A STUDY OF THE WEIGHTING ADJUSTMENT PROCEDURES FOR THE AMERICAN COMMUNITY SURVEY

Samson A. Adeshiyan, U.S. Bureau of the Census, Washington DC 20233
samson.adeshiyan@ccmail.census.gov

Key Words: ACS, Weighting Factors, Relative bias, Relative Variance, Relative MSE

I. Introduction

This paper discusses the weighting adjustment procedures for the 1996 American Community Survey (ACS)[1]. The effects of the noninterview and post-stratification adjustments are examined for selected data items at county and tract levels. This is done by computing mean square errors (MSEs) of their estimates at the different stages of weighting. The variance and bias components of the MSE are also examined.

Section II gives a brief description of the ACS, its weighting and estimation procedures, and how variances are computed. Section III describes the method for measuring the effects of the weighting adjustments. Section IV discusses the results. Section V discusses conclusions and areas for further research.

II. Description of the American Community Survey

A. Overview

The ACS is designed to update decennial census data by collecting the same information every year that the census collects only once in ten years. It also provides estimates for census long form items for various levels of geography including tracts and block groups.

The sampling procedure of the ACS involves selecting a systematic sample for all sites from the Master Address File (MAF) addresses. In 1996, there were four test sites: Rockland County, New York; Brevard County, Florida; Multnomah County, Oregon; and Fulton County, Pennsylvania[2]. The 12-month sampling rate for 1996 was 0.15 (0.30 for low population areas). Three data collection modes are used to conduct the ACS: Mail, Computer Assisted Telephone Interview (CATI), and Computer Assisted Personal Interview (CAPI). A systematic 1/12 subsample of the housing units (HUs) selected is mailed an ACS questionnaire each month. This mailing occurs on the last Wednesday of the month preceding the sample month. Approximately five weeks after the mailout of the original ACS questionnaire, the CATI staff begins to contact nonresponding sample households by telephone. This phase lasts for approximately one month. The CAPI universe consists of all outstanding nonresponse cases remaining after the completion of the CATI phase. A 1-in-3 subsample is selected from these outstanding cases and forwarded to the field representatives (FRs). The FRs visit each assigned household and conduct an interview. The CAPI phase also lasts for approximately one month.

B. Weighting and Estimation Procedures

The following are brief descriptions of the base weight and the adjustment factors used in the ACS weighting procedure.

Base Weight (*BW*) - The base weight adjusts the total monthly sample weight so that it equals the universe total. This weight is assigned to every HU record and is the inverse of a record's selection probability.

CAPI Subsampling Factor (*SSF*) - The subsampling factor makes the total monthly CAPI subsample weight equal to the CAPI universe weight. This factor is 1.0 for all Mail and CATI cases, 3.0 for those records selected in CAPI subsampling, and zero for those not selected.

Variation in Monthly Response by Mode (*VMS*) - This factor adjusts the total weight of the Mail, CATI, and CAPI subsampled records to be tabulated in a month so that it equals the total weight of all cases originally mailed for that month.

Noninterview Factor (*NIF*) - In order to account for both respondents and nonrespondents, this factor adjusts the weight of all respondents, regardless of mode. Nonrespondents are assigned an $NIF = 0$.

Noninterview Factor - Mode (*NIFM*) - This factor adjusts the weight of CAPI respondents to account for both CAPI respondents and all nonrespondents. Mail and CATI cases receive a value of $NIFM = 1.0$, and nonrespondents are assigned an $NIFM = 0$. This factor is not used directly, but rather in the computation of the mode bias factor.

Mode Bias Factor (*MBF*) - This factor adjusts the total weight of the specified weighting cells as if *NIFM* had been used directly instead of *NIF*. Basically, this factor corrects for the bias caused by not excluding Mail and CATI cases from *NIF* calculations.

First Housing Unit Post-Stratification Factor (*HPF1*) - This factor adjusts the number of HUs in a tract so as to

[1] The weighting procedure remains essentially the same in 1997 with minor changes.

[2] For Fulton County, PA a pseudo-MAF was created in a listing operation and used for sampling. Results for Fulton County are not presented in this study because of its relatively small sample size.

make it equal to the 1997 MAF [3] control count totals. This factor takes into account new construction since the time the sample had been selected.

Person Post-Stratification Factor (*PPSF*) - This factor is applied to individual person records based on age, race, sex, and Hispanic origin characteristics. It adjusts person weights so that the weighted sample approximately matches 1996 county population control counts by age, race, sex, and Hispanic origin.

