ACS Research
December 17, 2003

Comparing Quality Measures: The American Community Survey's Three-year Averages and Census 2000's Long Form Sample Estimates

Katie Bench
Planning, Research, and Evaluation Division

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EXECUTIVE SUMMARY

The Census Bureau initiated the American Community Survey (ACS) development program in 1994 to develop and test the feasibility of producing long form data on a yearly basis, instead of once a decade. In 2001, the Census Bureau initiated the ACS Research and Evaluation Program to answer questions about the usability and reliability of the ACS estimates. This report is an evaluation from the Research and Evaluation Program. The report compares selected quality measures for the 1999 – 2001 ACS three-year average estimates to selected quality measures for the Census 2000 long form estimates.

The ACS data reviewed in this report were collected from 1999 to 2001 in 36 counties across the United States. The 36 counties are not a random sample of all counties in the United States. Instead these counties were selected for the ACS demonstration project to represent different types of areas, containing large cities, medium cities, and rural counties. While the estimates examined in this report are three-year average estimates, they are roughly equivalent in terms of their sampling error to the five-year estimates that the ACS will produce when the survey is fully implemented. In order to simulate the sampling error for a five-year average, a greater percentage of the individuals living in these counties in 1999-2001 were included in each year's sample than will be included when the ACS moves to full implementation. The quality measures examined in this report, therefore, may approximate the quality measures for the five-year averages that can be expected using the fully-implemented sample size.

We compared the following quality measures:

- Self-Response Rates
- Nonresponse Rates for Sample Units
- Nonresponse Rates for Occupied Sample Units
- Sample Completeness Rates for Housing Units
- Sample Completeness Rates for Household Population
- Item Nonresponse Rates

The decennial census and the ACS are very different in methodology, scope, timing, and visibility. The main emphasis of the decennial census is to enumerate the U.S. population and housing; the collection of long form data is secondary. The ACS, in contrast, is designed to collect long form data only. The difference in the purpose of the two operations may be a major reason for the statistically significant differences we found between the quality measures for the ACS and the Census 2000 long form sample:

- The Census 2000 long form estimates exhibited higher self-response rates than the ACS estimates, indicating that a greater percentage of housing units mailed back the long form census questionnaires than mailed back the ACS questionnaires. This finding is reasonable considering the high visibility and large advertising campaign of Census 2000.

- The ACS estimates exhibited lower sample unit nonresponse rates, lower occupied sample unit nonresponse rates, and lower summary item allocation rates (except for vacant housing units) than did the Census 2000 sample estimates in majority of the counties and tracts. The higher Census 2000 sample nonresponse rates could be a signal of somewhat higher nonsampling errors in the census estimates. The lower ACS nonresponse rates make sense for several reasons, including the ACS's staff of permanent professional interviewers, Census 2000's decision not to followup on blank items on mail returned questionnaires, and the ACS's smaller and more manageable sample size.

- The ACS estimates exhibited housing unit sample completeness rates somewhat closer to one than did the Census 2000 sample estimates. However, the household population sample completeness rates for both surveys were nearly even. The sample completeness rates measure both nonresponse errors and coverage errors and indicate how well the target population was represented. A rate of 100 is optimal.

These quality measures suggest that the ACS multi-year averages are at least as good as the estimates from the long form. When we also consider the enhanced timeliness of information from the ACS, the superiority of reengineering the 2010 Census over retaining traditional methods is clear. In addition, while further study is needed, it appears that the permanent, on-going nature of the ACS program contributes to lower ACS nonresponse rates, and hence less chance for nonresponse error and bias in the estimates.

1. INTRODUCTION AND BACKGROUND

To reduce the operational complexity of the decennial census and increase the currency of detailed population and housing data, the U.S. Census Bureau has implemented the 2010 Census re-engineering strategy. The American Community Survey (ACS) is one of three program components required to achieve the 2010 Census re-engineering strategic goals. The ACS collects long form data throughout the decade, instead of all at once in the decennial census.

The proposal to replace the census long form with the ACS has raised issues concerning the operational feasibility of the ACS, and the reliability and usability of ACS data. To help answer these questions, the Census Bureau has conducted and continues to conduct research. In 1994, the Census Bureau began to develop the methods for providing long form data each year. Two of the programs implemented since then to develop methods are the Continuous Measurement program and the Census 2000 Supplementary Survey (C2SS). The Continuous Measurement program began to collect long form data in 1996 in four sites, and has since expanded to 36 counties. The C2SS was conducted as part of Census 2000 to demonstrate the operational feasibility of collecting long form data at the national level at the same time as, but independently from Census 2000 (Bureau of the Census, 2001). These and other ACS research programs have demonstrated the operational feasibility of the ACS, and the reliability of ACS data. Research objectives have continued more recently through the implementation of an ACS Research and Evaluation Program. As part of this research objective, we produced this report to help data users understand how the quality of the 1999 – 2001 ACS three-year average data compares to the Census 2000 long form sample data. These three years were chosen to center the estimate in the census year.

This report compares quality measures for the ACS three-year averages with those for the Census 2000 long form sample for the 36 counties in the Continuous Measurement Program (see Appendix A) and their associated tracts (except for the tracts associated with Fort Bend County, Texas and Harris County, Texas). These counties are not a random sample of counties in the country, but were chosen to represent different types of areas: differing county population sizes, different racial or ethnic groups, highly seasonal populations, migrant workers, American Indian reservations, improving or worsening economic conditions, and various predominant occupations or industry types (Bureau of the Census, ACS Operational Plan, 2003).

1.1 Census 2000 Long Form

Census 2000 collected data using two basic types of questionnaires—the short form, containing only the “100 percent” items asked of the entire population, and the long form, containing the “100 percent” items as well as a myriad of detailed housing unit, household, and population items known as sample items. The “100 percent” items were relationship, sex, age, Hispanic origin, race, and tenure for occupied housing units, and vacancy status for vacant housing units. A national average of about one-in six housing units were expected to be enumerated on the long form and make up the Census 2000 sample; the other five-sixths of the addresses were to be enumerated on the short form.

Variable sampling rates were used across the nation to obtain the national average of the about one-in six housing units expected to be enumerated on the long form and make up the Census 2000 sample. This was done to provide relatively more reliable estimates for small areas and decrease respondent burden in more densely populated areas while maintaining data reliability. There were four different housing unit sampling rates, which varied by census block: 1-in-8, 1-in-6, 1-in-4, and 1-in-2. These rates were assigned based on precensus estimates of the number of occupied housing units in various geographic and statistical entities, such as incorporated places and interim census tracts (Bureau of the Census, Summary File 3 Technical Documentation, 2003).

