents.

As an alternative to the specification with the item nonresponse rate, we tested the dichotomous indicators for INR on the net and gross earnings questions as predictors for UNR (results presented at bottom of Table 3a)[14]. The coefficient of INR on net earnings is insignificant in both waves and specifications. This result contradicts to the literature which hypothesizes that item nonresponse on sensitive key variables is correlated with UNR, since the net earnings question is one of the most sensitive items in the questionnaire (cf. Loosveldt et. al 2002).

INR on gross earnings 1987 was found to be significantly positively related to UNR in 1988. This finding could not be interpreted as contradictory to the finding above, since the respondent was invited to provide "as far as possible"[15] both earnings categories, but the majority opted to provide only net earnings. Item nonresponse on the gross earnings question therefore can be interpreted as a respondents' strategy to reduce the effort of the interview.

Table 3b presents estimation results for different sets of explanatory variables. The previously described effects are robust with respect to significance and magnitude, when it is controlled for respondent and interviewer characteristics.

Table 3c presents in columns 1 and 2 the marginal effects of a logit-regression of unit nonresponse in respective waves, now at the household level. The linear and quadratic effects of last year's INR rate are not significant, neither separately nor jointly. The same holds for the specification with linear INR-rate effect only, as well as for a specification with the dichotomous indicator for nonresponse on households' net income (result presented at bottom of Table 3c).

[14] Here the number of observations decreased by more than the half, since the earnings questions are only applicable to employees.
[15] GSOEP Questionnaire of 1987, 1988, 1989.

Regarding the effects of control variables, we find only household size having a negative significant effect on unit nonresponse in both years.

Column 3 of Table 3c presents the marginal effects for the model of QNR in 1988's wealth questionnaire. In contrast to the UNR-regressions presented in columns 1 and 2, data for the explanatory variables origins from the same year. The item nonresponse rate, also derived from the individual questionnaire in the same interview, has a highly significant negative (linear) effect on questionnaire nonresponse (result presented at bottom of column 3, Table 3c). In view of the quadratic INR-rate specification in column 3, it is obvious that the large negative but insignificant coefficient for the squared INR-rate dominates the coefficient of the linear INR-rate[16]. In contrast to the latter finding, item nonresponse on the net income of the household question has a highly significant positive impact on questionnaire nonresponse. These results support the hypothesis that two types of respondents participate in the panel study: Cooperators and reverse cooperators, with the latter preponderating. Item nonresponse on household's net income is strongly connected with refusing the wealth questionnaire. It seems that QNR is positively connected with item nonresponse on especially this sensitive item.

Regarding the control effects, the sex of interviewer and respondent influence the rejection probability, such that a male-male combination (the reference group) leads to lowest questionnaire nonresponse[17]. Same schooling of both interview partners, household size, and number of interviewer contacts have an increasing effect on rejecting the wealth questionnaire. If the interviewer or the respondent are not employed or the respondent works in the public sector, the questionnaire nonresponse is significantly lower. The finding for public sector employees is contrary to the effect on UNR in 1989. It seems that public sector

[16] The maximum QNR-probability of this polynomial is found at an INR-rate of 0.04. This is almost the lower bound (besides zero INR-rate) of observed values. This suggests that P(QNR) is strictly monotonic decreasing with increasing INR-rates and confirms the result of the linear specification with only the linear INR-rate effect.
[17] The combination interviewer and respondent being male is the omitted base category in our specification and all other gender combinations are positively significant.

employees are more likely to respond to the wealth questionnaire but drop out of the panel group after this interview. Robustness checks with different sets of explanatory variables presented in Table 3d acknowledge our main findings.

Comprising, it could be stated that no overall evidence could be found for our first hypothesis of the cooperation continuum. The item nonresponse rate in the linear specification has no significant explanatory power for panel attrition.

With regard to questionnaire nonresponse the INR-rate has a negative effect on UNR-probability, which supports our second hypothesis of a reverse cooperation continuum. With respect to the insignificance of the linear effect of the INR-rate in 4 of 5 cases, our third hypothesis of coexistence of two types of cooperators comes to the fore: The relation between INR-rate and UNR seems to be nonlinear and can be described by a inverse U-shaped polynomial of second order. In both cases where INR-rate and its square have significant explanatory power, they have the expected signs: a positive sign for the coefficient of the linear term and a negative sign for the squared term. This finding strongly supports our hypothesis that two types of respondents coexist in the panel: normal and reverse cooperators. For questionnaire nonresponse, a highly significant negative effect of INR is evaluated and we conclude that the latter type of respondent seems to preponderate[18]. Even if these results seem to be astounding, we have to concede that in 3 of 5 cases a correlation of unit and item nonresponse could not be detected.

