KEIO UNIVERSITY
MARKET QUALITY RESEARCH PROJECT
(A 21st Century Center of Excellence Project)

KUMQRP DISCUSSION PAPER SERIES

DP2006-031

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Abstract

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Abstract

The paper examines attrition in the Keio Household Panel Survey (KHPS) 2004–2006 and assesses the extent of attrition bias for a specific empirical example, household residential mobility, using information about interviewing process as identifying instruments for sample selection model. The results show that sample attrition does lead to statistically significant bias in the coefficient estimates of household residential mobility functions. Since it is typically difficult to determine the bias for a particular analysis a priori, it requires researchers to evaluate the effects of attrition in their analyses.

Key words: Residential Mobility, Attrition Bias, Sample Selection Model, Interviewing Process.

JEL classification: C33, C81, R23

⋆ The author is grateful to the 21st Century Center Of Excellence program at Keio University for generously providing us with the data (Keio Household Panel Survey). The author would like to thank Miki Seko, Colin McKenzie, Yoshio Higuchi, Kazuo Yamaguchi, and participants at the 20th Annual Meeting of the Applied Regional Science Conference at Hiroshima University for their helpful comments and suggestions.

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Introduction

Panel data often provide basis for understanding household behavior not possible with cross-sectional information alone. However, a typical concern in longitudinal research is that there can be substantial sample attrition caused by a survey refusal or death of the respondents. Sample attrition not only undermines the representativeness of the data over time but also biases inferences for specific application.

Generally, nonrandom attrition in panel data can be considered as sample selection problem, and, hence,.usual model of sample selectivity can be used to correct attrition bias (Maluccio, 2004; Behr, 2004; Ziliak and Kniesner, 1998; Hausman and Wise, 1979).[1] Aside from nonlinearity in the correction term of sample selectivity (e.g., inverse Mills ratio under usual bivariate normality assumption), identification of the "behavioral" coefficients requires an exclusion restriction, namely, there should be an instrument that affects nonresponse while independent from the behavior of interest.

However, finding a suitable instrument for unobservable selection is often difficult for the case of nonresponse because there are few variables that affect nonresponse that can be safely excluded from the main "behavioral" equation. While the situation depends on the specific model under consideration, individual/household characteristics are unlikely to be sources of instruments because most such characteristics are related to behavior in general (Fitzgerald, Gottschalk, and Moffit, 1998; Wooldridge, 2002).

More convincing candidates are variables external to the individual which are

[1] Under the assumption of "selection on observables," Inverse Probability Weighting (IPW) can also be used to account for attrition bias (Fitzgerald, Gottschalk, and Moffit, 1998; Wooldridge, 2002). Other studies examine the effect of sample attrition by comparing respondents within a single dataset (attriters vs. non-attriters: Fitzgerald, Gottschalk, and Moffit, 1998; Ziliak and Kniesner, 1998), or across different datasets (CPS vs. SIPP: Neumark and Kawaguchi, 2004).

not under his/her control, the interviewing process. Fortunately, in the survey used in this paper, detailed information about interviewing process, such as contact history and the list of interviewers assigned to each respondent, is available from supplemental questionnaire. Since interviewing process is closely associated with nonresponse (Bates, 2004, 2003; Hill and Willis, 2001; Zabel, 1998), and each survey interviewer is randomly assigned to respondents in general,[2] these information can be used as identifying instruments for sample selection model.

The paper examines the attrition bias in the Keio Household Panel Survey (KHPS) 2004–2006, with special reference to the household residential mobility that should be strongly associated with sample attrition. Using unique information about interviewing process as identifying instruments, we assess the extent of attrition bias by implementing a method of sample selection correction. The results show that attrition does lead to statistical bias in the estimation of household residential mobility functions in a manner that the estimated coefficients are "inflated."

The organization of the paper is as follows. In Section 1, we briefly introduce the KHPS, and summarize its attrition pattern. In Section 2, we explain estimation method, variables, and results, respectively. Section 3 concludes the discussion.