Principal Person Factor (*PPF*) - This accounts for differential HU response based on the age, race, sex and Hispanic origin of the principal person in the HU. That is, the value of *PPF* is the *PPSF* of the principal person.

Second Housing Unit Post-Stratification Factor (*HPF2*) - This factor makes the number of HUs in a tract again equal to the 1997 MAF control count totals after *PPF* has been applied.

The final weights are computed as:

$$Final\ Person\ Weight = BW \times SSF \times VMS \times NIF \times MBF \times HPF1 \times PPSF$$

$$Final\ HU\ Weight = BW \times SSF \times VMS \times NIF \times MBF \times HPF1 \times PPF \times HPF2.$$

C. Variance Estimation

The variance computation technique used for the ACS is successive difference replication. This method pairs successive HUs in the order of their selection to take advantage of the systematic nature of the ACS sampling scheme. Each HU occurs in two consecutive pairs, for example (HU1, HU2), (HU2, HU3), (HU3, HU4), etc. A pair, then, is similar to a standard error computation unit (SECU). Thus, there are many SECUs, and the maximum degrees of freedom and the precision of the variance estimates increase considerably. Eighty replicates are formed, and they are used to compute variances. The successive difference method was discussed by Wolter (1984) and extended by Fay (Fay and Train, 1995) to produce the successive difference replication method.

Each replicate sample is weighted through the various factor adjustments just as the full sample is weighted. A variance estimate for a data item of interest after a particular weighting stage is computed by the formula:

$$\text{var}(\hat{Y}_{0f}) = \frac{4}{80}\sum_{r=1}^{80}(\hat{Y}_{rf} - \hat{Y}_{0f})^2$$

where:

$\hat{Y}_{rf}$ = the rth replicate estimate for a data item after it has been weighted up to factor *f* for the domain of interest (county or tract), and

$\hat{Y}_{0f}$ = the full sample estimate for the data item after it has been weighted up to factor *f* for the domain of interest.

[3] The most current controls, the 1997 MAF control totals, were used during the weighting process.

III. Evaluation Methodology

This section describes the method for measuring the effects of the noninterview and post-stratification adjustments on estimates for selected data items. Apart from MSE comparisons done for estimates of data items at different stages of weighting, alternative ways of computing noninterview adjustments are also investigated. The variance and bias components of the MSE are also examined. Analysis is done at the site and tract levels of geography.

A. Selected Data Items

The key data items used in this study include gender, race/ethnicity, labor force, poverty status and tenure. The person-level items are Total, Male and Female; White, Black and Other; Hispanic and Nonhispanic; High School Graduate and Not High School Graduate; Employed, Unemployed and Not in Labor Force; In-Poverty and Not-in-poverty. The HU-level items are Owner and Renter.

B. MSE Computation

Let $\hat{Y}_f^g$ be the estimate of a data item after it has been weighted up to factor *f* at level of geography *g*, where g can be either site i.e. county (*c*) or tract (*t*). The MSE of such an estimate is defined as:

$$\text{MSE}(\hat{Y}_f^g) = \text{Var}(\hat{Y}_f^g) + \text{Bias}^2(\hat{Y}_f^g).$$

Now, define $\hat{Y}^g_{fb}$ as the estimate of the data item after it has been weighted up to the next factor *fb*, that is the estimate after the next weighting stage. In order to calculate the bias reduction associated with $\hat{Y}^g_{fb}$, we assume that $\hat{Y}^g_{fb}$ is our benchmark estimate and

$$E(\hat{Y}^g_f) - E(\hat{Y}^g_{fb}) = \text{Bias in using } f, \text{ or } \text{Bias}(\hat{Y}_f^g).$$

However, $\hat{Y}^g_f - \hat{Y}^g_{fb} = \hat{B}_f$.

The relationship between $\hat{B}^2_f$ and $\text{Bias}(\hat{Y}_f^g)$ is given as:

$$E(\hat{B}^2_f) = \text{Bias}(\hat{Y}_f^g) + \text{Var}(\hat{Y}^g_f - \hat{Y}^g_{fb}).$$

Thus, $\text{MSE}(\hat{Y}^g_f) = \text{Var}(\hat{Y}^g_f) + \text{Bias}(\hat{Y}_f^g)$

$= \text{Var}(\hat{Y}^g_f) + E(\hat{B}^2_f) - \text{Var}(\hat{Y}^g_f - \hat{Y}^g_{fb})$ and can be estimated by

$$\hat{MSE}(\hat{Y}^g_f) = \hat{Var}(\hat{Y}^g_f) + \hat{B}^2_f - \hat{Var}(\hat{Y}^g_f - \hat{Y}^g_{fb}).$$