5.2 Sample selection due to attrition

Correlation of item nonresponse with panel attrition leads to endogenously selected samples with biased estimation coefficients in regressions of item nonresponse. Since we

[18] To check for robustness of our results, we also tested cubic specifications for INR-rate. The cubic effect was found to be insignificant for all cases. A non-parametric specification with quantile-dummies confirmed the effect for the individual questionnaire in 1988: The coefficients for the lowest (INR-rate < 0.2) and highest quantile (INR-rate > 0.8) were significantly different with the middle quantile as reference category. The low numbers of observations and collinearity problems prohibited us to use more dummies with smaller quantile widths, and to provide this analysis for the household questionnaires. The results are not presented here to save space.

presented some evidence for the connection between INR and UNR, we now intend to find out whether panel attrition biases the results of a regression of INR using the bivariate probit approach described in section 3. 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 opposite to living on the countryside or in an industrial area) and type of the 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 variables of the selection equation are observed at time t-1 (the pre-wave interview) since we have no information for the year when the respondent attrited. The data for the specification equation are observed at present (t).

The results of the sample selection tests for selected items in the 1988 and 1989 waves are reported in Table 4[19]. In most cases there is no indication that a sample selection bias exists, since the null-hypothesis that the correlation coefficient ρ is zero cannot be rejected. When all considered items (the 14 items presented in table 2a) of the individual questionnaire in 1989's wave were pooled, the null-hypothesis cannot be rejected, which indicates a sample selection bias. The correlation coefficient is negative, which suggests that dropouts would have had a higher INR-probability in the following wave.

The questions in 1988's wealth questionnaire may be object of two sample selection processes: due to panel attrition in 1988 and due to (wealth) questionnaire nonresponse. Because of insufficient number of cases the bivariate probit model could not be estimated for the property item. We obtained credible estimates for the "total wealth of household"

[19] Probably due to the small share of UNR cases, the likelihood function did not converge properly for: net income of household 1989, property 1988, and securities, stocks, and bonds 1988. Therefore, these results may be misleading and are not presented.

question, as well as for this question pooled with the property item. Both estimated correlation coefficients are positive and significantly different from zero. This leads us to the conclusion, that respondents who did not fill in the wealth questionnaire would have been more likely to respond to wealth items. This result supports our hypothesis of a reverse cooperation continuum and goes in line with the findings in Section 5.1.

The last question addressed is, whether detected sample selection bias affects the coefficients of an item nonresponse regression. In Table 5 we present uncorrected and corrected probit estimates of INR for the total wealth of household question. The uncorrected estimates are calculated with standard probit, ignoring panel attrition. The corrected coefficients result from the bivariate probit with selection correction. We concede that both models have no explanatory power for item nonresponse behavior, since the hypothesis of all slope coefficients being simultaneously different from zero is not rejected. Nonetheless, with regard to the Wald-test statistic the explanatory power of the model is overestimated by uncorrected probit. This finding is also reflected in smaller standard errors for the regression coefficients in the uncorrected probit. The coefficients differ variably, depending on the explanatory variable.

Because of mentioned convergence problems of the likelihood function in the bivariate probit case, we try to identify possible sample selection bias by simulating the item nonresponse behavior of attriters under different assumptions. In Table 6 we present Hausman-Tests to compare coefficient vectors of probit regressions ignoring panel attrition with regressions including the attriters with their simulated INR-outcome. As described in Section 3 we present test results for 5 scenarios: (1) all attriters have no INR (best case), (2) all attriters have INR (worst case), INR outcome for attriters is randomly drawn with probability of the (3) half individual INR-Rate of the prewave, (4) INR-Rate, and (5) double INR-Rate. For the property item, the null hypothesis of the Hausman-Test that the difference in the coefficient vectors is not systematic, is not rejected neither for the "best case" nor for

the "worst case" scenario, and only for a minor number of estimations in the Monte-Carlo simulations. This leads us to the conclusion that attrition is irrelevant for the results of a INR-study on property. For all other questions there seems to be systematic difference in the coefficients in the best case scenario. We obtain the same result for the "securities, stocks and bonds" item and "all wealth items pooled" for the worst case scenario. In the 100 calculated simulations the weighted INR-rate of the prewave was used for simulating the probability of the occurrence of item nonresponse in the year of attrition. Table 6 shows that with increasing weight both coefficient vectors of the models become similar more often, since the number of Hausman-Tests where the null is rejected decreases in the simulations. While similarity of coefficients assuming all attriters having INR is still rejected, this result may be astounding at first glance. Nevertheless it supports the hypothesis that our data comprises both types of respondents. By increasing the weight w, only the INR-probability of attriters with INR-rate$_{t-1} > 0$ increases, the INR probability for attriters with INR-rate$_{t-1} = 0$ stays zero. Thus the bias will be lowest if INR is assumed for attriters with some INR-rate>0 and if item response is assumed for attriters with no item nonresponse in the prewave. If the hypothesis of cooperation continuum would hold, the similarity between estimated coefficients should be largest if INR for attriters is assumed. Evidence for this type of interaction can be found for the total wealth of household question, even if pooled with the property item.

Summing up, our results show, that an analysis of the determinants of item nonresponse based on data from only one panel wave and neglecting self selection of respondents may suffer from attrition bias. Existence and strength of this bias depends on the sample used. Even if this bias seems to be negligible in the presented INR-model, it may be considerable when other data or models are used.

6 Summary and Conclusion

The nonresponse literature which gives attention to the interaction of unit- and item nonresponse and to the problem of endogenous sample selection with respect to item nonresponse is scarce. This paper contributes to the literature by answering two questions: First, how are item and unit nonresponse interrelated and second, does panel attrition cause a selection bias in the results of INR studies?