1 Sample Attrition in KHPS

The Keio Household Panel Survey (KHPS), sponsored by the Ministry of Education, Culture, Sports, Science and Technology, is the first comprehensive

[2] The situation is somewhat different in other surveys. For example, interviewers of PSID are assigned on the basis of respondent characteristics. In such a case, interviewing process might be correlated with respondent characteristics, and, hence, with the behavior of interest.

panel survey of households in Japan conducted annually from 2004 by Keio University. Questionnaires were left for self-administration with 4005 male and female respondents aged 20 to 69 who were selected by stratified two-stage random sampling. If the primary respondent was married at the time of the survey, same questionnaire was given for his/her spouse. The standard procedure for the KHPS was to send a pre-survey letter to the respondent and then provide a post-interview payment of 3,000 yen (about $25) per household. Although the overall response rate was not so high (29.8%), the age and sex distribution of the 4005 respondents is quite similar to that of the Japanese population. [3]

By 2006 the KHPS had experienced approximately 28% sample loss from cumulative attrition from its initial 2004 sample. Compared with other longitudinal surveys, there is somewhat heavy attrition in KHPS, possibly due to fairly long and comprehensive questionnaire. For example, cumulative attrition rate for first three waves are about 15% in PSID and 5.7% in NLSY (Fitzgerald, Gottschalk, and Moffit, 1998; Branden, Gritz, and Pergamit, 1995). For European Community Household Panel (ECHP), these figures range from 12.1% (Germany) to 36.5% (Denmark) (Peracchi, 2002). At any rate, heavy attrition in KHPS suggests that its effect should be examined in the analyses.

Moreover, it is shown that residential mobility is one of the most important factor determining the panel attrition. Table 1 gives the cross tabulation of residential mobility and sample attrition. [4] It is found that residential mobility is strongly and positively related to the sample attrition; 36.3% of movers attrited from the survey at wave 2, while only 15.9% of non-movers attrited. Same pattern can be observed for wave 3 (the difference between attrition rates are even larger). Since sample attrition poses even more serious problem

[3] For more general discussion of KHPS, see Moriizumi and Naoi (2006).

[4] Note that, in Table 1, residential mobility (whether or not the respondent moves from the previous interview) is based on the information answered by the interviewer, rather than self-answered question by each respondent.

when it is not independent from behavior of interest, this suggests that one should care about the extent of attrition bias for an analysis of household residential mobility.

(Table 1 around here)

2 Residential Mobility and Sample Attrition

2.1 Empirical Model and Variables

As mentioned above, our primary interest is on the binary choice of residential mobility, which can be observed only if the respondent remains in the panel. To estimate such a model, we use the method proposed by Van de Ven and Van Pragg (1981), which extends Heckman's (1979) selection model to the case of a probit with sample selection. The model is formally given as follows.

$$y_{it}^* = x_{it}\beta + \varepsilon_{it}, \tag{1}$$

$$y_{it} = \left\{ \begin{array}{c} 1 \\ \\ 0 \end{array} \right\} \quad \text{if} \quad y_{it}^* \left\{ \begin{array}{c} > \\ \\ \leq \end{array} \right\} 0, \tag{2}$$

where y_{it} takes one if household i moves between wave $t-1$ to t,which is observed if i stays in wave t, and x_{it} is the relevant set of explanatory variables. Following previous studies on the residential mobility, x_{it} includes respondent's age, sex, marital status, educational attainment, health condition[5], employment status[6], whether there are children, changes in household type

[5] Respondent's health condition is represented by a 5-point Likert scale ranging from 1 (good) to 5 (bad).

[6] For respondent's employment status, we use set of dummy variables for firm size (reference=unemployed), full-time employment, and retirement.

and composition[7], housing tenure, and region of household's residence.[8]

For attrition equation, the model is given as

$$s_{it}^* = x_{i1}\gamma + z_{i2}\delta + \nu_{it}, \tag{3}$$

$$s_{it} = \left\{ \begin{array}{c} 1 \\ \\ 0 \end{array} \right\} \quad \text{if} \quad s_{it}^* \left\{ \begin{array}{c} > \\ \\ \leq \end{array} \right\} 0, \tag{4}$$

where s_{it} takes one if household i remains in the wave t panel and zero otherwise, x_{i1} is the same set of explanatory variables as in equation (1) but with its value at the first wave, and z_{i2} is the identifying instruments excluded from the main equation (1), which we will give detailed explanation later. With the assumption that ε_{it} and ν_{it} are joint normally distributed, existence of attrition bias can be tested by $\rho = 0$,either by Wald or likelihood ratio test.

