KM 26(1987)
pag 13 - 25

SURVEY NON-RESPONSE IN RELATION TO ABILITY AND FAMILY BACKGROUND: STRUCTURE AND EFFECTS ON ESTIMATED EARNINGS FUNCTIONS

joop hartog*

Abstract

Non-response in a 1983 re-interview of a 1952 random sample of Dutch sixth-graders is analysed with a probit model, relating non-response to family background, ability and schoolrelated variables. Family background appears irrelevant, while ability and class failures have the expected effect. Differences between procedures for males and females (a follow-up interview on the mail survey for male non-respondents only) have no effect on structural relations. The selectivity bias term inserted in a simple wage equation has no significant effect.

---

* Vakgroep micro-economie, Fac.der Economische Wetenschappen, Jodenbreestraat 23, 1011 NH Amsterdam, The Netherlands; tel.020-5254252/5254298.

1. Introduction

Obtaining adequate response to surveys is a key problem in empirical research. More and more, it has become difficult to reach high rates of participation, in particular in mail surveys. Potentially the most worrisome aspect of this is the systematic non-response, with the researcher unable to retrieve its structure. In follow-up surveys the situation is different however, as at least the relation of non-response to variables measured in the first survey can be traced. This paper reports on such an approach. Children interviewed in 1952 in grade 6 (for ability, background and school related variables) were reinterviewed in 1983 about their midcareer situation: schooling accomplished, labor force attachment and labor market position, if relevant.

In estimating relations among variables, systematic non-response can only be accounted for if something is known about that system in the non-response. This paper will attempt mainly to throw some light on the nature of non-response itself, as estimates of relations among labor market variables (earnings, job level, schooling) will be dealt with elsewhere. It will do so by estimating probit models for non-response and attempt to derive some systematic inferences from that. A more precise statement of the models is given in the next section. Thereafter the data are described, and finally, empirical results will be given.

2. Non-response as a problem

Suppose, one is interested in explaining a variable w from explanatory variables Z by a postulated linear relation:

$$(1) \qquad w_i = Z_i\beta + u_i$$

For the applications used here, w_i will be an individual's wage rate observed at mid-career (in 1983) and Z_i is a vector of explanatory variables. Suppose, the observations are obtained by a follow-up survey among individuals included in an earlier survey. For these individuals, one has observations on a set of variables X_i, but not on w_i. w_i is only

observed for those sufficiently willing to participate in the survey. Let y_i indicate the latent, non-observed inclination to non-response, which is dependent on X_i. Using the index I for participation in the survey, with I=1 for participants, the resulting structure is:

$$(2) \qquad I = 1 \text{ if } y_i = X_i\gamma + v_i < 0$$

$$= 0 \text{ otherwise.}$$

Relation (2) conditions the observations on (1), which in particular has consequences for the error term. Since (1) is only conditionally observed, the distribution of the error term will be truncated and hence

$$(3) \qquad E(u_i | y_i<0) = E(u_i | v_i<-X_i\gamma)$$

If u and v are bivariate normally distributed, with means 0, standarddeviations 1 and covariance σ_{12}, the expectation in (3) can be written (Maddala, 1983, p.367):

$$(4) \qquad E(u_i | v_i<-X_i\gamma) = -\sigma_{12}\phi(-X_i\gamma/\Phi(-X_i\gamma)$$

where $\phi()$ is the density function and $\Phi()$is the distribution function of the standard normal distribution.

Equation (4) has the following important implications. If u and v are independent, $\sigma_{12}=0$, $E(u|.)=0$ and (1) can be estimated by OLS. If $\sigma_{12} \neq 0$, OLS applied to (1) would produce biased estimates and other methods would be called for. If in this case the vector $\gamma=0$, the correction for the bias would be quite simple, since $E(u_i|.)$ would be a constant, independent of X_i.[1] If $\sigma_{12} \neq 0$ and $\gamma \neq 0$, consistent estimates of β can be obtained either by applying the maximum likelihood method to joint estimation of (1) and (2) or by a two-step procedure, estimating (2) as a probit-model and then use these estimates to insert (4) as a correction term in (1), generating an estimate of σ_{12} at the same time. The latter method will be applied here.