The theory of a latent cooperation continuum predicts a positive correlation between the propensities of unit and item nonresponse. Since this finding is not undividedly supported by the literature and not at all by our data, we argue that the cooperation continuum could in principle also be inverse. And we hypothesize that both cooperation hypotheses may apply to different types of respondents in the same panel. Therefore the interaction of INR and UNR propensities may be described by an inverse U-shaped pattern. Evidence for the latter is provided applying logit regressions to unit nonresponse behavior in the individual questionnaire, as well as for partial UNR behavior in households' wealth questionnaire of GSOEP's 1988 wave. Furthermore, it can be shown, that unit nonresponse is mainly explained by other effects such as respondent's age and household size.

Addressing the second question, we identified sample selection bias due to panel attrition in the results of INR-regressions. Since the used data "suffer" from few cases of panel attrition, the bias can only be identified for the pooled income questions from the personal questionnaire and for the "total wealth of household" item. Even if the bias seems to be negligible for the presented INR models, its existence may become considerable when other data are used.

The paper has shown, that item and unit nonresponse should not be analyzed separately, since they are connected. The correlation between item nonresponse and panel attrition propensities is not linear, but quadratic. This indicates that two types of respondents may coexist in a panel study: One type behaving as predicted by cooperation continuum theory

with attrition following high item nonresponse. The other type behaving in a reverse manner with dropout after no or low INR.

The researcher as well as the survey conductor may wish to find out which nonresponse type is prevalent in his panel group to derive a judgment about attrition bias and may impose correction methods. This will lead to more reliable results for the determinants of item nonresponse. In the end this knowledge enables him to improve his survey method.

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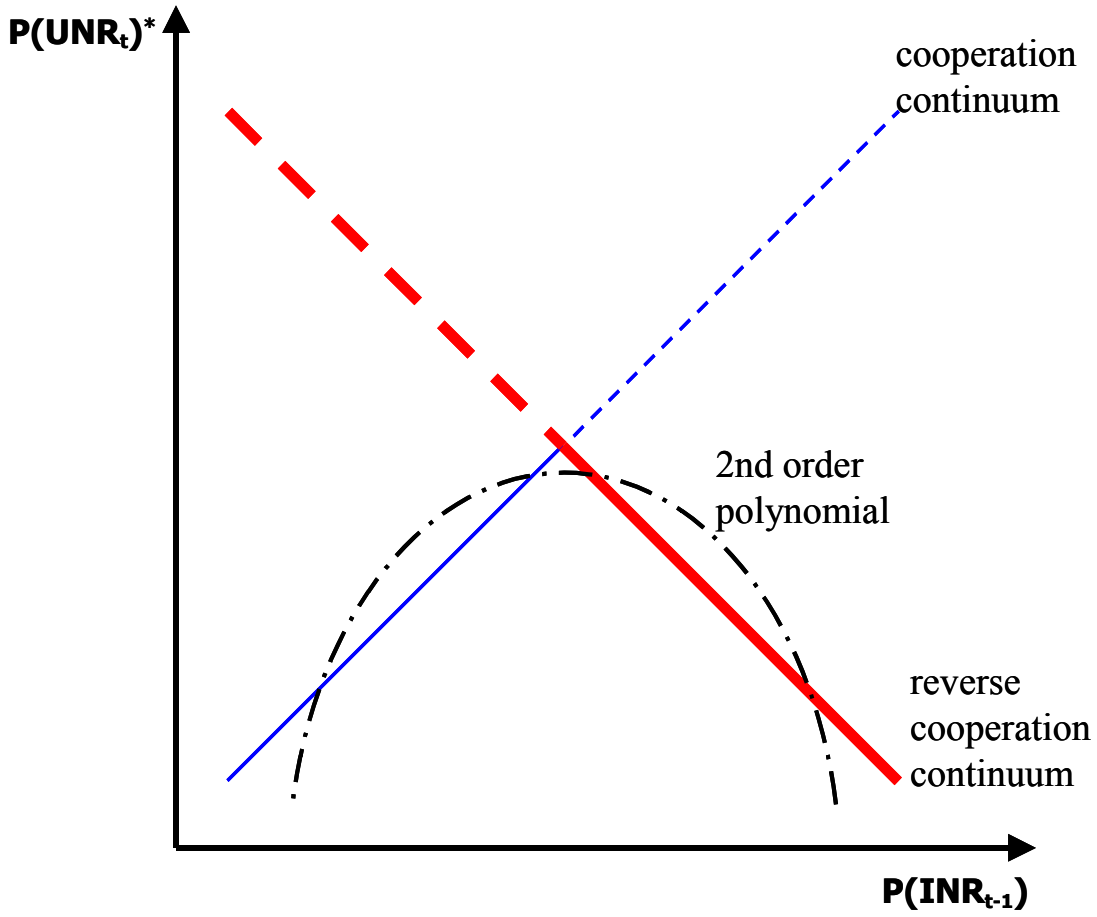
Appendix

Figure 1: Possible correlations of latent unit nonresponse and prewave´s item nonresponse probabilities



Notes:
Dashed lines are less likely to be observed in a panel study, because of high unit nonresponse probability.
Second order polynomial describes occurrence of both respondent types for lower unit nonresponse probability