The key variables in equation (3) is the identifying instrument z_{i2} that is excluded from equation (1). We use information about interviewing process to construct these variables. Supplemental questionnaire of KHPS gives detailed information about (a) contact history (up to five visits) answered by each interviewer, and (b) full list of assignment of interviewers to the targeted respondents. Using these information, we construct following four variables for z_{i2}; (1) the month of first contact by the interviewer, (2) whether or not the interviewer visits targeted respondent in weekend (1 if all visits are made in weekday), (3) number of respondents (including targeted respondent himself) that the interviewer is in charge, and (4) whether or not the same interviewer is assigned as in the first wave. The first two variables are constructed

[7] Changes in household type and composition are (1) changes in the number of household member (increased, decreased, no change = reference), (2) getting married, and (3) having newborn child between wave $t-1$ and t.

[8] Since housing tenure and residential region are likely to be simultaneously determined with household mobility, we use one-year lagged value for these two variables.

from the contact history information, while the latter two are from the list of interviewer–respondent matching.

Given that there is certain time-constraint on the interviewing process, and that each interviewer must allocate his/her time to the targeted respondents that he/she is in charge, the first and third variables will capture the interviewer's potential effort toward each targeted respondent, namely, a slow start of the interviewing process or handling too many respondents are likely to end up in failure. The second variable is used to take account of the difficulties of making contact with targeted respondent. Since it seems difficult to make contact with targeted respondent in weekday, especially when he/she is working full-time, this variable is likely to have negative impact on survey responses (Bates, 2003, 2004). The last variable, assigning the same interviewer wave after wave, is included to control for some form of "familiarity" or "trust" between the interviewer and respondent, which might reduce the implicit cost of participating the survey (Hill and Willis, 2001; Zabel, 1998).

2.2 Results

The results of the estimation of equation (1) and (3) as a system are shown in Tables 2 and 3. Summary statistics are presented in Table A1.

(Tables 2 and 3 around here)

Table 2 presents estimated coefficients of the various predictors on Wave 2 and Wave 3 participations, respectively. Dummy variables for regions are also controlled but omitted from the results. For explanatory variables, we use respondent/household characteristics at wave 1, and the interviewing process at wave 2.

First of all, the result of Wald test shows that the null hypothesis of no attrition bias, i.e., $\rho = 0$, is rejected in both models. However, likelihood ratio test gives slightly different result. While the null of $\rho = 0$ is also rejected in Wave 2, it is not in Wave 3 model. Perhaps this is due to the differences in the pattern and determinants of Wave 2 and Wave 3 response behavior (McKenzie, Miyauchi, Naoi, and Kiso, 2007). Because Nawata and McAleer (2001) show that the Wald test of $\rho = 0$ often excessively reject the null, and the likelihood ratio test is preferable with small sample, it is fair to say that household residential mobility function is biased at least in Wave 2 panel.

Table 3 presents estimated coefficients of respondent/household characteristics on residential mobility. To assess the extent of attrition bias for each parameter estimate, baseline model, estimated by standard probit model using only non-attriter, is presented along with the more appropriate probit model with sample selection. We also estimated the model with interviewer fixed effect (i.e., including interviewer dummy variables), which shows qualitatively same result as in Table 3.

Since we have strong evidence of attrition bias for Wave 2 panel, we will confine our discussion primarily to the results of Model [1] (wave 2). Comparing the results for probit with sample selection with uncorreted probit, it is found that most of estimated coefficients are "inflated" in the baseline model, i.e., estimated coefficients in the uncorrected probit model are larger in absolute value than in bias–corrected model. For example, the estimate coefficient of "full-time employment" in the uncorrected model (0.3145) is about 6% larger than its corrected value (0.2966). This is especially serious problem because the estimated coefficient becomes excessively significant when there is sample attrition bias.

To sum, the results show that attrition does lead to statistical bias in the estimation of household residential mobility functions at least in the Wave

2 panel, and that attrition bias leads to too large estimated coefficients in uncorrected models.

3 Conclusion

The paper examines attrition in the Keio Household Panel Survey (KHPS) 2004–2006 and assesses the extent of attrition bias for a specific empirical example, household residential mobility, using information about interviewing process as identifying instruments for sample selection model. The results show that sample attrition does lead to statistically significant bias in the coefficient estimates of household residential mobility functions. Since it is typically difficult to determine the bias for a particular analysis a priori, and such bias is by its nature model-specific, it requires researchers to evaluate the effects of attrition in their analyses.