This comparison project is based on characteristic distributions as estimated by the Census 2000 sample, and additionally on information reflecting overall response to the Census 2000 long form questionnaire. Not all units enumerated on long form questionnaires are eligible to be members of the Census 2000 sample. To be eligible for inclusion, long form response records had to meet a set of criteria identifying them as 'sample data defined.' The occupied housing unit or household long form records had to contain at least one person who was both "100 percent" data defined and sample data defined. To satisfy these criteria a person record had to have answers to at least two of the "100 percent" population items and two of the sample population items. No answers to any housing items were required of occupied long form units to be considered census sample-eligible. For vacant long form units to be placed in the Census 2000 sample they had to have answers to at least two sample housing items.

In addition to estimates based on housing units and the household population, the Census 2000 sample also included data from the group quarters population. These records were removed from the sample for this analysis. All but one of the Census 2000 quality measures included in this study are based on information directly affecting the sample. The one exception is the long form questionnaire self-response rate, which is based on the count of housing units enumerated using the long form, and not the count of housing units that are members of the Census 2000 sample (Bench, 2003).

To enumerate the U.S. population, the U.S. Census Bureau distributed and collected forms using three basic methods: mailout/mailback, update/leave, and list/enumerate. These are referred to as Type of Enumeration Areas (TEAs). For mailout/mailback TEAs, questionnaires were delivered to housing units with city style addresses (house number and street name) via the U.S. Postal Service. The householder then completed the questionnaire and returned it via mail. For update/leave TEAs, enumerators left census questionnaires at housing units for the householder to complete and mailback. This occurred in areas with predominantly noncity style addresses. For list/enumerate TEAs, enumerators visited the housing units, and completed the form while there. This occurred in remote or sparsely populated areas (Bureau of the Census, 2000).

In conjunction with the three basic enumeration methods, a variety of operations were used to collect the "100 percent" and sample items. The Census 2000 long forms were mailed in March 2000 along with the short forms; Nonresponse Followup began in late April 2000, and lasted about nine weeks. During this operation, housing units that had not returned a form by mail were visited multiple times to secure a response. If no response could be obtained from the residents, enumerators used a last resort method

known as proxy. In addition, housing units identified as vacant or nonexistent by the U.S. Postal Service were also visited. After Nonresponse Followup, the Census Bureau also conducted Coverage Improvement Followup, and Coverage Edit and Telephone Followup. Coverage Improvement Followup visited vacant housing units, and newly discovered addresses. Coverage Edit and Telephone Followup identified and resolved count discrepancies. Discrepancies occurred if the number of persons reported for a household did not match the number of persons for whom census information was provided on the form. The Coverage Edit and Telephone Followup should not be confused with a content edit to followup and obtain answers for blank items on a questionnaire. There was no attempt to followup on items left blank on questionnaires returned by mail. Blank items on mail returned questionnaires were statistically inferred (Bureau of the Census, 2001; Bureau of the Census, 2000).

1.2 American Community Survey Three-year Averages

The American Community Survey is designed to collect long form data throughout the decade. This is done with continuous, monthly samples with three-month collection cycles for each using a combination of mailout/mailback questionnaires, Computer Assisted Telephone Interviewing (CATI), and Computer Assisted Personal Interviewing (CAPI). During the first phase of the three-month collection cycle, the questionnaires are mailed and a second questionnaire sent to those who have not responded by mail by a certain date. During phase two of the cycle, CATI is used to follow-up with housing units not responding by mail, and for whom telephone numbers have been obtained by vendors. Finally, during phase three of the cycle, a sub-sample of the nonresponding housing units is drawn, and CAPI is used to help field representatives conduct the interviews (Bureau of Census, 2001).

Forms that are returned by mail are processed at the Census Bureau National Processing Center in Jeffersonville, Indiana. The forms returned by mail go through a check-in process, are keyed to capture the data, and then go through Telephone Edit Followup. In Telephone Edit Followup the keyed response records data undergo a computerized coverage and content edit. This edit identifies questionnaires where an insufficient number of questions were answered, or with missing or inconsistent information on the total count of people. Questionnaires that fail this edit and for which there is a telephone number are contacted during Telephone Edit Followup to obtain missing answers (Bureau of the Census, ACS Operations Plan, 2003).

The ACS samples were selected using variable sampling rates, which generally paralleled Census 2000. These variable sampling rates provide relatively more reliable estimates for small areas. For the 1999, 2000, and 2001 ACS, most of the 36 counties were sampled at an annual rate of five percent. The exceptions were the larger counties. Specifically, for Fort Bend and Harris Counties, Texas, the overall housing unit sampling rate was one percent. For Broward County, Florida; Bronx County, New York; Lake County, Illinois; San Francisco County, California; and Franklin County, Ohio, the overall housing unit sampling rate was three percent. The sampling rate within the county varied by the size of the governmental unit in which the housing unit was located (Bureau of the Census, 2003).

Eventhough the ACS sampling rates paralleled the Census 2000 sampling rates, they were not the same. There were two reasons for this. First, the ACS used total housing unit counts to determine sampling rates; Census 2000 used estimates of occupied housing units (which was based on 1990 block vacancy rates) . This was a source for different differential sampling rates between the ACS and Census 2000 in all 36 counties. Second, only Census 2000 used minor civil divisions (MCD) to determine the size of governmental units (in areas with MCDs). This was a source for different differential sampling rates between the ACS and Census 2000 in areas with MCDs.

The one percent sampling rate in Fort Bend and Harris Counties, Texas yielded small sample sizes at the tract level. Tract estimates based on these small sample sizes are not representative of the five-year averages that will be produced at full ACS implementation levels. The standard errors based on the one percent sampling rate are much larger than the five-year average standard errors will be, and therefore, are not representative of the ACS.

1.3 Errors in the Data

The ACS and Census 2000 data used for this comparison are based on samples, and subject to errors. There are two main types of errors: sampling error and nonsampling error. Sampling error is the deviation of a sample estimate from the average of estimates from all possible samples. The sample estimates may differ from the figures that would be obtained from interviewing the entire population using the same questionnaires, instructions, and interviewers. The sample estimates will also differ from other samples of the population (Bureau of the Census, Summary File 3 Technical Documentation, 2003).