C. Noninterview (NI) Adjustment

Comparing $\hat{Y}^g_{NIF}$ and $\hat{Y}^g_{MBF}$ to $\hat{Y}^g_{NIFM}$

An underlying assumption is that the characteristics of the nonrespondents (CAPI noninterviews) are most likely similar to the CAPI interviews. There is a concern that calculating the NI adjustment factor based on only CAPI interviews (excluding Mail and CATI cases) and the noninterviews, will produce large *NIFM* factors. This in turn causes a greater variation in weights and tends to increase the variance in resulting estimates. To prevent this, an alternative NI adjustment factor which is the product of *NIF* and *MBF* is used instead of *NIFM*. *NIF* is expected to yield estimates with lower variances and the *MBF* is expected to correct for its bias. This section examines these issues.

To compute the noninterview factor, *NIF*, sample HU units are first grouped into NI adjustment cells : type of building (single vs multi-units), tract and tabulation month. In each cell, the weights of the interviewed HUs are multiplied by the factor *NIF* which is computed as:

$$\frac{total\ interview\ weight\ +\ total\ noninterview\ weight}{total\ interview\ weight}$$

where the total weight is the sum of $BW\ x\ SSF\ x\ VMS$ for all HUs in each cell. Interviews in the above formula include Mail, CATI and CAPI cases; that is, all interview cases regardless of mode.

The *NIF* which has a more uniform spread is used instead of *NIFM*. However, to correct for the inherent bias, the mode bias factor, *MBF*, is applied: *NIF x MBF*. The *MBF* makes the total weight within specified weighting cells the same as if *NIFM* had been used. The cells used are tenure, month, and marital status. Bias correction is done at the site level.

$$MBF = \frac{total\ NIFM\ weight\ in\ cell}{total\ NIF\ weight\ in\ cell}$$

where total *NIFM* weight is the sum of $BW\ x\ SSF\ x\ VMS\ x\ NIFM$ for all HUs in the specified cell, and total *NIF* weight is the sum of $BW\ x\ SSF\ x\ VMS\ x\ NIF$ for all HUs in the specified cell. With $\hat{Y}^g_{NIFM}$ as the benchmark estimate,

$E(\hat{Y}^g_{NIF})$ - $E(\hat{Y}^g_{NIFM})$ = Bias in using *NIF*, or $Bias(\hat{Y}^g_{NIF})$.

Thus, $MSE(\hat{Y}^g_{NIF}) = Var(\hat{Y}^g_{NIF}) + Bias(\hat{Y}^g_{NIF})$

$$= Var(\hat{Y}^g_{NIF}) + E(\hat{B}^2_{NIF}) - Var(\hat{Y}^g_{NIF} - \hat{Y}^g_{NIFM})$$

and $$M\hat{S}E(\hat{Y}^g_{NIF}) = V\hat{a}r(\hat{Y}^g_{NIF}) + \hat{B}^2_{NIF} - V\hat{a}r(\hat{Y}^g_{NIF} - \hat{Y}^g_{NIFM}).$$

Since *NIFM* is our benchmark for computing the noninterview adjustment, $\hat{Y}^g_{NIFM}$ is assumed to be unbiased. Similarly, we can compare MSEs of estimates after correcting $\hat{Y}^g_{NIF}$ for bias by applying the *MBF* to obtain $\hat{Y}^g_{MBF}$.

$$\hat{Y}^g_{MBF} - \hat{Y}^g_{NIFM} = \hat{B}_{MBF} \quad \text{and}$$

$$M\hat{S}E(\hat{Y}^g_{MBF}) = V\hat{a}r(\hat{Y}^g_{MBF}) + \hat{B}^2_{MBF} - V\hat{a}r(\hat{Y}^g_{MBF} - \hat{Y}^g_{NIFM}).$$

Recall that the bias is calculated by computing the difference between the benchmark estimate $\hat{Y}^g_{NIFM}$ and the estimate from the alternative noninterview procedures $\hat{Y}^g_{NIF}$ or $\hat{Y}^g_{MBF}$. Since the absolute bias does not show how large it is relative to the estimate itself, each bias is scaled by its respective estimate. This is referred to as the relative bias. In addition, relative MSEs and relative variances are measures used in the comparisons.

