Using Contact History Information to Adjust for Nonresponse in the Current Population Survey

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Abstract
The Current Population Survey (CPS) adjusts the sampling weights for nonresponse to match population controls based on cells which combine similar primary sampling units (PSU) based on size and urbanicity. The adjustment method assumes that the nonresponse is random within the adjustment cells. This adjustment increases weights for responding units in PSUs with higher nonresponse. The present study uses information from the Contact History Instrument (CHI) to adjust the weights based on the patterns of responses interviewers experience in contacting and attempting to interview households. This paper explores whether this additional adjustment has the potential to reduce nonresponse bias.

Key Words: Nonresponse, weighting, Contact History Instrument

1. Introduction

The proportion of sample households not interviewed in the CPS due to non-contact or refusals typically varies between 8 and 9 percent. The weights for all interviewed households are adjusted to account for occupied sample households for which no information was obtained because of the occupants' absence, impassable roads, refusals, or unavailability of the respondents for other reasons. This non-interview adjustment is made separately for clusters of similar sample areas that are usually, but not necessarily, contained within a state (BLS Handbook of Methods, 2012). Since the adjustment method assumes that the nonresponse is random within the adjustment cells, this adjustment increases weights for responding sample units in PSUs with higher nonresponse. This usually produces greater variance in estimates.

The Contact History Instrument (CHI) was designed to collect information about each contact attempt made by a field representative (FR), including information about why respondents refuse and what actions the FR took to attempt to obtain the interview (Dyer, 2004).

The present study uses information from the Contact History Instrument (CHI) to adjust the weights based on the patterns of responses interviewers record while attempting to contact and interview households. This unique source of information provides additional adjustment data that has the potential to reduce nonresponse bias. Since the reasons for nonresponse are obtained from both the nonrespondents and respondents, the relationship between nonresponse and survey estimates can be modeled.

2. Data Sources

Details about the CPS can be found in Technical Paper 66. The CPS is the primary source of information on the labor force characteristics of the U.S. population. The CPS uses a multistage probability sample based on the population counts from the decennial census, with coverage in all 50 states and the District of Columbia. The sample is continually updated to account for new residential construction.

In the first stage of the sampling process, PSUs are stratified within states and selected for sample with the probability of selection proportional to the population of the PSU (usually PSUs are counties, although some sparsely populated counties are combined). Metropolitan areas within a state are used as a basis for forming many PSUs. Outside of metropolitan areas, two or more counties normally are combined to form a PSU except when the geographic area of an individual county is too large. Combining counties to form PSUs provides greater heterogeneity; a typical PSU includes urban and rural residents of both high and low economic levels and encompasses, to the extent feasible, diverse occupations and industries.

The households are selected in clusters to make data collection more efficient. Base weights are created from this sampling. Nonresponse factors are estimated based on the response rates, with PSUs with higher nonresponse rates getting larger factors. Second stage weights are produced using population controls based on the updated results of the decennial census.

The Contact History Instrument (CHI) was added to the CPS in 2009 to collect detailed contact history data (Bates, 2004). The interviewer records times and outcomes of attempted contacts, problems or concerns reported by reluctant households, and strategies used to gain contact or overcome reluctance. This provides a very rich source for studying the interview process. However, this study only used the answers recorded by interviewers in response to a question about reasons for not responding reported by reluctant households. Answers to a question about the strategies employed by an interviewer were not used in this analysis.

3. Methods

The BLS Handbook of Methods describes the non-interview adjustment methods used in the CPS. Non-interview adjustment is made separately for clusters of similar sample areas that are usually, but not necessarily, contained within a state. Similarity of sample areas is based on metropolitan statistical area (MSA) status and size, so if a cluster is dissimilar to others within the state, it may become part of an adjustment cell with similar clusters nearby in a different state. Within each cluster, there is a further breakdown by residence type.

Each MSA cluster is split by "central city" and "balance of the MSA," whereas non-MSA clusters are split by "urban" and "rural" residence categories. These clusters are the bases for non-interview adjustments, and will be called "non-interview clusters" in this paper. The weights are further adjusted to population totals (giving different person weights by adjusting for demographic characteristics: sex, race, age), previous values (which are called composite weights), or for longitudinal use.

This study only examines the estimates for the base-weight and non-interview adjustments.