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Table 1: Cross Tabulation of Mobility and Attrition

2005 (wave 2)		Attrition Status in wave *t*		Total
		Attrited	Survived	
Mobility between wave *t* - 1 and *t*	Not Move	604 (15.9)	3,191 (84.1)	3,795 (100.0)
	Move	70 (36.3)	123 (63.7)	193 (100.0)
	Total	674 (16.9)	3,314 (83.1)	3,988 (100.0)

2006 (wave 3)		Attrition Status in wave *t*		Total
		Attrited	Survived	
Mobility between wave *t* - 1 and *t*	Not Move	315 (10.1)	2,807 (89.9)	3,122 (100.0)
	Move	37 (32.5)	77 (67.5)	114 (100.0)
	Total	352 (10.9)	2,884 (89.1)	3,236 (100.0)

Note: Row percentages are in the parentheses.

Table 2: Estimation Results for Survey Response

Model	[1] 2005 (wave2)		[2] 2006 (wave 3)	
Survey Response	Probit with Sample Selection		Probit with Sample Selection	
(=1 if R responds wave t panel)	Coef.	(S.E.)	Coef.	(S.E.)
Respondent Characteristics				
Age				
20-29	—		—	
30-39	0.1344	(0.0918)	0.2069	(0.0813) *
40-49	0.1998	(0.0984) *	0.1945	(0.0864) *
50-59	0.0590	(0.0974)	0.1003	(0.0871)
60+	0.0865	(0.1052)	0.1190	(0.0939)
Sex (=1 if R is female)	0.0613	(0.0603)	0.0298	(0.0534)
Marital status (=1 if R is married)	0.0893	(0.0861)	0.1052	(0.0766)
No child (=1 if R has no child(ren))	-0.1099	(0.0766)	-0.1130	(0.0688)
Health condition (1: Good - 5: Bad)	-0.0213	(0.0243)	-0.0286	(0.0219)
Education				
Junior high school	-0.1388	(0.0854)	-0.0892	(0.0772)
High school	—		—	
Junior college	0.2813	(0.0895) **	0.2096	(0.0765) **
4-year college+	0.1155	(0.0704)	0.0971	(0.0619)
Other professional school	0.0777	(0.1318)	0.1154	(0.1163)
R's firm size				
Unemployed	—		—	
1-4 person	0.3328	(0.0903) **	0.3092	(0.0788) **
5-29 person	0.0122	(0.0874)	-0.0058	(0.0777)
30-99 person	-0.0051	(0.1033)	-0.0576	(0.0937)
100-499 person	0.1698	(0.1023) +	0.1101	(0.0917)
500 person+	0.2205	(0.1030) *	0.1882	(0.0913) *
Government	0.3226	(0.1545) *	0.2661	(0.1345) *
Full-time employment	-0.0821	(0.0710)	-0.0308	(0.0633)
Retired	0.3806	(0.1505) *	0.2008	(0.1249)
Household Characteristics				
Changes in HH type and composition				
# of HH member				
Unchanged	—		—	
Increased	0.2320	(0.1834)	0.0560	(0.1509)
Decreased	-0.0341	(0.1029)	-0.0669	(0.0914)
R is newly wed	0.5414	(0.3737)	0.3354	(0.2730)
R has newborn child(ren)	-0.3129	(0.2368)	-0.0655	(0.2020)
Place of residence				
14 major cities	-0.2042	(0.0844) *	-0.1027	(0.0747)
Other cities	-0.0722	(0.0696)	-0.0272	(0.0609)
Town/village	—		—	
R owns house	-0.0351	(0.0646)	-0.0306	(0.0583)
Interview Process Characteristics (wave 2)				
Month of first visit	-0.2359	(0.0507) **	-0.0951	(0.0440) *
All visits in weekday	-0.1680	(0.0576) **	-0.0907	(0.0515) +
# of Interviewees in charge	-0.0072	(0.0049)	-0.0099	(0.0043) *
Interviewer changed	-0.2435	(0.0701) **	-0.2178	(0.0645) **
Constant	1.3901	(0.2278) **	0.8232	(0.2012) **
ρ	0.7533	(0.2957) *	-0.6672	(0.3087) *
Likelihood Ratio Test (H_0: $\rho = 0$)	7.60 **		1.70	
Log Likelihood	-1983.522		-2374.923	
Number of Observations	3,592		3,626	
Number of Censored Observations	601		995	

Note:
**, *, + indicates that estimated coefficient is significant at 0.01, 0.05, and 0.10 levels, respectively. A set of dummy variables for regions is also controlled but omitted from the results. Wave 1 values are used for all explanatory variables except for interviewing process characteristics. Corresponding estimation results for residential mobility are shown in Table 3.
Dependent variables:
Model [1]: 1 if R responds 2005 survey, 0 otherwise.
Model [2]: 1 if R responds both 2005 and 2006 survey, 0 otherwise.