A measure of sampling error is the standard error. The standard error of a sample estimate is a measure of the variation among the estimates from all possible samples. It measures the precision with which an estimate from a particular sample approximates the average result of all possible samples (Bureau of the Census, Summary File 3 Technical Documentation, 2003).

Nonsampling error is human and processing error that may be introduced during any of the various complex operations used to collect and process data. These errors can be introduced during editing, reviewing, keying, or interviewing operations, and can include: failing to obtain all required information from the respondents, obtaining incorrect or inconsistent information, and recording information incorrectly. Nonsampling error can affect the data in two ways. First, errors that are introduced randomly will increase the variability of the data, which should be reflected in the standard errors. Second, errors that tend to be consistent in one direction will introduce a bias into the survey estimates in that direction (Bureau of the Census, Summary File 3 Technical Documentation, 2003).

The quality measures compared in this analysis are computed to help indicate the presence of potential errors and bias. Nonsampling error caused by nonresponse is one of the main errors the quality measures deal with. Nonresponse to particular questions on a questionnaire or failure to obtain any information for a housing unit allows for the

introduction of bias into the data because the characteristics of the nonrespondents have not been observed and may differ from those characteristics reported by respondents. As a result, any imputation procedure using respondent data may not completely reflect these differences at either the person or housing unit level or on average (Bureau of the Census, Summary File 3 Technical Documentation, 2003).

2. METHODOLOGY

We computed the quality measures listed below for the 36 counties and their associated tracts (except for the tracts associated with Fort Bend County, Texas and Harris County, Texas). Quality measures are indicators of potential error and bias. We then compared the ACS three-year average quality measures and the Census 2000 sample quality measures for both the counties and the tracts. Section 2.1 describes how we compared the ACS three-year average and Census 2000 sample quality measures. Section 2.2 describes the methods we used to calculate their standard errors. The quality measures are described in detail in section 3.

- Self-Response Rate (SRR)
- Nonresponse Rate for Sample Units (UNR)
- Nonresponse Rate for Occupied Sample Units (OUNR)
- Item Allocation Rate
- Sample Completeness Rate for Housing Units (HCR) (county level only)
- Sample Completeness Rate for Household Population (PCR) (county level only)

2.1 Comparisons of the Quality Measures

Since the ACS and Census 2000 sample quality measures are both based on sample data, we expect them to differ. However, we wanted to know if the estimates differ because of sampling error (sampling variability) or nonsampling error. To determine this, we calculated the difference between the two quality measures, and the standard error of this difference. We then used the standard error to determine if the difference was due to sampling error or nonsampling error. The difference between the quality measures is the ACS three-year average estimate minus the Census 2000 sample estimate.

If the difference is caused by something other than sampling variability, we refer to the difference as significant. To determine if the difference between the quality measures was significant, we calculated a z-score by dividing the difference by its standard error. We then determined the probability that the computed z-score would yield a value as extreme or more extreme than the value computed if the ACS and Census 2000 sample quality measures were truly equal. We call this probability the p-value, and compare it against some pre-specified level of confidence or alpha value. If the p-value is less than the alpha value, the difference is deemed to be statistically significant because we are not confident that the difference was due to sampling error. If the p-value is greater than the alpha value, the difference is deemed not to be statistically significant because we are confident that it is due to sampling error.

At the Census Bureau, the standard alpha value for determining statistical significance is 0.10. We need to test for statistical significance because our estimates are based on samples and not the entire population. When we test a tract/county level difference for significance using a 0.10 alpha value, the chance of finding that difference to be statistically significant would be 0.10. However, we tested a large number of tracts/counties, and needed to incorporate a multiplicity allowance to allocate the significance level equally among all the tracts/counties. To do this, we used the Bonferroni multiple comparison procedure to adjust the overall alpha value ($alpha_N$) to a value ($alpha_R$) where the chance of finding one or more significant differences by chance alone, among all the tracts/counties is 0.10. The Bonferoni multiple comparison procedure adjusts $alpha_N$ for multiple comparisons by dividing it by the number of comparisons (m). So, in the Bonferoni equation $alpha_R=alpha_N/m$. For this analysis $alpha_N$ is set to 0.10, and m is set to the number of counties for the county level quality measure comparisons, and the number of tracts for the tract level quality measure comparisons.

For the tract level quality measure comparison, we split the tracts into five different groups, and calculated a separate $alpha_R$ value for each group. So, m is set equal to the number of tracts in the tract group. The tract groups are defined based on county and tract population sizes. Grouping the tracts according to population size helped us see if there were differences in nonresponse and coverage between tracts of different population size, and made it easier to graphically display significant tract differences. In addition, we excluded tracts with a population less than 500 from the analysis because the estimates would be based on a small amount of data. The five tract groups are defined as follows.

- Group 1 - tracts in small counties (under 100,000 persons) and tract population greater than 500 (207 tracts)
- Group 2 - tracts in medium counties (100,000 - 1,000,000 persons) and tract population between 500 and 4000 (592 tracts)
- Group 3 - tracts in medium counties (100,000 - 1,000,000 persons) and tract population greater than 4000 (580 tracts)
- Group 4 - tracts in large counties (1,000,000+ persons) and tract population between 500 and 4000 (401 tracts)
- Group 5 - tracts in large counties (1,000,000+ persons) and tract population greater than 4000 (470 tracts)

In addition to testing the difference between the ACS three-year average and Census 2000 sample quality measure for each county/tract for significance, we also tested the difference between the average quality measures for significance. That is, we tested the difference between the average of the county/tract ACS three-year average quality measures and the average of the county/tract Census 2000 sample quality measures. We tested the difference between the average quality measures using the margin of error. The margin of error is used to calculate a confidence interval for an estimate. A confidence interval is defined as a range about a given estimator that has a specified probability of containing the results of a complete interview. The margin of error specifies the range of the confidence interval about a given estimator. In other words, the

confidence interval is equal to the estimator plus or minus the margin of error. The margin of error is calculated by multiplying the standard error of the difference by the critical z-score value. The critical z-score is the z-score yielded when the resulting p-value is equal to the alpha value. Any z-scores equal to or greater than the critical z-score value are deemed significant. For this comparison, we used an alpha value of 0.10. The critical z-score for $alpha_N$, 0.10 is 1.645. So, the margin of errors shown in the tables of this report are equal to 1.645 times the standard error of the difference. Note, since we were only testing the one difference, we did not adjust for multiplicity. Once the margin of error is determined, a confidence interval can be computed. The upper limit of the confidence interval is the difference plus the margin of error. The lower limit of the confidence interval is the difference minus the margin of error. If this interval contains zero, the difference is not significantly different. So, if the margin of error is greater than the absolute value of the difference, the confidence interval will contain zero and the difference will not be significant. If the margin of error is not greater than the absolute value of the difference, the confidence interval will not contain zero, and the difference will be significant.