The current non-interview adjustments assume the missing data aren't related to estimates after conditioning on the non-interview clusters. This study adds process information about the non-interviews to try to adjust for nonresponse differences within the clusters.

Contact History Instrument (CHI) responses are used to categorize responders to the CPS as similar to nonresponders based on their contact history (which includes the number of contact attempts and barriers to contact) and reasons for not responding. Propensity scores are predicted values from a logistic model based on the CHI using the reasons given to explain noncontact or refusal. Those responders who are most like the nonresponders get a higher propensity score. These propensity scores are then used to adjust the CPS weights using a general linear model where the sampling characteristics (strata, PSU, metropolitan status, etc.) are entered in the model as well as the propensity scores. The dependent variable is the base weight. The predicted values are the adjusted weights. Refusal is significant, but noncontact has no impact on adjusting the weights (See Appendix A for the full model).

Since we don't know how nonrespondents respond to the survey we have to use respondents who are similar to nonrespondents. Contact history information can be used to have reluctant respondents represent refusers and difficult-to-contact respondents to represent noncontacts. In summary, the nonresponse factors used in the adjustment of the base weights were modified to include propensity scores from the CHI factors related to refusal and noncontact.

4. Results

Table 1: Unemployment estimates and standard errors for different stages of weighting.

	Base weight (S.E.)	NR Adjusted(S.E)	CHI Adjusted(S.E)	Published Estimate
Unemp	**0.086** (0.0014)	**0.089** (0.0014)	**0.089** (0.0013)	**0.090**
Unemp Male	**0.088** (0.0019)	**0.093** (0.0018)	**0.093** (0.0018)	**0.094**
Unemp Female	**0.083** (0.0019)	**0.085** (0.0018)	**0.085** (0.0018)	**0.086**
Unemp Asian	**0.070** (0.0048)	**0.073** (0.0053)	**0.074** (0.0053)	**0.071**
Unemp Black	**0.148** (0.0052)	**0.149** (0.0048)	**0.149** (0.0048)	**0.152**
Unemp White	**0.078** (0.0015)	**0.081** (0.0014)	**0.081** (0.0014)	**0.081**

The differences between the base-weight estimates and the nonresponse adjusted estimates were small relative to their standard errors (but sometimes statistically significant at twice their standard error), and the differences among the nonresponse adjusted weights were even smaller (and less than 1 standard error).

Unemployment differences greater than 3 tenths of a percent are considered "interesting" to economists (which is used to determine the coefficient of

variation in the design of the survey). The difference between the base-weighted estimate and the nonresponse adjusted estimate is .003, whereas the difference between the nonresponse adjusted estimate and the CHI adjusted estimate is only .0001.

Table 2: Mean estimates for different stages of weighting.

	Base weight (S.E.)	NR Adjusted (S.E)	CHI Adjusted (S.E)
Age	**37.85** (0.114)	**37.74** (0.108)	**37.75** (0.107)
Male	**0.487** (0.0013)	**0.487** (0.0012)	**0.487** (0.0012)
Earnings	**26716** (701)	**26020** (666)	**26033** (663)
Disability	**0.115** (0.0014)	**0.113** (0.0012)	**0.113** (0.0012)

Table 2 shows other estimates from the CPS. They showed similar effects as Table 1, with the differences small relative to the standard errors, and the differences between the two nonresponse adjustment methods being very small.

5. Discussion

Dixon (2010) found that estimates of nonresponse bias for the Consumer Expenditure Survey and the National Health Interview Survey weren't impacted much by the addition of contact history variables. Moreover, his 2004 study of matching the CPS to the census long form found small bias in employment. The current study hoped to replicate this finding for unemployment estimates.

The potential biases found were moderate for the unemployment estimates (about 0.3% underestimate; see Table 1), and were largely adjusted for by the customary adjustment cell method (comparing the base-weighted estimates for unemployment to the traditional nonresponse adjustment and the current CHI adjustment). The direction of the adjustments was the same for both methods for all estimates, with the adjustments resulting in larger estimates.

Using surrogates to estimate nonresponse is always a leap of faith, since we don't know anything about the nonresponders, except they were as difficult to contact or had similar reasons for not responding as those who eventually responded. Sensitivity analysis could help show how worried we should be by studying the impact of nonresponders being more different than the model estimated. For example, a simulation varying the relationship between the surrogates and the nonresponders could show how large a difference would impact the results.