Figure 2: Samples sizes for GSOEP waves 1987 to 1989 at the individual level

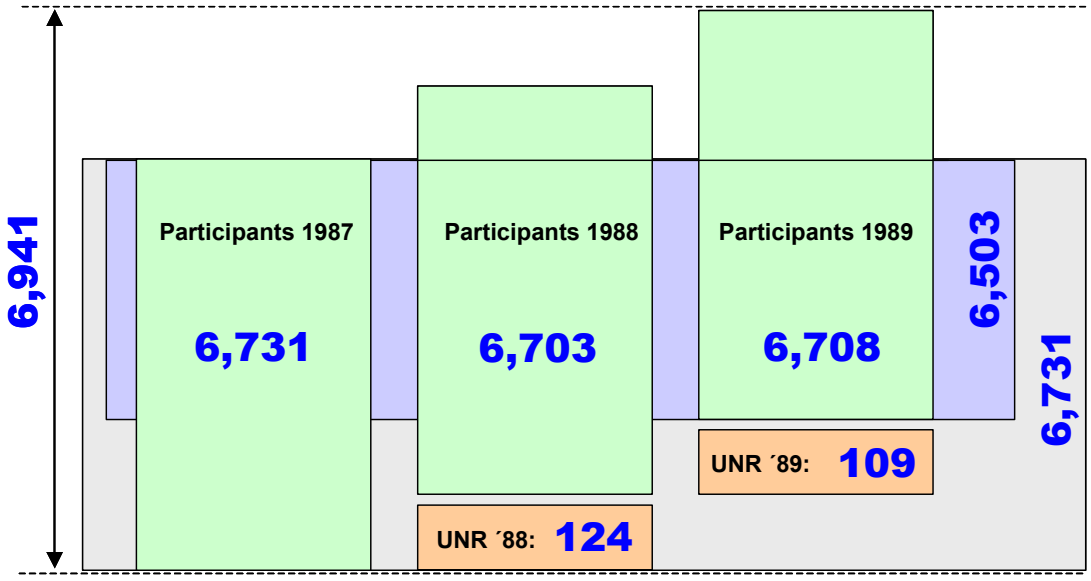


Figure 3: Sample sizes for GSOEP waves 1987 to 1989 at the household level

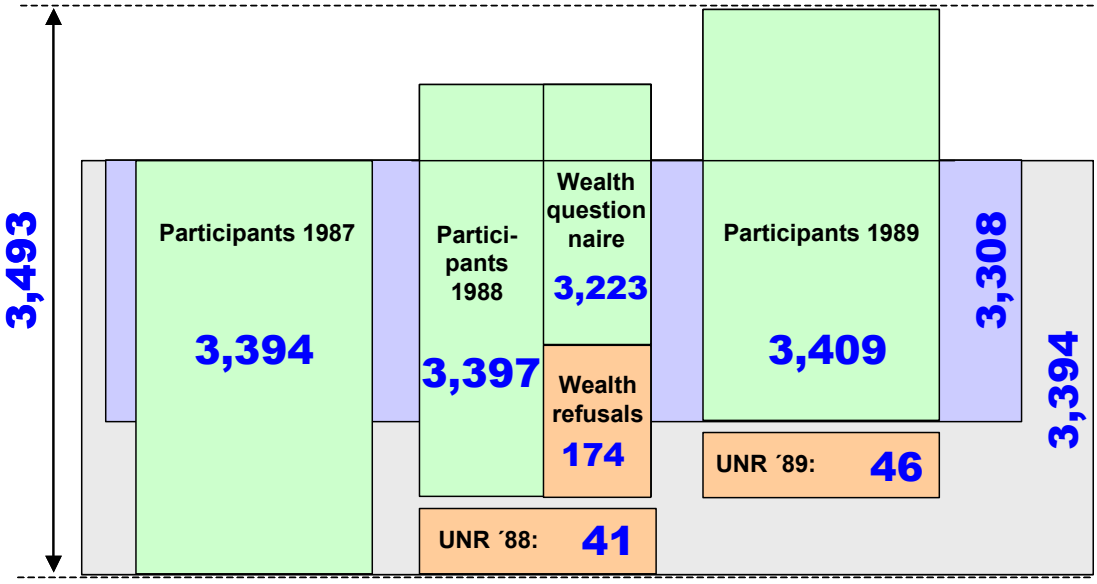


Figure 4: Related income and expenditure questions and their corresponding assets in the questionnaires.

Household Questionaire (repeating every wave)	**Wealth Questionnaire (only 1988)**
Wealth Category 1: *Property*	
Rental or lease incomes (yes/no) Amount of rental or lease incomes Maintenance expenditures on property Annuity and mortgage expenditures	Ownership of occupied flat or home: … market value … assessed value Property other than occupied flat or home
N = 407	R:285; DK: 70; INR:20; QNR:30; UNR: 2
Wealth Category 2: *Savings*	
Interest and dividend income	Savings account Home loan savings certificate Stocks and Bonds
N = 2522	R: 1611; DK: 121; INR: 614; QNR: 142; UNR: 34
Wealth Category 3: *Total household wealth*	
Unit respondents in 1988 (filled in HH-Questionnaire)	Total household wealth (applicable to every household)
N = 3389	R: 2901; DK: 201; INR: 77; QNR: 169; UNR: 41

Notes:

a) All questions in both questionnaires refer to the amount or ownership in the last year (1987).
b) The left column lists those income questions which inform on the factual possession of wealth items, listed in the right column. It is assumed that due to panel care activities of the survey organization, the information from the household questionnaire is reliable.
c) N: Number of households having declared to obtain at least one of the mentioned income categories.
d) R: response, DK: don't know statement, INR: item nonresponse, QNR: (wealth) questionnaire nonresponse (= participation in wave E but refusing wealth questionnaire), UNR: panel attrition in 1988.