3. The data

In 1952, a survey was held among children in the sixth grade of the elementary school in the Dutch province of Noord-Brabant, to obtain information on ability, school achievement, family background and related variables. One fourth of the population was sampled, primarily by including every fourth child at the school's list of pupils[3)]. Information about the school and the child's family background was to be given by the head of the school. The organisation of the survey was initiated by the Provincial Government, and cooperation of the schools was virtually complete. To measure the children's ability, some tests were administered to them, an IQ-test and a scholastic achievement test. Even though the return to this survey was not a 100%, there is no reason to doubt its randomness.

In order to reinterview these individuals, the Dutch system of population administration could be used. All inhabitants are legally bound to register in their city's population register, and when they move to live in another area, the city of destination is recorded in their former city of residence. So, starting from the 1952 home address (their parents' address usually), in principle the present address can be retrieved by an administrative tour through the city population register. About 85% of the 1952 addresses were located in 1983, in a procedure that took from Spring 1982 to April 1983.

Those individuals were mailed a questionnaire, with questions about educational career, labor force attachment, labor market position, marital status, family composition and the like at the present time. Two reminders have been sent to non-respondents. Six months after the initial mailing, the remaining male non-respondents were approached by an interviewer, with the same questionnaire. Only males were approached, because of their higher labor force participation rate (research was primarily aimed at working individuals) and because of budgettary restrictions.

Table 1 gives an overview of the results of the data collection. Out of the total sample size in 1952, the response in 1983 was 45%. Out of the sample of addresses, the response rate was 55%. The analysis in this report will consider the total loss between the number of surveys mailed and the number of usable returns, i.e. 45%, as non-response. Although

not all categories so lumped together will be subject to the same attrition rules and causes, from the point of view of selectivity bias it is only the total that counts.

Table 1. Total sample attrition

Sample size 1952		5771	(100.0)	
deceased	122		(2.1)	
emigrated	23		(.4)	
address not found	920		(15.9)	
total not located		1065-	(18.5)	
survey mailing 1983		4706	(81.5)	(100.0)
refusal	717		(12.4)	(15.2)
incorrect address returns	182		(3.2)	(3.9)
no response (females)	1166		(20.2)	(24.8)
Total survey losses		2065-	(35.8)	(43.9)
matching 1952 and 1983 records unsuccesful		54-	(.9)	(1.1)
sample size 1983		2587	(44.8)	(55.0)

4. Estimation results

To answer the questions asked in the previous section, the probit model for non-response was applied to two data-sets, separately for males and females. First, it was estimated on the total sample of individuals for which observation on explanatory variables X_i are available, where the X_i all relate to 1952. Thus, non-response is meant as not returning a questionnaire in 1983. Second, a two-step procedure including wage equation (1) was applied.Now, non-response is meant as lack of observation on the wage rate. Non-return of the questionnaire is augumented by selective non-response on the earnings question which was rather high (29% of the 1983 respondents provided no information on earnings). Generally, one would expect non-response to be lower for children from better family backgrounds and for better performing children. Perhaps one may also expect a positive correlation between partial non-response in 1952 (measured with some dummies) and non-response in 1983.

Results are presented in Table 2, with the first column giving the coefficient and the second the asymptotic t-values. Looking first at the results for the probit model only, it is clear that non-response is not related to family background as measured here. All the variables used are dummy variables. Work at home in the firm would usually involve farm work. Two categories are combined, 'regularly' and 'very often and long', while the omitted category combines 'occasionally' and 'only in the season'. A rating of the family was given by the head of the school, to be chosen from 'definitely anti-social', 'weakly social', 'normal, good family', 'no judgement', and the first two categories are combined here. 'Both parents present' contrasts with situations where one or both parents are absent due to death, divorce or other reason. Neither for females nor for females is any of these background variables significant.