While this analysis showed slight overall effects using contact history information, larger effects may be present for subgroups or other estimates. The variances were little affected by the nonresponse weights, but other methods may be useful in adjusting the variances to account for how much we don't know about the nonresponders. While

nonresponse may not relate to sampling (and thus weights) it may relate to estimates, so other adjustments may be necessary. For example; unemployment may relate to age and nonresponse, which wouldn't be captured well in the geographic variables used in the weighting model. So some other adjustment, either in a different model or a different weighting method might be needed to capture that relationship.

References

BLS Handbook of Methods, http://www.bls.gov/opub/hom/

Bates, N. (2004). Contact Histories: A Tool for Understanding Attrition inPanelSurveys., A paper presented at the 59th Annual AAPOR Conference,May 11-13

Bates, N., Dahlhamer, J., and Singer, E. (2008). "Privacy Concerns, Too Busy, or Just Not Interested? Exploring the Relationship Between Doorstep Concerns andNonresponse Bias", *Journal of Official Statistics*, Vol. 24.4, December.

Chopova, B., Edgar, J., Gonzalez, J., King, S., McGrath, D., and Tan, L. (2009). "Assessing nonresponse bias in the CE Interview Survey: A summary of four studies", presented at the Federal Committee for Statistical Methodology Workshop on How to Do Nonresponse Bias Analyses in Household and Establishment Surveys, June 10.

Dahlhamer, J., Simile, C., and Taylor, B. (2006). "Exploring the Impact of Participant Reluctance on Data Quality in the National Health Interview Survey (NHIS)", paper presented at the Statistics Canada Symposium; Methodological Issues in Measuring Health.

Dixon, J. (2002). "The Effects of Item and Unit Nonresponse on Estimates of Labor Force Participation", Paper presented at the Joint Statistical Meetings, N.Y., N.Y..

Dixon, J. (2004). "Using Census Match Data to Evaluate Models of Survey Nonresponse", A paper presented at the Joint Statistical Meetings.

Dixon, J. (2006). "Models of Nonresponse Bias, Survey Quality, Paradata, and Household Characteristics in the Consumer Expenditure Survey.", A paper presented at the International Survey Nonresponse Workshop, Omaha, Nebraska.

Dixon, J. (2010). " Assessing Nonresponse Bias and Measurement Error Using Statistical Matching", presented at the Joint Statistical Meetings.

Dyer, W. (2004). Contact History Instrument (CHI). **http://www.blaiseusers.org/2004/papers/03.pdf**

Henley, M., and Bates, N. (2006). "Using Call Records to Understand Response in Longitudinal Surveys", paper presented at the American Association for Public Opinion Research.

Tucker, C., and Dixon, J. (2000). "Predicting Interviewer Nonresponse Rates from Household and Regional Characterstics", Paper presented at AAPOR.

U.S. Census Bureau. 2006. *Current Population Survey: Design and Methodology*. Technical Paper 66. Washington, DC: Government Printing Office. http://www.census.gov/prod/2006pubs/tp-66.pdf

Appendix A: GLM for Non-interview Weights

Note: variables were selected to mimic the sampling variables used in non-interview adjustment, with the addition of non-contact and refusal.

R-Square	Coeff Var	Root MSE	wgt Mean
0.986310	5.805764	1147538	19765487

Source	DF	SS	Mean Square	F Value	Pr > F
Gestfips	50	1.3947788E19	2.7895577E17	211837	<.0001
Gepsu	1289	9.0119316E16	6.9914132E13	53.09	<.0001
Hrsample	17	7.5820629E13	4.460037E12	3.39	<.0001
Geframe	3	2.2421865E15	7.4739549E14	567.57	<.0001
Geur	1	7.3931725E13	7.3931725E13	56.14	<.0001
Geplsz	21	7.3057354E14	3.4789216E13	26.42	<.0001
Hufinal	11	2.8773634E16	2.6157849E15	1986.41	<.0001
Genicell	1	1.1575007E14	1.1575007E14	87.90	<.0001
Gerot	5	1.5903725E14	3.1807451E13	24.15	<.0001
Gepovc	1	4.7655577E12	4.7655577E12	3.62	0.0571
HUNONTYP	2	2.4132396E12	1.2066198E12	0.92	0.4000
Non-contact	1	3.2060169E12	3.2060169E12	2.43	0.1187
Refusal	1	1.946884E13	1.946884E13	14.78	0.0001