Table 3: Estimation Results for Household Residential Mobility

Model	[1] 2005 (wave 2)				[2] 2006 (wave 3)			
Residential Mobility	Baseline Model		Probit with Sample Selection		Baseline Model		Probit with Sample Selection	
(=1 if HH moved from *t*-1)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)	Coef.	(S.E.)
Respondent Characteristics								
Age								
20-29	—		—		—		—	
30-39	-0.0574	(0.1338)	-0.0387	(0.1268)	-0.3138	(0.1693) +	-0.3468	(0.1451) *
40-49	-0.4612	(0.1585) **	-0.4086	(0.1513) **	-0.3104	(0.1814) +	-0.3541	(0.1554) *
50-59	-0.6420	(0.1774) **	-0.5977	(0.1695) **	-0.7576	(0.2191) **	-0.7038	(0.2141) **
60+	-0.5948	(0.2095) **	-0.5451	(0.2003) **	-0.6366	(0.2382) **	-0.6072	(0.2186) **
Sex (=1 if R is female)	0.1317	(0.1155)	0.1410	(0.1101)	-0.1317	(0.1308)	-0.1167	(0.1137)
Marital status (=1 if R is married)	-0.2371	(0.1741)	-0.1986	(0.1668)	0.0962	(0.1824)	0.0314	(0.1618)
No child (=1 if R has no child(ren))	-0.1924	(0.1684)	-0.1900	(0.1616)	0.2165	(0.1678)	0.2147	(0.1436)
Health condition (1: Good - 5: Bad)	-0.0212	(0.0478)	-0.0191	(0.0454)	-0.0135	(0.0579)	-0.0107	(0.0490)
Education								
Junior high school	-0.2262	(0.2175)	-0.2376	(0.2071)	-0.3230	(0.2555)	-0.2252	(0.2317)
High school	—		—		—		—	
Junior college	-0.1457	(0.1491)	-0.0800	(0.1441)	-0.0082	(0.1666)	-0.0865	(0.1504)
4-year college+	0.0461	(0.1218)	0.0741	(0.1170)	0.0275	(0.1345)	-0.0076	(0.1172)
Other professional school	-0.1232	(0.2272)	-0.0966	(0.2182)	-0.3642	(0.3303)	-0.3668	(0.2841)
R's firm size								
Unemployed	—		—		—		—	
1-4 person	-0.3522	(0.1756) *	-0.2986	(0.1685) +	0.0903	(0.2103)	-0.0157	(0.1930)
5-29 person	-0.1380	(0.1634)	-0.1262	(0.1552)	0.1918	(0.2144)	0.1443	(0.1882)
30-99 person	-0.2621	(0.1917)	-0.2432	(0.1824)	0.2393	(0.2375)	0.1923	(0.2083)
100-499 person	-0.5722	(0.2018) **	-0.5189	(0.1920) **	0.1663	(0.2191)	0.1167	(0.1889)
500 person+	-0.3479	(0.1808) +	-0.2995	(0.1724) +	0.1769	(0.2167)	0.1054	(0.1933)
Government	-0.0928	(0.2347)	-0.0448	(0.2238)	0.2629	(0.2893)	0.1643	(0.2586)
Full-time employment	0.3145	(0.1293) *	0.2966	(0.1227) *	-0.0543	(0.1436)	-0.0412	(0.1228)
Retired	-0.2887	(0.4566)	-0.2518	(0.4427)	0.3624	(0.3226)	0.2624	(0.2858)
Household Characteristics								
Changes in HH type and composition								
# of HH member								
Unchanged	—		—		—		—	
Increased	0.4312	(0.2468) +	0.3881	(0.2362)	0.6847	(0.2700) *	0.5695	(0.2633) *
Decreased	0.4408	(0.1765) *	0.4171	(0.1678) *	0.0662	(0.2385)	0.0689	(0.1969)
R is newly wed	1.7777	(0.3187) **	1.5784	(0.3129) **	2.1007	(0.3434) **	1.8166	(0.4510) **
R has newborn child(ren)	-0.6056	(0.3360) +	-0.5367	(0.3208) +	-0.1221	(0.3814)	-0.1126	(0.3266)
Place of residence								
14 major cities	-0.1133	(0.1545)	-0.1395	(0.1475)	-0.3132	(0.1906)	-0.2237	(0.1838)
Other cities	-0.1949	(0.1327)	-0.1947	(0.1271)	-0.0586	(0.1580)	-0.0315	(0.1365)
Town/village	—		—		—		—	
Own House	-1.1169	(0.1036) **	-1.0679	(0.1005) **	-0.7894	(0.1158) **	-0.6546	(0.1874) **
Constant	-0.5130	(0.3826)	-0.7254	(0.3648) *	-1.4923	(0.4798) **	-0.8832	(0.5735)
Log Likelihood	-431.978		-1983.522		-316.215		-2374.923	
Number of Observation	2,991		3,592		2,631		3,626	
Number of Censored Observation	—		601		—		995	