Effect of Noninterview Adjustment

The effect of noninterview adjustment is measured by comparing estimates before and after application of the noninterview factor. In this case $\hat{Y}^g_{VMS}$ is compared to $\hat{Y}^g_{MBF}$, which will be regarded as the benchmark estimate at this stage. Under the assumptions in Section III. B,

$$M\hat{S}E(\hat{Y}^g_{VMS}) = V\hat{a}r(\hat{Y}^g_{VMS}) + \hat{B}^2_{VMS} - V\hat{a}r(\hat{Y}^g_{VMS} - \hat{Y}^g_{MBF}).$$

D. Housing Unit Post-Stratification Adjustments

HU post-stratification adjusts for differential coverage of various types of households. It also takes into account new construction between the time the sample was selected and when estimation is done. For the 1996 ACS, this factor adjusts the number of HUs in a tract to the 1997 MAF control count totals. To measure its effect, estimates of the selected data items before and after the adjustment are compared.

The HU post-stratification factor, HPF, is a ratio adjustment computed as:

$$HPF = \frac{MAF\ count\ of\ HUs\ in\ tract}{total\ weight\ of\ sample\ units\ in\ tract}$$

where the total weight is the sum of $BW\ x\ SSF\ x\ VMS\ x\ NIF\ x\ MBF$ for all HUs in the tract. Under the assumptions in Section III. B,

$$M\hat{S}E(\hat{Y}^g_{MBF}) = V\hat{a}r(\hat{Y}^g_{MBF}) + \hat{B}^2_{MBF} - V\hat{a}r(\hat{Y}^g_{MBF} - \hat{Y}^g_{HPF1}).$$

For HU-level estimates, two additional factors are computed: the *PPF* which is described in Section III. E, and a second *HPF*. The *HPF* needs to be computed again to ensure that the number of HUs in a tract again equals the 1997 MAF control count totals since the application of *PPF* must have altered the weights. The effect of the *HPF2* is determined by calculating

$$M\hat{S}E(\hat{Y}^g_{PPF}) = V\hat{a}r(\hat{Y}^g_{PPF}) + \hat{B}^2_{PPF} - V\hat{a}r(\hat{Y}^g_{PPF} - \hat{Y}^g_{HPF2}).$$

E. Person Post-Stratification Adjustments

Person post-stratification is used to improve estimates of person-level items when the number of persons in a certain population stratum is known from an independent source. For ACS, these strata or cells are defined in terms of age, race, sex, and Hispanic origin characteristics. The independent estimates are based on decennial census counts updated based on birth, death, immigration and emigration records, and taking into account the natural aging of the population. Essentially, to compute the post-stratification factor, person records are first grouped into age by race by sex by Hispanic origin cells. Then,

$$PPSF = \frac{\textit{population control counts in cell}}{\textit{total weight of person records in cell}}$$

where the total weight is the sum of $BW \times SSF \times VMS \times MBF \times HPF1$ for all person records in the cell. The weights before this stage are normally at the HU level, but to calculate the PPSF, these weights are assigned to each person in a HU.

The post-stratification factor has two beneficial effects: reduction of the coverage bias and reduction in variance. Under the assumptions in Section III. B, the effects of PPSF on person-level items are measured by

$$\hat{MSE}(\hat{Y}^{g}_{HPF1}) = \hat{Var}(\hat{Y}^{g}_{HPF1}) + \hat{B}^{2}_{HPF1} - \hat{Var}(\hat{Y}^{g}_{HPF1} - \hat{Y}^{g}_{PPSF}).$$

In order to reduce coverage bias for estimates of HU items too, the PPSF for the principal person (usually the wife of the reference person) is applied to the HU-level weights. This value is referred to as the PPF. Its effects on HU-level items are measured by

$$\hat{MSE}(\hat{Y}^{g}_{HPF1}) = \hat{Var}(\hat{Y}^{g}_{HPF1}) + \hat{B}^{2}_{HPF1} - \hat{Var}(\hat{Y}^{g}_{HPF1} - \hat{Y}^{g}_{PPF}).$$

IV. Results

The following results are in terms of percentage changes in relative MSE (RelMSE), relative variance (RelVar), and relative bias (Relbias).