Note, even though a difference is statistically significant, the difference may be very small. The small difference may be statistically significant as a result of a large sample size and small standard error. So, a very small difference with a small standard error estimated from a large sample size may be statistically significant even though the difference is of no practical importance.

2.2 Calculation of Standard Errors

The calculation of the standard errors for the Census 2000 sample and ACS three-year averages quality measures are described in this section. Section 2.2.1 describes the calculation of the standard errors of the Census 2000 sample quality measures. They were computed using the Census 2000 published design factors. Section 2.2.2 describes the calculation of the standard errors of the ACS three-year average quality measures. Section 2.2.3 describes the calculation of the standard error of the difference between the ACS three-year average and Census 2000 sample quality measures. For the ACS, the single year estimates were obtained directly via a replication method, and then used to calculate the ACS three-year average standard errors.

2.2.1 Standard Errors for Census 2000 Quality Measures

To estimate standard errors for the Census 2000 quality measures, we applied Census 2000 long form data variance estimation procedures. The standard errors for the Census 2000 self-response rates, sample unit nonresponse rates, and item allocation rates were calculated as described below.

$$SE(\hat{p}) = DF \times \sqrt{\left(\frac{5}{B}\right)\hat{p}\left(100 - \hat{p}\right)}$$

where, B is the base of the percentage or denominator of the rates shown in sections 3.1 through 3.4, and DF is the design factor defined in section 2.2.1.1. For these standard

errors, if p was less than 2 percent or greater than 98 percent, then p was set to 2 percent. Also, we set any of the standard errors greater than 70 to 70.

The standard errors for the Census 2000 sample completeness rates were calculated as described below.

$\hat{R}$ = sample completeness rate

$$\hat{R} = \frac{\hat{Y}_1}{\hat{Y}_2} \times 100$$

where $\hat{Y}_2$ is an actual Census 2000 count based on the "100 percent" items, and therefore has no standard error. $\hat{Y}_2$ is the Census 2000 total housing units for the housing unit sample completeness rate, and the Census 2000 total household population for the household population sample completeness rate. Therefore, $\hat{Y}_2$ was treated as a constant in the sample completeness rate standard errors.

$$SE(\hat{R}) = \left[DF \times \frac{1}{\hat{Y}_2} \sqrt{5\hat{Y}_1\left(1 - \frac{\hat{Y}_1}{N}\right)} \right] \times 100$$

where N is the size of the publication area or in this case $\hat{Y}_2$, and DF is the design factor.

It should be noted that the formulae for $SE(\hat{p})$ and $SE(\hat{R})$ are derived from the simple random sample variance for a total with a 1-in-6 sampling rate. In addition, the method used to calculate $SE(\hat{R})$ underestimates (overestimates) the standard error if the two items in the rate are negatively (positively) correlated. For more information on the Census 2000 long form variance procedures, see the Summary File 3 Technical Documentation, released in 2003. This can be found on the U.S. Census Bureau web site at http://www.census.gov/prod/cen2000/doc/sf3.pdf .

2.2.1.1 Design Factors

The design factor used in the Census 2000 long form variance procedure is the ratio of the estimated standard error to the standard error of a simple random sample. This reflects the effects of the actual sample design and the complex ratio estimation procedure used for Census 2000 (Summary File 3 Technical Documentation, 2003). There are published Census 2000 design factors for a wide range of housing unit and population characteristics (Asiala and Haines, 2002). These design factors are available for each state and the United States, and are calculated by the four levels of percent in sample (observed sampling rate). The characteristics for which design factors are published can be found in the Summary File 3 Technical Documentation. The four levels of percent in sample are:

- Level 1 - less than 15 percent
- Level 2 - 15 percent to less than 25 percent

- Level 3 - 25 percent to less than 35 percent
- Level 4 - 35 percent or more

To calculate the standard errors for the Census 2000 long form quality measures, we first identified the appropriate design factors to use in the equation. The first step was to identify the appropriate percent-in-sample level for each of the 36 counties and tracts. The percent in sample for varying geographic levels is available on the Census Bureau web site.

The second step was to select the design factor of the most related housing or population characteristics. There are not directly corresponding published designed factors for all of the quality measures. So, we determined the design factor to use in the standard error calculation by:

- Identifying housing unit/population characteristic with published design factors that correlate to the quality measure.

- Identifying the correlated housing unit/population characteristic with the largest published design factor for each state, and applying this design factor to the quality measure values for the counties and tracts that lie within a state. Using the largest published design factor provided a conservative standard error estimate.

Appendix B contains a list of the quality measures and the housing or population characteristic group design factor used to calculate standard errors for the quality measures. The national and state design factors can be found in chapter 8 of the Summary File 3 Technical Documentation.

2.2.2 Standard Errors for ACS Quality Measures

For the ACS quality measures, the single year quality measures and standard errors were computed first. That is, the 1999, 2000, and 2001 quality measures with their associated standard errors were computed separately first. Then they were combined to produce the three-year average quality measure and standard error. The standard errors for the single year quality measures were obtained directly via a replication method. The standard errors (SE) for the three-year average quality measures were then computed as follows (Bench, 2003).

Let $Rate_{Year} = \frac{N_{Year}}{D_{Year}} \times 100$, where N stands for numerator and D stands for denominator.