Among the variables combined as 'child quality' the teacher's advice has never any significant effect on non-response, but the other variables do, in the expected direction. The results jointly support the hypothesis that abler, scholastically more succesful persons are more inclined to fill out a questionnaire. If the child failed one or more

Table 2. Probit estimates for non-response

	males				females			
	probit only		two-step		probit only		two-step	
intercept	0.279	(1.13)	.727	(2.73)**	0.913	(3.17)**	2.025	(6.24)**
Family background								
work in firm at home								
-often or regularly	-0.098	(-0.83)	-.113	(- .86)	-0.037	(-0.35)	0.002	(0.02)
-not	0.013	(0.16)	-.077	(- .87)	-0.049	(-0.64)	-0.124	(-1.36)
family situation								
anti or weakly social	0.036	(0.40)	-.052	(- .54)	0.204	(1.85)	0.057	(0.46)
oldest child	-0.012	(-1.27)	-.012	(-1.03)	0.0007	(0.06)	0.011	(0.83)
both parents present	-0.022	(-0.20)	-.092	(- .79)	-0.068	(-0.50)	-0.019	(-0.13)
Quality of child								
failed one/more years	0.119	(2.99)**	.203	(4.77)**	0.121	(2.50)**	0.157	(2.81)**
IQ	-0.005	(-2.18)**	-.007	(-2.93)**	-0.002	(-0.71)	-0.005	(-1.69)
scholastic achievement score	0.032	(1.19)	.034	(1.20)	-0.089	(-2.73)**	-0.164	(-4.33)**
teachers advice:								
-lower secondary	0.004	(0.06)	.032	(.42)	-0.037	(-0.46)	-0.144	(-1.62)
-higher secondary	-0.056	(-0.56)	- .063	(- .60)	-0.021	(-0.19)	-0.161	(-1.32)
Early non-response								
non-response for:								
-work in firm at home	0.133	(0.98)	- .099	(- .73)	-0.032	(-0.27)	-0.376	(-2.89)**
-family situation	-0.155	(-0.17)	-1.653	(-7.68)**	a)		a)	
-oldest child	-0.095	(-0.70)	.399	(2.17)*	-0.146	(-0.50)	-0.572	(-1.98)*
-failed in school	0.243	(0.86)	.217	(.67)	a)		a)	
-IQ	-0.561	(-2.07)**	- .884	(-3.03)**	-0.275	(-0.84)	-1.002	(-2.74)**
-scholastic achievement score	0.250	(1.52)	.222	(1.27)	-0.370	(-2.21)*	-0.763	(-3.89)**
teacher advice	0.030	(0.14)	.302	(1.23)	0.099	(0.48)	-0.283	(-1.36)
n	2391		2181		2032		1789	
degrees of freedom	17		17		15		15	
likelihoodratio	57.28				78.63			
Pseudo -R^2	0.031		0.249		0.052		0.219	

a) not included for lack of variation
*) significant at 2.5%
**) significant at .5%

classes in grade school, the probability of non-response is increased, both for males and females. As to ability, higher IQ reduces non-response for men, whereas higher scholastic achievement score does the same for females. One might be led to think that the two variables are so similar, that they may act as each other's substitute; some support for this idea is given by the high intercorrelation of .71 for men and women alike. The IQ-score applies to a standard test, abbreviated for the 1952 survey, and consisting of 6 subtests (algebraic series, analogies in figures and in words, similarities between concepts, spatial orientation and conceptual relations). The scholastic achievement test was developed by the 1952 research group, with 20 questions at least for each of 7 fields. Later, after evaluating intercorrelations among the 18 subtests involved, results for 6 subtests were taken apart for extended research purposes: history, physics, arithmetic, reading, expression and completion exercises. For the present purposes, the mean score on these 6 tests is used (graded from 0 to 10). The research group preparing these subtests data for their own research (published in 1958), after reviewing both the literature and the nature of the tests, had greater confidence in the scholastic achievement score than the IQ-score to predict further successes.[4] In logit analyses of non-response, applied as a cheap reconnaissance of the dataset, IQ and scholastic achievement have been used alternatively in otherwise identical specifications. It then turned out that for females IQ became significant (negative) if used without including scholastic achievement, while the latter would remain significant if used alone. For males, scholastic achievement is not significant even if IQ is eliminated. Whereas for females, the two variables appear substitutes of one another, for males the two variables have clearly different effects. Searching for an explanation, one might think that scholastic achievement measures the combined effect of ability and effort, and that IQ is closer to measure ability <u>per se</u>. Then, a more uniform effort by girls would make both measures much alike, more so than for boys, with a more uneven distribution of effort. However, this argument is invalidated by the equally high correlation coefficient between the two measures for boys and girls. So, it's not yet clear what the answer must be.