A. Comparing $\hat{Y}^{g}_{NIF}$ and $\hat{Y}^{g}_{MBF}$ to $\hat{Y}^{g}_{NIFM}$

For person-level and HU-level items at the site level, there is some indication that RelVar($\hat{Y}^{c}_{NIF}$) < RelVar($\hat{Y}^{c}_{MBF}$) < RelVar($\hat{Y}^{c}_{NIFM}$) with RelVar($\hat{Y}^{c}_{NIF}$) slightly less than RelVar($\hat{Y}^{c}_{MBF}$) across the three sites. For person-level items with large estimates, RelMSE($\hat{Y}^{c}_{NIF}$) tends to be lower than RelMSE($\hat{Y}^{c}_{MBF}$). In contrast, for person-level items with smaller estimates including Black items, not-in-labor-force, and in-poverty, RelMSE($\hat{Y}^{c}_{MBF}$) tend to be lower than RelMSE($\hat{Y}^{c}_{NIF}$). For the HU-level items at the site level, RelMSE($\hat{Y}^{c}_{MBF}$) tends to be lower than RelMSE($\hat{Y}^{c}_{NIF}$).

Similar to site-level results for person-level items, at the tract level, there is some evidence that RelVar($\hat{Y}^{t}_{NIF}$) < RelVar($\hat{Y}^{t}_{MBF}$) < RelVar($\hat{Y}^{t}_{NIFM}$) with RelVar($\hat{Y}^{t}_{NIF}$) slightly less than RelVar($\hat{Y}^{t}_{MBF}$). In addition, both RelMSE($\hat{Y}^{t}_{NIF}$) and RelMSE($\hat{Y}^{t}_{MBF}$) tend to be lower than RelMSE($\hat{Y}^{t}_{NIFM}$). Also, RelMSE($\hat{Y}^{c}_{NIF}$) tends to be lower than RelMSE($\hat{Y}^{c}_{MBF}$) for large estimates, but for smaller estimates, RelMSE($\hat{Y}^{c}_{MBF}$) tends to be lower than RelMSE($\hat{Y}^{c}_{NIF}$). At the tract level, both RelMSE($\hat{Y}^{t}_{NIF}$) and RelMSE($\hat{Y}^{t}_{MBF}$) tend to be lower than RelMSE($\hat{Y}^{t}_{NIFM}$).

Additional results show that when NIFM is used in the NI adjustment instead of the product of NIF and MBF (which is actually used in our weighting process), the person-level estimates have a larger variance, especially at the tract level. This in turn results in larger MSEs. Similar results are evident for the HU-level estimates. Tables illustrating the above results are available from the author at (Samson.Adeshiyan@ccmail.census.gov).

B. NI Adjustment

The bias reduction due to NI adjustment ranges from 1.6% to 4.3%. It is roughly 2% for most of the person-level items considered at the site level. There is a small percentage increase in variance for most items as shown in the third column of Table 1, but the bias reduction is large enough to ensure a decrease in MSE due to NI adjustment. At the tract level, there is a similar decrease in MSE for their estimates. Figure 1 shows percentage changes in RelMSE vs tracts sorted by NI rate. The scatterplot shows that tracts with higher NI rates tend to have larger decreases in RelMSE for their estimates. This trend is more evident for items with large estimates, e.g. White. Based on the assumptions in Section III. B, the bias due to nonresponse is the only type of bias being considered at this stage. For large estimates where this bias accounts for most of the error, reduction in MSE can be as high as 90% or more at the site level. Usually in these cases as shown in the last column of the Table 1, the variance accounts for a small part of their MSE; that is, most of the error is due to the bias which is being reduced.

C. Post-stratification Adjustments

The HU post-stratification factor shows evidence of a bias reduction of about 2% at the site level. Generally, there is a reduction in relative variance for large items, and a small increment for smaller items. This results in a decrease in RelMSE for their estimates. At the tract level, there is evidence of a decrease in RelMSE for HU-level estimates. Although not shown here, scatterplots show that larger tracts (in terms of HUs) tend to have larger decreases in RelMSE, whereas, for person-level items at the tract level, HU post-stratification does not seem to reduce RelMSE. The bias measured here is due to new construction captured in the updated MAF counts since the sample was collected. For large estimates where this bias accounts for most of the error, reduction in MSE can be as high as 90% or more at the site level.

As expected, after application of *PPSF* (Table 2), both the relative variances and the relative MSEs are reduced considerably especially for items with large estimates. Generally, the magnitude of bias reduction is higher for smaller estimates than for the larger ones. Similar trends are evident at the tract level especially for the larger tracts as shown in Figure 2, which is a scatter plot of percent change in RelMSE vs tract size (in terms of people). For site-level estimates that have exact population controls, both relative variance and relative MSE are reduced by 100%. (The *PPSF* is the last factor applied for person-level items, and the remaining factors are applicable only to HU-level items). For the HU-level items, after the application of the *PPF*, there is evidence of a bias reduction, but also an increase in relative variance at the site level. The bias reduction is large enough to result in a decrease in MSE for most items. The same pattern is evident at the tract level.