Table 1: Overall Item Nonresponse Rates of Attriters and Stayers

	Wave 1987		Wave 1988	
	individual quest.	household quest.	individual quest.	household quest.
INR-rate				
… of participants in next wave (stayers)	0.040	0.045	0.043	0.048
… of dropouts / attriters	0.044	0.053	0.044	0.036
Difference in means	-0.003	-0.008	-0.002	0.012
t-value, H_0: equal means (p-value)	-0.20 (0.84)	-0.53 (0.60)	-0.08 (0.94)	0.81 (0.42)
No. of obs.	4639	2459	4485	2353
- stayers	4543	2422	4410	2319
- dropouts	96	37	75	34

Notes: Samples conditioned on participation in 1987; own calculation based on GSOEP.

Table 2a: Difference of Item Nonresponse Rates of selected items for Attriters and Stayers from individual questionnaire

	Wave D 1987				Wave E 1988		
Item	Mean diff.	t		No. of cases	Mean diff.	t	No. of cases
Gross earnings last month	-0.086	-3.55	***	2784	-0.022	-0.94	2480
Net earnings last month	-0.016	-0.87		2784	-0.018	-0.95	2480
End year paym.: 13. monthly salary [1)]	0.022	1.06		1103	0.024	1.15	968
End year paym.: 14. monthly salary [1)]	0.015	0.17		69	0.043	0.47	51
Christmas bonus [1)]	-0.017	-0.89		1225	0.011	0.47	1110
Vacation benefits [1)]	-0.013	-0.68		1643	0.004	0.17	1474
Bonus / profit sharing [1)]	0.054	0.62		119	0.222	-1.18	111
Other benefits [1)]	-	-		-	0.103	0.46	31
Gross wage [1)]	-0.008	-0.60		2649	-0.001	-0.05	2384
Income from self employment [1)]	-0.050	-0.52		262	-0.049	-0.58	271
Earnings from other employment [1)]	0.047	0.80		205	-0.065	-0.73	142
Retirement benefits [1)]	0.014	0.68		1019	-0.022	-1.19	987
General unemployment transfer [1)]	-0.156	-2.10	**	180	0.101	0.74	144
Means tested unemployment transfer[1)]	-	-		58	0.098	0.56	44

Notes:
[1)] Average gross monthly amount in the last calendar year. If the respondent was unable to provide the exact figure the questionnaire prompted for an approximation.

For "other benefits" and "means tested unemployment transfer" a difference in mean item nonresponse rate could not be calculated, because all respondents to whom these questions were applicable in 1987 were re-interviewed in the next year (no dropouts).

Significance levels: * 10 %, ** 5 %, *** 1 %

Table 2b: Difference of current Item Nonresponse Rates of selected items for Attriters and Stayers from the household questionnaire

Item	Wave 1987 Mean diff.	t		No. of cases	Wave 1988 Mean diff.	t	No. of cases
Welfare benefits [1]	-0.006	-1.28		2411	0.002	0.50	2157
General welfare benefits [2]	0.018	0.30		61	0.130	0.66	49
Special welfare benefits [2]	-0.200	-3.68	***	61	0.109	0.59	49
Child benefits [1]	0.006	0.75		1512	-0.008	-1.22	1413
Child benefits [2]	-0.025	-2.19	**	899	0.003	0.32	744
Rental or lease incomes [1]	-0.002	-0.20		2411	0.003	0.67	2157
Rental or lease incomes [2]	-0.062	-1.65		280	0.019	0.49	282
Maintenance expend. On property [2] [3]	-0.148	-1.84	*	280	0.141	1.46	282
Annuity and interest payments [2] [3]	-0.063	-0.47		280	0.177	1.33	282
Interest payments [2] [3]	-0.025	-0.18		280	0.145	1.05	282
Interest and dividend income [3]	-0.041	-0.98		1783	-0.035	-0.95	1632
Monthly household net income [2]	-0.007	-0.43		2411	0.002	0.13	2157

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

Table 2c: Difference of current Item Nonresponse Rates of selected items for Attriters and Stayers from the wealth questionnaire in 1988

Item	Wave 1988 Mean diff.	t		No. of cases
Ownership of occupied flat or home: rateable value	0.012	0.74		891
Ownership of occupied flat or home: market value	0.005	0.47		891
Property	0.011	0.28		268
Farm	0.190	0.95		46
Equity in a business	-0.258	-1.80	*	138
Savings account	0.014	0.75		1781
Home loan savings certificates (*Bausparvertrag*)	-0.164	-2.42	**	817
Stocks and bonds	-0.266	-2.60	***	554
Life Insurance: Originally insured amount	-0.012	-0.70		1113
Life Insurance: Current monthly payment	0.006	0.24		1113
Household debt	0.010	0.54		621
Total household wealth	-0.020	-1.70	*	2094
Inheritances since 1960	-0.057	-0.74		325