Year = 1999, 2000, or 2001

$N_{3yr} = N_{1999} + N_{2000} + N_{2001}$ and $D_{3yr} = D_{1999} + D_{2000} + D_{2001}$

$$Ratio_{3yr} = \frac{N_{3yr}}{D_{3yr}}, \qquad Rate_{3yr} = \frac{N_{3yr}}{D_{3yr}} \times 100$$

$$\left(SE\left(N_{3yr}\right)\right)^2 = \left(SE\left(N_{1999}\right)\right)^2 + \left(SE\left(N_{2000}\right)\right)^2 + \left(SE\left(N_{2001}\right)\right)^2$$

$$\left(SE\left(D_{3yr}\right)\right)^2 = \left(SE\left(D_{1999}\right)\right)^2 + \left(SE\left(D_{2000}\right)\right)^2 + \left(SE\left(D_{2001}\right)\right)^2$$

$$SE\left(Rate_{3yr}\right) = \left[\frac{1}{D_{3yr}}\sqrt{\left(SE\left(N_{3yr}\right)\right)^2 + \left(Ratio_{3yr}\right)^2 \times \left(SE\left(D_{3yr}\right)\right)^2}\right] \times 100$$

If the standard error of N_{Year} or D_{Year} was calculated as zero using the replication method, we used the approximation below to obtain their standard errors. This would happen if $N_{Year}=0$ or $D_{Year}=0$, and sometimes for nonzero estimates.

$$\left(SE\left(D_{Year}\right)\right)^2 = 400 \times AvgWeight_{County}$$

where the average weight is the maximum of the average person and average household final weights for observations in the county for that year.

When any of the single year estimates have been approximated this way, the standard error of the three-year average rate can be quite large.

If the value calculated for $SE(Rate_{3yr})$ was greater than 70, the standard error of the three-year average rate was set to 70.

If $D_{3yr} = 0$, meaning there were no observations in the denominator for any of the three years, the standard error for the three year average rate was set to missing.

2.2.3 Standard Errors for the Differences between the ACS and Census 2000 Quality Measures

The standard errors for the differences between the ACS and census quality measures were calculated as follows.

$$SE\left(difference\right) = \sqrt{SE\left(Rate_{ACS\,3yr}\right)^2 + SE\left(Rate_{Census}\right)^2}$$

where difference = $Rate_{ACS3yr}$ - $Rate_{Census}$

It should be noted that the standard error of the difference does not take into account the covariance between the ACS quality measure and the census quality measure. So, this method overestimates the standard error of the difference.

3. ANALYSIS/RESULTS

A description of each quality measure and summary of the ACS three-year average and Census 2000 quality measure comparison results is given in this section. Section 3.1 covers the self-response rate. Section 3.2 covers the sample unit nonresponse rate and the occupied sample unit nonresponse rate. Section 3.3 covers the item allocation rates, and section 3.4 covers the sample completeness rates.

3.1 Self-Response Rate

To help measure the public cooperation with the ACS and Census 2000 long form, we calculated the self-response rate. The self-response rate measures the percent of occupied housing units that mailed back their questionnaire. One minus the self-response rate (1 – self-reponse rate) shows the percent of data that need collecting in follow-up operations. These followup operations can have an important effect on the quality of the data and cost of the survey. Self-response rates were calculated for each of the 36 ACS counties, and for tracts in 34 ACS counties. (The tracts in Fort Bend County, Texas and Harris County, Texas were excluded.[1]). The county-level comparison results are presented in section 3.1.1, and the tract-level comparison results are presented in section 3.1.2.

The Census 2000 long form self-response rate is the percent of all occupied housing units enumerated in mailback TEAs[2] on long form questionnaires that were returned by mail. The numerator and denominator of the percent are weighted by the reciprocal of the sampling fraction used to designate long form sample units for the block in which they were enumerated. This weight is equal to 2, 4, 6 or 8. The weighted block level long form units are aggregated to the county/tract level, and the rate computed from the weighted county/tract counts. Note, the numerator and denominator of this rate also include noninterviews. The noninterviews are housing units that mailed back a questionnaire *but* did not provide enough information to be considered 'sample data defined.' So, these housing units were not eligible for inclusion in the Census 2000 sample.

The ACS three-year average self-response rate is the percent of all occupied housing units that mailed back a questionnaire. The numerator and denominator of this percent are weighted by their probability of selection or the initial ACS sampling weight multiplied by the CAPI subsampling weights (base weights). The numerator includes the base weighted self-response noninterviewed units and the denominator includes all base weighted noninterviewed units.

The self-response rate formulae are below.

[1] Tracts in Fort Bend County and Harris County were excluded because of their low sampling rate compared to the ACS five-year design level.

[2] In mailback TEAs, respondents were asked to return their completed census form by mail. This could have been a mailout/mailback TEA where the census form was delivered to the housing units by the United States Postal Service (USPS), or an update/leave TEA where the form was delivered in person by a census enumerator. In list/enumerate TEAs a form was delivered in person by a census enumerator, and then completed at the time of delivery with the help of the census enumerator.

- Census 2000 long form self-response rate = (weighted count of occupied self-response long form housing units enumerated in mailback TEAs / weighted count of occupied long form housing units enumerated in mailback TEAs) × 100

- ACS self-response rate = (weighted count of occupied self-response housing units including self-response noninterviews / weighted count of total occupied housing units including noninterviews) × 100

3.1.1 County Comparisons

This section contains the county level quality measures comparison results. In this section we compare the ACS three-year average and Census 2000 long form self-response rate differences for each of 35 counties, and then examine the differences when the values are averaged across all the counties. Vilas County, Wisconsin was excluded from the self-response rate comparison. For this county, there is no Census 2000 long form self-response rate because the county was not part of a mailback TEA. The entire county was part of a list/enumerate TEA, so the denominator or universe of the self-response rate is zero.

Table 1 shows the number of counties with statistically significantly different ACS three-year average and Census 2000 long form self-response rates. More specifically, it shows three numbers. First, it shows the number of counties whose self-response rates were not statistically significantly different. Second, it shows the number of counties whose self-response rates were statistically significantly different with the self-response rates for the ACS three-year averages being larger than the Census 2000 long form estimates. Third, it shows the number of counties whose self-response rates were statistically significantly different with the self-response rate for the Census 2000 long form being larger than the ACS three-year estimate. To determine the number of counties with statistically significantly different self-response rates, we calculated a z-score for each county. We then compared the z-score against the alpha value yielded by the Bonferoni multiple comparison procedure (see section 2) to see which of the counties were statistically significantly different.

While Table 1 shows the results of comparing each of the county differences, Table 2 shows the results of comparing the average of the 35 county self-response rates. The second column in Table 2 shows the average of the 35 county ACS three-year average self-response rates. The third column shows the average of the 35 county Census 2000 long form self-response rates. Column four shows the differences between the ACS and census average self-response rates, where the difference is the ACS average minus the census average. Column five contains the margin of error for the difference of the average.