The early non-response variables have been brought in both to prevent the need to throw out a whole record for any missing observation and to see if there is any relation between the non-response at the two dates. It turns out that for males, only non-response on IQ-score affects later total non-response significantly, while for females this occurs with respect to scholastic achievement score. Conclusions are hard to draw, however, as the reasons for non-response in the 1952 survey are not clear and probably mainly related to random events (e.g. sickness or absence for any other reasons on day of testing).

If the dataset is reduced to allow the two-step procedure including the wage equation, there are no substantial changes in the systematic part of the model (family background and quality of the child). Neither the significance levels nor the magnitudes of coefficients change dramatically. The only changes occur in the intercept and in the early non-response. In the probit model sec, females had a significantly positive intercept, while the male intercept was not significantly different from zero. This difference seems to point to the differences in sampling procedure, where males are harder pressed to answer. However, the other coefficients differ as well, so a more precise comparison should be made. If the probability of non-response is compared for standardized individuals (say,all dummies equal to zero, IQ = 100, scholastic test score = 7), the difference is minor, if not negligible: .52 for males, .54 for females in the probit model, .60 for males, .65 for females in the two-step model.[5)] The difference between the two models can be explained from the high non-response rate on the earnings question included in the second model (which will be larger for females due to higher non-participation in the labor force). The very small difference in response rates for males and females in a standardized comparison is remarkable and suggests that the structure of non-response is not affected by the nature of the sampling method (mail or mail + interview). Only the total rate of non -response seems affected.

As to the additional significant effects of early non-response in the two-step model, this should be related to the non-response on the earnings question. The results suggest a relation between them, but again, as the reasons for early non-response are hard to trace, interpretation of the relation will be difficult.

Estimated earnings functions are presented in Table 3, with coefficients in the first column and t-ratio's in the second of each entry. Earnings is measured as net hourly earnings (net of taxes and social security contributions), calculated by dividing reported net earnings per period (including vacation pay and profit-sharing) by reported average hours per period. The earnings function is very simple, and uses only 1983 observations, since the estimation is just meant as an illustration. The most important thing to note is the insignificance of Heckman's λ (the selectivity term of equation (4)) in both the male's and the female's wage equation. This indicates that the co-variance between errors in the non-response model and the earnings function does not differ significantly from zero. Hence, one need not fear selectivity bias in estimating an earnings function like the one specified here, including education dummies, a dummy for not graduating from the highest level of education attended, hours worked and job level. Job level is a 7 grade ordinal ranking of jobs by level of difficulty and complexity of the activities to be performed. Here, only a simple linear specification is used; more laborate work is contained in e.g. Hartog (1986a,b) (more elaborate work on non-graduation is in Hartog (1983).

Most remarkably, with the exception of hours worked for females, none of the other variables has any significant effect on earnings, although the variables are quite standard in related work. This effect disappears if the earnings function is estimated without the selectivity correction. Then, quite normal earnings functions emerge, with perhaps only some unexpectedly low significance for lower education levels for females. For both males and females, the coefficients do not differ much between specifications, only the estimated standard errors do.