Note:
Significance levels: * 10 %, ** 5 %, *** 1 %

Table 3a: Determinants of Unit Nonresponse (marginal effects of logit regression) for the individual questionnaire

	UNR in wave E (1988)						UNR in wave F (1989)					
	(1)			(2)			(3)			(4)		
Explanatory Variables:	ME	t		ME	t		ME	t		ME	t	
Item nonresponse rate												
INRR	0.032	0.42		0.651	2.03	**	0.024	0.56		-0.366	-1.05	
$INRR^2$	-			-0.691	-1.95	**	-			0.425	1.19	
Sex												
R female I male	0.023	0.62		0.024	0.64		-0.005	-0.22		-0.005	-0.20	
R male I female	0.008	0.17		0.004	0.08		0.009	0.38		0.011	0.44	
R female I female	-0.020	-0.43		-0.022	-0.47		-0.028	-0.89		-0.029	-0.89	
Age												
R age	0.004	2.07	**	0.004	2.00	**	0.003	2.06	**	0.003	2.09	**
age difference: R - I	0.001	0.87		0.001	0.93		0.001	1.06		0.001	1.06	
Employment status												
R part time employed	0.020	0.32		0.007	0.11		0.010	0.28		0.014	0.39	
R not employed	0.084	1.76	*	0.100	2.03	**	0.009	0.36		0.005	0.17	
I part time employed	-0.002	-0.04		-0.002	-0.05		-0.067	-1.48		-0.073	-1.53	
I not employed	0.025	0.56		0.024	0.54		-0.029	-1.14		-0.030	-1.12	
same employment status	0.010	0.28		0.014	0.40		0.018	0.99		0.019	0.97	
Schooling												
R medium level school.	-0.095	-1.61		-0.091	-1.58		0.017	0.86		0.018	0.87	
R high schooling	-0.069	-1.04		-0.066	-1.01		0.025	1.22		0.026	1.22	
I medium level schooling	0.036	0.80		0.036	0.79		0.031	1.35		0.033	1.34	
I high schooling	0.000	0.01		0.002	0.04		0.029	1.23		0.029	1.20	
same schooling	0.005	0.11		0.005	0.11		-0.021	-0.91		-0.023	-0.93	
Interview Situation												
change of I	-0.063	-1.05		-0.061	-1.03		-0.021	-0.61		-0.020	-0.56	
R public sector employee	0.061	1.19		0.069	1.39		0.006	0.20		0.004	0.12	
self administered survey	0.013	0.30		0.015	0.35		-0.057	-1.13		-0.060	-1.14	
HH in small town	-0.005	-0.15		-0.003	-0.10		-0.019	-1.04		-0.020	-1.07	
household size	0.003	0.27		0.002	0.01		0.012	1.62		0.012	1.62	
number of I contacts	0.002	0.22		0.002	0.20		0.002	0.32		0.002	0.38	
HH in high-rise building	0.015	0.46		0.014	0.43		0.003	0.16		0.004	0.19	
HH in residential area	-0.021	-0.71		-0.020	-0.72		0.049	1.73	*	0.0521	1.75	*
interview duration (min.)	-0.001	-0.73		-0.001	-0.70		0.000	0.45		0.000	0.42	
Constant (coefficient)	-6.304	-6.21	***	-6.369	-6.24	***	-7.671	-6.95	***	-7.621	-6.90	***
No. of obs.	4501			4501			4253			4253		
Pseudo R^2 (McFadden)	0.10			0.10			0.12			0.12		
Log Likelihood	-397.57			-395.73			-329.31			-328.11		
LR – Test (df)	87.25 (25)			90.94 (26)			87.67 (25)			90.1 (26)		
$P > \chi^2$	0.00			0.00			0.00			0.00		
Wald-Test on joint sig. of		χ^2 :		4.62 *				χ^2 :		2.47		
INRR coeff.		$p> \chi^2$:		0.099				$p> \chi^2$:		0.292		
alternative item nonresponse (INR) specifications (complete models not presented here):												
INR on net earnings	0.057	0.91		(2423 obs.)			0.009	0.07		(2283 obs.)		
INR on gross earnings	0.132	2.38	**	(2423 obs.)			0.045	0.44		(2283 obs.)		