Table 1. Number of Counties with Statistically Significantly Different Self-response Rates [C]

Quality Measure	Number of 35 Counties Not Statistically Significantly Different	Number of 35 Counties Statistically Significantly Different with ACS > Census	Number of 35 Counties Statistically Significantly Different with Census > ACS
Self-response rate	3	0	32

C – Comparisons are based on a non-random sample of counties

Table 2. Comparison of Self-response Rates: ACS Three-year Averages and Census 2000 Long Form Estimates, County Averages

Quality Measure	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Self-response rate	55.3%	68.1%	-12.8%	± 3.6%

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

Table 1 and Table 2 show that the census usually collected more forms by self-response than the ACS. Table 1 shows that 32 out of the 35 counties were statistically significantly different. For all 32 counties with statistically significantly different self-response rates, the self-response rate for the Census 2000 long form was larger than the ACS three-year average estimate. Table A-1 in Appendix A contains the ACS three-year average and Census 2000 long form self-response rates (SRR) for each of the 36 counties. The three counties whose differences are not statistically significant are marked with an "NS" in the table. Table 2 shows, that on average the self-response rate for the Census 2000 long form was 12.8 percent larger than the ACS three-year average estimate. Since the margin of error for the difference is only 3.6 percent, the resulting confidence interval would not contain zero. So, the average difference is statistically significant.

Figure C-1 in Appendix C displays the county-level self-response rate differences for the 35 counties through the use of a one-dimensional scatter plot. For this plot, differences between the ACS three-year averages and the Census 2000 sample quality measures are located on the vertical axis; counties are on the horizontal axis. We sorted counties by their 100 percent count of census housing units. The sort was in ascending order, from left to right. For example, the difference for the county with the smallest count is the left-most point in Figure C-1, while the difference for the county with the largest count is the right-most point. We used a "jittering" process so that we could plot the differences in this way. The "jittering" process assigned a unique integer to each county so as to achieve this sort, where the county with the smallest count received the smallest integer, etc.

Figure C-1 shows that the self-response rate for the ACS three-year average was consistently lower than the Census 2000 long form estimate. These differences are

usually centered on –10. It also shows that the counties with the smaller number of census housing units tend to have the largest differences. Statistically significant differences are indicated by an "X" on this plot.

The results presented in Table 1, Table 2, Appendix A, and Figure C-1, show that in general, the census collected more forms via self-response than the ACS. The higher census long form self-response rates mean that the success of the census depended less on followup operations than did the success of the ACS. The higher census long form self-response rates are to be expected considering the high visibility and large advertising campaign of Census 2000.

3.1.2 Tract Comparisons

This section contains the self-response rate comparison for the tracts. In this section we compared the ACS three-year average and Census 2000 long form self-response rate differences for the tracts in the 34 counties by tract group, and then compared the differences when the values were averaged across all the counties by tract group.

Table 3 shows the number of tracts with statistically significantly different ACS three-year average and Census 2000 long form self-response rates for each of the five tract groups. More specifically, it shows three numbers. First, it shows the number of tracts for each group whose self-response rates were not statistically significantly different. Second, it shows the number of tracts for each group whose self-response rates were statistically significantly different with the self-response rate for the ACS three-year average being larger than the Census 2000 long form estimate. Third, it shows the number of tracts for each group whose self-response rates were statistically significantly different with the self-response rate for the Census 2000 long form being larger than the ACS three-year average estimate. To determine the number of tracts with statistically significantly different self-response rates, we calculated a z-score for each tract. We then compared the z-score against the alpha value yielded by the Bonferoni multiple comparison procedure (see section 2) to see which of the tracts were statistically significantly different. We used the Bonferoni multiple comparison procedure to obtain a different alpha value for each tract group.

While Table 3 shows the results of comparing each tract difference, Table 4 shows the results of comparing the average of the tract self-response rates for each group. The third column in Table 4 shows the average of the ACS three-year average tract self-response rates. The fourth column shows the average of the Census 2000 long form tract self-response rates. Column five shows the differences between the ACS and census average self-response rates, where the difference is the ACS average minus the census average. Column six contains the margin of error for the difference of the average.

Table 3. Number of the Tracts with Statistically Significantly Different Self-response Rates, by Tract Group [C]

Quality Measure	Tract Group[N]	Number of Tracts Not Statistically Significantly Different	Number of Tracts Statistically Significantly Different with ACS > Census	Number of Tracts Statistically Significantly Different with Census > ACS
Self-response rate	1	149	0	42
	2	578	0	11
	3	556	0	23
	4	387	0	14
	5	396	8	66

N – Note, group 1 contains 191 tracts, group 2 contains 589 tracts, group 3 contains 579 tracts, group 4 contains 401 tracts, and group 5 contains 470 tracts.

C – Comparisons are based on a non-random sample of counties

Table 4. Comparison of Self-response Rates: ACS Three-year Averages and Census 2000 Long Form Estimates, Tract Group Averages

Quality Measure	Tract Group[N]	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Self-response rate	1	54.8%	67.6%	-12.8%	± 2.0%
	2	62.8%	69.5%	-6.7%	± 1.2%
	3	60.3%	68.4%	-8.0%	± 1.1%
	4	48.3%	57.6%	-9.3%	± 1.8%
	5	51.5%	60.7%	-9.2%	± 1.5%

N – Note, group 1 contains 191 tracts, group 2 contains 589 tracts, group 3 contains 579 tracts, group 4 contains 401 tracts, and group 5 contains 470 tracts.

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

Some tracts were excluded from the self-response rate comparison. For these tracts, there is no Census 2000 long form self-response rate because the entire tract was part of the list/enumerate TEA. So, the denominator or universe of the self-response rate is zero. So, for group 1, 16 tracts were removed from the self-response rate comparison. For group 2, three tracts were removed, and for group 3, one tract was removed. There are now 191 tracts, 589 tracts, and 579 tracts in groups 1, 2, and 3 respectively for the self-response rate comparisons.

Table 3 shows that the only two groups to yield more than 10 percent of their tract differences statistically significant are group 1 and group 5. For group 1, 22.0 percent (42 out of 191) of the tract differences are statistically significant. For group 2, 1.9 percent (11 out of 589) of the tract differences are statistically significant. For group 3, 4.0 percent (23 out of 579) of the tract differences are statistically significant. For group

4, 3.5 percent (14 out of 401) of the tract differences are statistically significant. For group 5, 15.7 percent (74 out of 470) of the tract differences are statistically significant. So, we see the largest number of statistically significant differences for the tracts in small counties (group 1), and the tracts with large populations in counties with large populations (group 5). In addition, for all of the statistically significant differences for groups 1, 2, 3, or 4, the Census 2000 long form self-response rates were larger than the ACS three-year average rates. For group 5, for 66 out of the 74 statistically significant differences, the ensus self-response rate was larger than the ACS self-response rate. So, for groups 1 and 5, the census received a larger number of forms via self-response.