5. Concluding remarks

This paper studied non-response to a follow-up survey held 30 years later among a random sample of sixth-graders of 1952. The original 1952 observations were used as explanatory variables, and this has led to some interesting results.

1. Non-response appeared unrelated to any of the earlier family background variables available here.

Table 3. Earnings functions: the effect of correction for non-response (two-stage probit estimates)

	males				females			
	with bias correction		without bias correction		with bias correction		without bias correction	
	coeffic.	t-value	coeffic.	t-value	coeffic.	t-value	coeffic.	t-value
intercept	19.313	(2.45)**	18.401	(22.50)**	9.403	(1.62)	9.011	(12.31)**
Heckman's λ	- 1.112	(- .21)			- 0.328	(-0.08)		
job level	1.130	(1.56)	1.142	(12.88)**	1.291	(1.51)	1.301	(7.37)**
education:								
-lower vocational	- .843	(-.33)	- 0.810	(-2.65)**	.256	(0.09)	0.227	(0.41)
-intermediate vocational	.188	(.28)	1.240	(2.44)**	.365	(0.10)	0.388	(0.52)
-intermediate general	3.227	(.63)	3.281	(5.24)**	0.559	(0.11)	0.641	(0.63)
-higher vocational	2.544	(.66)	2.615	(5.57)**	4.257	(1.08)	4.337	(5.43)**
-university	7.448	(1.35)	7.551	(11.22)**	9.926	(1.19)	10.037	(5.86)**
-unknown	- 1.075	(.15)	- 0.958	(-1.09)	0.463	(0.05)	0.475	(0.24)
-not finished	- .406	(.14)	- 0.377	(-1.08)	- 0.272	(-0.10)	- 0.271	(- 0.50)
hours worked	- .255	(1.70)	-0.256	(-13.89)**	- 0.207	(- 3.06)**	- 0.207	(- 14.68)**
n	2181		1076		1789		492	
R^2	0.427		0.426		0.533		0.533	

*) significant at 2 ½ %

**) significant at ½ %

a) If the bias correction is included, n measures total sample size, not only the observations for the earnings

2. Ability scores and failures in grade school did have the expected effect on the probability of non-response (negative for ability, positive for failures), but the effect was produced differently for males and females. For males, only the IQ score had a significant effect, while for females either IQ score or scholastic achievement score could be used to generate the same result (but not both at the same time).
3. The different sampling procedures for females (mail questionnaire only) and males (mail questionnaire and interview of non-respondents), while obviously affecting the level of non-response, had virtually no effect on the structure of non-response, i.e. the relation to childhood variables. In fact, predicted non-response for comparable males and females differs only slightly.
4. The correction for non-response in a simple earnings function turned out to be insignificant, only blowing up standard errors of the other variables' coefficients. The implied insignificant covariance between errors in the non-response equation and in the earnings equation gives support to earnings function estimates not corrected for selectivity bias. This is comforting as some of the models involved are rather complex. Obviously, however, insignificant covariance in the present specification does not imply insignificance in other specifications.

Notes

*. The paper was written while I was visiting at Queen's University in Canada where the Department of Economics partially financed my stay; I am grateful to Michael Visser for skillful computer assistance and diligent work effort. Comments by Aldi Hagenaars and Jules Theeuwes are gratefully acknowledged.

1).The correction would involve no more than subtracting the constant from all the w_i realizations; this also holds if only the intercept term in γ would be non-zero.

2).A detailed accounted of the data collection is given (in Dutch) in Hartog & Pfann (1985).

3).Some schools had school years beginning in April rather than in September. For these schools, half the pupils of half the schools were included in the sample; this yielded 369 answers (among a total of 5823).

4).This expectation was proven correct in Hartog & Van Ophem (1986).

5).The probability of non-response for a standard male (all dummies at zero, IQ = 100, scholastic achievement score = 7) in the probit-only model is the area under the standard normal distribution up to z = .279 - (.005) 100 + (.032)7 = + .052.
The other calculations are similar.

Ontvangen: 04-02-1987
Geaccepteerd: 20-08-1987