Note:
Significance levels: * 10 %, ** 5 %, *** 1 %
I: interviewer; R: respondent; HH: household; ME: marginal effects

Table 3b: Alternative Specifications of UNR-Model to check for robustness of results (marginal effects presented)

	UNR 88				UNR 89			
Explanatory vars.:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
INRR	0.342	0.328	0.615	0.627	-1.833	-0.759	-0.842	-0.418
t-value	0.63	1.51	2.01**	2.06**	-1.63	-1.15	-1.19	-1.08
$INRR^2$	-0.386	-0.375	-0.658	-0.667	1.973	0.823	0.906	0.474
t-value	-0.63	-1.52	-1.94**	-1.99**	1.73	1.22	1.26	1.19
Controls:								
Sex		**yes**	**yes**	**yes**		**yes**	**yes**	**yes**
Age		**yes**	**yes**	**yes**		**yes**	**yes**	**yes**
Employment status			**yes**	**yes**			**yes**	**yes**
Situation Effects				**yes**				**yes**
Number of obs.	4501	4501	4501	4501	4253	4253	4253	4253
pseudo R^2	0.00	0.09	0.09	0.10	0.01	0.08	0.09	0.11
Log likelihood	-441.00	-403.41	-400.72	-398.7	-370.8	-341.5	-339.1	-331.9
LR-test (df)	0.38 (2)	75.6 (7)	80.9 (12)	85.0 (21)	4.68 (2)	63.2 (7)	68.2 (12)	82.6 (21)
$p > \chi^2$	0.95	0.00	0.00	0.00	0.18	0.00	0.00	0.00
Wald-Test (INRR),χ^2:	0.41	2.47	4.71*	4.94*	3.22	1.97	2.02	2.30
$p > \chi^2$:	0.816	0.290	0.095	0.085	0.199	0.373	0.364	0.317

Note:
Marginal effects presented for INR-rate coefficients: INR and $INRR^2$.
Significance levels: * 10 %, ** 5 %, *** 1 %

Table 3c: Determinants of Unit Nonresponse (marginal effects of logit regression) for household questionnaires

Explanatory variables:	(1) ...in wave 1988 household questionnaire ME	t	(2) ...in wave 1989 household questionnaire ME	t	(3) ...in wealth questionnaire in wave 1988 ME	t
Item nonresponse rate						
INRR	-0.236	-0.71	-0.091	-0.07	4.158	2.40 **
$INRR^2$	0.297	0.31	-1.887	-0.27	-17.25	-0.82
Sex						
R female I male	0.059	0.96	-0.173	-1.95 **	0.074	1.80 *
R male I female	0.106	1.51	0.002	0.02	0.077	1.88 *
R female I female	0.048	0.72	-0.098	-1.08	0.084	1.87 *
Age						
R age	0.000	0.17	0.002	0.51	0.002	0.91
age difference: R - I	0.001	0.82	0.001	0.41	0.000	0.07
Employment status						
R part time employed	0.000	0.00	0.069	0.36	-0.032	-0.50
R not employed	0.022	0.37	0.163	1.31	-0.090	-1.86 *
I part time employed	-0.017	-0.37	0.039	0.38	-0.045	-0.76
I not employed	-0.048	-0.96	-0.055	-0.59	-0.084	-1.80 *
same employment status	0.025	0.57	0.120	1.57	-0.019	-0.55
Schooling						
R medium level schooling	-0.056	-1.39	-0.068	-0.8	-0.079	-1.24
R high schooling	-0.064	-1.45	-0.195	-1.65 *	0.055	1.50
I medium level schooling	0.019	0.37	-0.035	-0.41	0.049	1.05
I high schooling	-0.029	-0.51	-0.086	-0.79	-0.013	-0.23
same schooling	-0.025	-0.51	-0.104	-1.17	0.080	1.95 **
Situation Effects						
change of I	0.006	0.11	-0.102	-0.84	-0.062	-0.86
R public sector employee	-0.053	-0.81	0.214	2.11 **	-0.116	-1.61 *
Self administered survey	-0.027	-0.35	-0.189	-1.17	0.010	0.25
HH in small town	-0.005	-0.13	-0.060	-0.88	0.021	0.57
R's household size	-0.079	-3.05 ***	-0.117	-3.14 ***	0.029	2.07 **
number of I contacts	-0.021	-1.36	0.037	1.82 *	0.017	1.57
R living in high-rise buildings	-0.013	-0.35	0.125	1.75 *	0.037	0.96
R living in residential area	-0.054	-1.51	0.111	1.33	0.015	0.40
interview duration (min.)	0.002	0.90	0.002	0.52	-0.002	-0.86
Constant (coefficient)	-2.562	-1.42	-4.925	-2.85 **	-5.744	-4.40 ***
No. of obs.	2172		2107		2107	
Pseudo R^2	0.18		0.16		0.13	
Log Likelihood	-130.5		-138.9		-222.72	
LR – Test (df)	55.58 (26)		53.5 (26)		64.1 (26)	
$P > chi^2$	0.00		0.00		0.00	
Wald-Test on joint significance χ^2 :	0.49		1.71		5.70*	
of INRR coeff. $p> \chi^2$:	0.783		0.426		0.058	
alternative INR-specifications (complete models not presented here):						
INRR (linear effect only)	-0.067	-0.39	-0.694	-1.45	-1.284	-2.84 ***
INR on net income of household	-	-	0.018	0.11	0.133	4.68 ***

Notes:
Samples conditioned on cases where the same person was answering household questionnaire in both years.
Significance levels: * 10 %, ** 5 %, *** 1 %
I: interviewer; R: respondent; HH: household; ME: marginal effects

Table 3d: Alternative Specifications of UNR-Model to check for robustness of results (marginal effects presented)