Table 4 shows that for all five groups the census on average, received a larger number of forms via self-response. The average tract census self-response rate for all five groups is larger than the average tract ACS self-response rate. The margin of error for each of the five groups was less than the absolute value of the difference between the averages. So, the difference between the average is statistically significantly different for all five groups.

Figure D-1 in Appendix D displays tract-level self-response rate differences through the use of a one-dimensional scatter plot. We grouped all of the tract-level differences by tract group. For this plot, differences between the ACS three-year average and Census 2000 long form self-response rate are located on the vertical axis; tracts and tract groups are on the horizontal axis. We sorted tracts within each tract group by their 100 percent count of census housing units. The sorts were in ascending order, from left to right, within each tract group. For example, the difference for the tract with the smallest count is the left-most point within each tract group, while the difference for the tract with the largest count is the right-most point within each tract group. We used a "jittering" process so that we could plot the differences in this way. Within each tract group, the "jittering" process assigned a unique integer to each tract so as to achieve this sort, where the tract with the smallest count received the smallest integer, etc.

Figure D-1 shows that for each tract group, a majority of the ACS three-year average self-response rates are lower than the Census 2000 long form self-response rates. The majority of the differences are between –20 and 10. Statistically significant differences are indicated by an "X" on these plots.

The results presented in Table 3, Table 4, and Figure D-1, echo the county level results showing that on average, the census received a larger number of forms via self-response than the ACS.

3.2 Nonresponse Rates: Sample Units and Occupied Sample Units

We calculated the sample unit nonresponse and occupied sample unit nonresponse rates as measures of the overall success of the ACS and Census 2000 data collection and to indicate potential nonsampling errors in the final estimates. These rates were calculated for each of the 36 ACS counties, and for tracts in the 34 ACS tract-level comparison counties. The county-level comparison results are presented in section 3.2.1, and the tract-level comparison results are presented in section 3.2.2.

Sample unit nonresponse rates measure the percent of housing units for which we did not obtain enough information for the units to be considered interviews (see below) . Such nonresponse can introduce bias into the sample estimates because the characteristics of noninterviewed units and their residents may differ from the characteristics of interviewed units and their residents. While the ACS and census used similar, but not identical, rules to determine which housing units provided enough information to be considered interviews, they treated noninterviews differently during weighting and estimation. The ACS accounts for noninterviewed units by applying noninterview factors. The census did not use any noninterview adjustment.

The numerator of the Census 2000 sample unit nonresponse rate is the Census 2000 total housing units minus the Census 2000 weighted count of long form sample data defined housing units. The denominator is the Census 2000 total housing units. Each long form sample data defined housing unit is weighted by the reciprocal of the sampling fraction used to designate long form sample units for the block in which it was enumerated. This weight is equal to 2, 4, 6 or 8.

The numerator of the census formula represents the shortage in the Census 2000 sample of housing units due to response records for long form units not being "sample data defined." It is expressed as a percent of the total enumerated units. To be sample data defined (SDD), an occupied census long form unit had to contain at least one person who was both "100 percent" data defined and sample data defined. To satisfy these criteria a person record had to have answers to at least two of the "100 percent" population items and two of the sample population items. Housing item responses were not required of occupied long form units in order to be placed in the Census 2000 sample. Vacant long form units had to have answers to at least two sample housing items to be placed in the Census 2000 sample.

The numerator of the ACS three-year average sample unit nonresponse rate is the base weighted count of noninterviewed units, and the denominator is the base weighted count of total (noninterviewed plus interviewed) housing units.

The ACS uses an "Acceptability Index" (AI) to determine whether a unit provided enough data to be considered successfully interviewed. The AI index is computed by adding the number of basic items with answers (e.g., age, complete date of birth, race, etc.), and then dividing this sum by the number of household members. Households with AIs of less that 2.5 are treated as survey noninterviews. Vacant housing units are not subjected to this AI requirement, but are included in the denominator of the ACS total sample unit nonresponse rate.

The sample unit nonresponse rate formulae are below.

The Census 2000 sample unit nonresponse rates are:

- Total sample unit nonresponse rate = [(Census 2000 total housing units – Census 2000 weighted count of long form sample data defined housing units) / Census 2000 total housing units] × 100

- Occupied sample unit nonresponse rate = [(Census 2000 occupied housing units – Census 2000 weighted count of long form occupied sample data defined housing units) / Census 2000 occupied housing units] × 100

The ACS sample unit nonresponse rates are:

- Total sample unit nonresponse rate = (weighted count of noninterviewed units / weighted count of total (noninterviewed plus interviewed) housing units) × 100

- Occupied sample unit nonresponse rate = (weighted count of noninterviewed units / weighted count of total occupied housing units) × 100

3.2.1 County Comparisons

This section contains the nonresponse rate comparisons for sample units and occupied sample units for counties. In this section we compare the ACS three-year average and Census 2000 sample unit nonresponse rate differences for each of the 36 counties, and then compare the differences when the values were averaged across all the counties.

Table 5 shows the number of counties with statistically significantly different ACS three-year average and Census 2000 sample unit nonresponse rates and occupied sample unit nonresponse rates. Table 6 shows the results of comparing the average of the 36 county rates.