On a second application of the HU post-stratification factor, there is evidence of some bias reduction for the HU-level items, but the relative variances do not display any particular pattern. However, there is still a reduction in RelMSE for the items at both the site and tract levels. In both cases, the reduction in RelMSE is not as much as the first time the factor was applied immediately after the NI adjustment.

V. Conclusion

Results from this study show that the ACS weighting procedure generally reduces bias in estimates at each stage. The adjustments for noninterview and person post-stratification appear to be the two dominant adjustments for person-level items. Additional results show that when the HU post-stratification adjustment is omitted from the weighting process, the MSEs for estimates of the person-level items studied remains about the same as when the full weighting process is done. However, the effect of the omission of HU post-stratification adjustments is clearly evident in higher MSEs for estimates of the HU-level items. These observations indicate that the weighting procedure can be simplified by omitting *HPF* in the computation of person-level weights, and applying *HPF* just once, at the last stage, in computing HU-level weights.

Both the $\hat{Y}^g_{NIF}$ and $\hat{Y}^g_{MBF}$ have lower variances when compared to $\hat{Y}^g_{NIFM}$. However, contrary to our expectations, $\hat{Y}^g_{MBF}$ does not outperform $\hat{Y}^g_{NIF}$ for person-level items. Currently, research is going on to determine better variables and weighting cell definitions for computing MBF. Other future research plans include evaluating the effect of the VMS, and reviewing the cell definitions, including the extent of collapsing, for computing post-stratification factors so as to minimize heterogeneity within post-strata.

Based on the results, the current weighting procedure accomplishes its goals of reducing sampling bias; however, with ongoing and future research, further improvements could still be made in simplifying the weighting process.

This paper reports the results of reearch and analysis undertaken by Census Bureau Staff. It has undergone a more limited review than official Census Bureau Publications. This report is released to inform interested parties of research and to encourage discussions.

Supporting Materials:

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Table 1. Effect of the Noninterview Adjustment
Brevard County, Florida -- Site Level

Items	% change in Rel MSE	% change in Rel Var	% RelBias	$\frac{Var(\hat{Y}^c_{VMS})}{MSE(\hat{Y}^c_{VMS})}$ (%)
White	-93.52	-1.85	-2.16	6.74
Black	-40.79	1.00	-2.94	60.49
Employed	-90.73	5.42	-2.39	8.99
Unemployed	-37.92	3.54	-2.36	61.48
In-Poverty	-57.57	6.40	-3.32	41.23
Owner	-90.33	3.32	-1.60	9.51
Renter	-88.86	10.68	-4.30	10.48

Table 2. Effect of the Person Post-Stratification Factor
Brevard County, Florida -- Site Level

Items	% change in Rel MSE	% change in Rel Var	% RelBias	$\frac{Var(\hat{Y}^c_{HPF1})}{MSE(\hat{Y}^c_{HPF1})}$ (%)
White	-100.00	-100.00	-2.55	4.34
Black	-100.00	-100.00	-19.87	2.73
Employed	-99.69	-64.57	-7.82	0.95
Unemployed	-90.57	9.46	-9.37	9.43
In-Poverty	-92.04	-12.43	-8.43	9.86

Figure 1. Effect of the NI Adjustment on RelMSE -- Tract Level
White

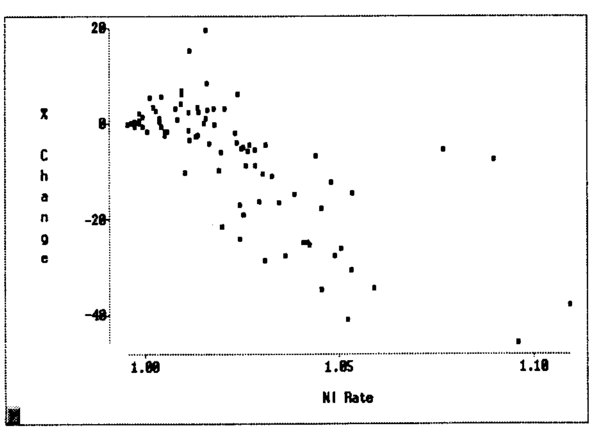

Figure 2. Effect of the Person Post-Stratification on RelMSE -- Tract Level
Black