	UNR 1988			UNR 1989			QNR 1988	
Explanatory vars.:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
INRR	0.198	-0.042	-0.263	-0.492	-0.051	-0.037	8.977	5.181
(t-value)	0.20	-0.13	-0.62	-0.30	-0.04	-0.03	3.00 ***	2.41 **
$INRR^2$	-0.057	0.018	0.397	-2.033	-1.409	-2.064	-103.32	-29.01
(t-value)	-0.02	0.02	0.32	-0.26	-0.24	-0.31	-2.85 ***	-1.12
Controls:								
Sex		**yes**	**yes**		**yes**	**yes**	**yes**	**yes**
Age		**yes**	**yes**		**yes**	**yes**	**yes**	**yes**
Employment status			**yes**			**yes**		**yes**
Situation Effects			**yes**			**yes**		**yes**
Number of obs.	2172	2172	2172	2107	2107	2107	2107	2107
pseudo R^2	0.10	0.10	0.16	0.01	0.07	0.15	0.06	0.11
Log likelihood	-158.2	-143.1	-133.0	-164.7	-154.4	-141.4	-240.02	-227.1
LR-test (df)	0.15 (2)	30.4 (7)	50.5 (21)	2.11 (2)	22.8 (7)	48.6 (21)	29.5 (7)	55.5 (21)
$p > \chi^2$	0.98	0.00	0.00	0.61	0.00	0.00	0.00	0.00
Wald-Test (INRR),χ^2:	0.15	0.02	0.37	1.48	1.97	1.76	7.78***	5.66*
$p > \chi^2$:	0.927	0.993	0.833	0.478	0.374	0.415	0.020	0.059

Note:
Significance levels: * 10 %, ** 5 %, *** 1 %

Table 4: Tests of sample selection bias in INR models due to panel attrition. Results of bivariate probit.

Questionnaire Items	Panel wave	No. obs. (thereof UNR)	ρ	Std.err.	H_0: ρ=0 p-value	
Individual Questionnaire						
Gross earnings last month	1988	2459 (24)	-0.6912	0.437	0.309	
Gross earnings last month	1989	2317 (23)	0.0008	1.774	0.999	
Net earnings last month	1988	2459 (24)	-0.8654	0.596	0.580	
Net earnings last month	1989	2317 (23)	-0.7926	0.335	0.232	
All applicable income questions	1989	11942 (142)	-0.9351	0.073	0.004	***
Household Questionnaire						
Net income of household	1988	2219 (35)	0.9319	0.313	0.609	
All applicable income questions	1988	11779 (179)	-0.3623	0.349	0.446	
All applicable income questions	1989	15050 (157)	0.0159	0.918	0.986	
Wealth Questionnaire						
Total wealth of household	1988	2160 (94) [1)]	0.8500	0.177	0.015	**
Property and total wealth, pooled	1988	2411 (108) [1)]	0.8749	0.149	0.003	***

Notes:
[1)] Number of cases in brackets consist of UNR + QNR.
Significance levels: * 10 %, ** 5 %, *** 1 %

Table 5: Regression coefficients of uncorrected and corrected probit estimation on item nonresponse for the total wealth question.

Variable	uncorrected probit coeff.	s.e.		corrected probit coeff.	s.e.	
R female I male	0.1834	0.207		0.1063	0.235	
R male I female	0.1929	0.205		0.1642	0.229	
R female I female	0.4108	0.193	**	0.3913	0.214	*
R part time employed	0.1854	0.228		0.1685	0.256	
R medium level schooling	0.1299	0.166		0.1769	0.182	
R high schooling	0.0094	0.203		-0.0169	0.230	
R age	0.0136	0.008	*	0.0141	0.009	
age difference: R - I	-0.0066	0.006		-0.0092	0.007	
self administered survey	0.1582	0.177		0.1093	0.199	
household size	0.0266	0.063		0.0176	0.071	
Constant	-3.1578	0.535	***	-3.3037	0.601	***
ρ ; $p > \chi^2$ (H_0: ρ=0)				0.85	0.015	**
No. of obs. (censored ; uncensored)	2066			2160 (94 ; 2066)		
Wald / LR χ^2 (df) ; $p > \chi^2$	10.15 (10) ; 0.42			8.07 (10) ; 0.62		
Pseudo R^2	0.03					

Note:
Significance levels: * 10 %, ** 5 %, *** 1 %
I: interviewer; R: respondent; HH: household

Table 6: Hausman-Tests for models ignoring attrition vs. simulated INR-outcomes of Attriters in wealth questionnaire

1988's wealth questionnaire items	**best case**[1] (p-value)	**worst case**[2] (p-value)	**100 Monte-Carlo Simulations:** $P(INR_{i,t} \mid UNR_{i,t}) = w * P(INR_{i,t-1})$ number H_0 rejected ($p<0.05$) w = 0.5	w =1	w = 2
Property	0.178	0.999	0	3	2
Securities, Stocks and Bonds	0.000	0.004	93	55	14
Total wealth of household	0.000	0.960	0	3	3
Property and total wealth, pooled	0.000	0.875	9	9	9
All applicable wealth questions	0.000	0.000	88	43	10

Notes:
[1] best case assumption on probability of INR of attriters: $P(INR_{i,t} \mid UNR_{i,t}) = 0$
[2] worst case assumption on probability of INR of attriters: $P(INR_{i,t} \mid UNR_{i,t}) = 1$