Note:
**, *, + indicates that estimated coefficient is significant at 0.01, 0.05, and 0.10 levels, respectively. A set of dummy variables for regions is also controlled but omitted from the results. Variables for place of residence and housing tenure are one-year lagged. Corresponding estimation results for survey response are shown in Table 2.

Table A1: Descriptive Statistics

	2004 (1st wave)			2005 (2nd wave)			2006 (3rd wave)		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Residential mobility (1=moved)		—		0.048	0	1	0.035	0	1
Survey response (=1 if R responds wave *t* panel)[1)]		—		0.833	0	1	0.726	0	1
Respondent Characteristics									
Age	46.372	20	70	47.402	21	71	48.439	22	72
Sex (1=female)	0.495	0	1	0.497	0	1	0.491	0	1
Married	0.736	0	1	0.750	0	1	0.759	0	1
No child	0.398	0	1	0.384	0	1	0.384	0	1
Health condition (1: good - 5: bad)	1.955	1	5	2.335	1	5	2.344	1	5
Education									
Junior high school	0.116	0	1	0.110	0	1	0.109	0	1
High school	0.490	0	1	0.485	0	1	0.481	0	1
Junior college	0.124	0	1	0.132	0	1	0.132	0	1
4-year college+	0.226	0	1	0.230	0	1	0.232	0	1
Other professional school	0.043	0	1	0.044	0	1	0.046	0	1
Firm size									
1-4 person	0.161	0	1	0.188	0	1	0.186	0	1
5-29 person	0.171	0	1	0.145	0	1	0.144	0	1
30-99 person	0.100	0	1	0.097	0	1	0.084	0	1
100-499 person	0.122	0	1	0.127	0	1	0.130	0	1
500 person+	0.142	0	1	0.144	0	1	0.150	0	1
Government	0.043	0	1	0.048	0	1	0.048	0	1
Full-time employment	0.378	0	1	0.364	0	1	0.368	0	1
Retired	0.044	0	1	0.049	0	1	0.059	0	1
Household Characteristics									
Changes in HH type and composition									
Number of household member									
Increased	0.055	0	1	0.058	0	1	0.043	0	1
Decreased	0.066	0	1	0.068	0	1	0.066	0	1
R is newly wed	0.009	0	1	0.007	0	1	0.007	0	1
R has newborn child(ren)	0.031	0	1	0.026	0	1	0.018	0	1
Residence									
14 major cities	0.241	0	1	0.238	0	1	0.242	0	1
Other cities	0.564	0	1	0.565	0	1	0.585	0	1
Town/village	0.195	0	1	0.197	0	1	0.173	0	1
Owned house	0.765	0	1	0.767	0	1	0.777	0	1
Interviewing Process[2)]									
Month of first visit		—		1.767	1	4		—	
All visits in weekday		—		0.261	0	1		—	
# of interviewees in charge		—		13.205	1	41		—	
Interviewer changed		—		0.147	0	1		—	
Number of Observations		3,592			2,991			2,631	

1) # of obs. = 3,592 (2005) / # of obs. = 3,626 (2006)