Table 5. Number of Counties with Statistically Significantly Different Nonresponse Rates for Sample Units and Occupied Sample Units [C]

Quality Measure	Number of 36 Counties Not Statistically Significantly Different	Number of 36 Counties Statistically Significantly Different with ACS > Census	Number of 36 Counties Statistically Significantly Different with Census > ACS
Sample unit nonresponse rate	9	1	26
Occupied sample unit nonresponse rate	13	1	22

C – Comparisons are based on a non-random sample of counties

Table 6. Comparison of Nonresponse Rates for Sample Units and Occupied Sample Units: ACS Three-year Averages and Census 2000 Sample Estimates, County Averages

Quality Measure	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Sample unit nonresponse rate	4.4%	9.7%	-5.3%	± 1.5%
Occupied sample unit nonresponse rate	5.2%	8.7%	-3.5%	± 1.3%

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

Table 5 and Table 6 show that the ACS usually had less unit nonresponse than the Census 2000 sample. The lower sample unit nonresponse rates for the ACS suggest that the ACS collected more information during follow-up operations than the census. Table 5 shows that 27 out of the 36 counties had statistically significantly different sample unit nonresponse rates, and 23 out of 36 had statistically significantly different occupied sample unit nonresponse rates. For 26 counties with statistically significantly different sample unit nonresponse rates, the sample unit nonresponse rate for the Census 2000 sample was larger than the ACS three-year average estimate. For 22 counties with statistically significantly different occupied sample unit nonresponse rates, the occupied sample unit nonresponse rate for the Census 2000 sample was larger than the ACS three-year average estimate. Table A-1 in Appendix A contains the ACS three-year average and Census 2000 sample unit nonresponse rates (UNR) and occupied sample unit nonresponse rates (OUNR) for each of the 36 counties. The counties whose differences are not statistically significantly significant are marked with an "NS" in the table.

Table 6 shows that, on average, the Census 2000 sample unit nonresponse rate was 5.3 percent larger than the ACS three-year average sample unit nonresponse rate. Since the margin of error for the difference is only 1.5 percent, the resulting confidence interval would not contain zero. So, the average sample unit nonresponse rate difference is statistically significant. For the occupied sample unit nonresponse rate, the Census 2000 sample rate was 3.5 percent larger than the ACS three-year average rate. The margin of error for the occupied sample unit nonresponse rate is only 1.3 percent. So, the average occupied sample unit nonresponse rate is also statistically significantly different.

Figures C-2 and C-3 in Appendix C display the county-level sample unit nonresponse rate and occupied sample unit nonresponse rate differences, respectively, for all 36 counties through the use of one-dimensional scatter plots. For these plots, differences between the ACS three-year averages and the Census 2000 sample quality measures are located on the vertical axis; counties are on the horizontal axis. We sorted counties by their 100 percent count of census housing units. The sorts were in ascending order, from left to right. For example, the difference for the county with the smallest count is the left-most point in the plots, while the difference for the county with the largest count is the right-most point. We used a "jittering" process so that we could plot the differences in this way. The "jittering" process assigned a unique integer to each county so as to achieve this sort, where the county with the smallest count received the smallest integer, etc.

Figure C-2 shows that nearly all of the sample unit nonresponse rates for the ACS three-year averages were lower than the Census 2000 sample estimates. For the most part, these differences are either centered between –2 and 2, or around –6. Statistically significant differences are indicated by an "X" on this plot.

Figure C-3 shows that nearly all of the occupied sample unit nonresponse rates for the ACS three-year averages were lower than the Census 2000 sample estimates. For the most part, these differences ranged between –8 and 2. Statistically significant differences are indicated by an "X" on this plot.

The results presented in Table 5, Table 6, Appendix A, Figures C-2, and Figure C-3, show that, in general, the ACS obtained more information during followup operations than the census. These differences in unit nonresponse rates could be a signal of higher nonresponse error in the Census 2000 sample.

The larger Census 2000 sample unit nonresponse rates are not unexpected because of differences between the census and ACS. The main emphasis of the decennial census is to enumerate the U.S. population, and only secondarily to collect long form sample data. In addition, temporary enumerators collect census data while permanent, professional interviewers collect ACS data. Census 2000 enumerated the nations' population and collected detailed demographic information via the census long form over the span of six months, and did not followup on items left blank on mail returned questionnaires. In contrast, the sole focus of the ACS is collecting "long form" data, using monthly samples with three-month collection cycles, and the ACS conducts a followup of items left blank on mail returned questionnaires. The census has to follow-up on all non-responding units in the country in a tight time frame, making it difficult for the census to obtain complete long form information, especially if it is necessary to obtain information from neighbors. The ACS, on the other hand, follows-up on only a sample of nonresponding units, and does not allow information to be collected from neighbors. All these differences between the census and ACS could contribute to the differences in sample unit nonresponse rates.

3.2.2 Tract Comparisons

This section contains the nonresponse rate comparisons for sample units and occupied sample units for tracts. In this section we compare the ACS three-year average and Census 2000 sample unit nonresponse rate and occupied sample unit nonresponse rate differences for the tracts in the 34 counties by tract group, and then compare the differences when the values are averaged across all the tracts in a group.

Table 7 shows the number of tracts with statistically significantly different ACS three-year average and Census 2000 sample unit nonresponse and occupied sample unit nonresponse rates for each of the five tract groups. Table 8 shows the results of comparing the average of the tract rates for each group.

Table 7. Number of Tracts with Statistically Significantly Different Nonresponse Rates for Sample Units and Occupied Sample Units, by Tract Group [C]

Quality Measure	Tract Group[N]	Number of Tracts Not Statistically Significantly Different	Number of Tracts Statistically Significantly Different with ACS > Census	Number of Tracts Statistically Significantly Different with Census > ACS
Sample unit nonresponse rate	1	162	3	42
	2	569	0	23
	3	510	1	69
	4	388	0	13

Table 7. Number of Tracts with Statistically Significantly Different Nonresponse Rates for Sample Units and Occupied Sample Units, by Tract Group [C]

Quality Measure	Tract Group[N]	Number of Tracts Not Statistically Significantly Different	Number of Tracts Statistically Significantly Different with ACS > Census	Number of Tracts Statistically Significantly Different with Census > ACS
	5	392	0	78
Occupied sample unit nonresponse rate	1	193	0	14
	2	580	0	12
	3	533	2	45
	4	392	0	9
	5	398	0	72

N – Note, group 1 contains 207 tracts, group 2 contains 592 tracts, group 3 contains 580 tracts, group 4 contains 401 tracts, and group 5 contains 470 tracts.

C – Comparisons are based on a non-random sample of counties

Table 8. Comparison of Nonresponse Rates for Sample Units and Occupied Sample Units: ACS Three-year Averages and Census 2000 Sample Estimates, Tract Group Averages

Quality Measure	Tract Group[N]	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Sample unit nonresponse rate	1	4.3%	10.7%	-6.4%	± 1.0%
	2	4.6%	9.4%	-4.8%	± 0.6%
	3	4.4%	8.9%	-4.5%	± 0.4%
	4	5.9%	15.7%	-9.9%	± 1.0%
	5	4.9%	11.8%	-6.9%	± 0.7%
Occupied sample unit nonresponse rate	1	5.4%	9.3%	-3.9%	± 0.8%
	2	5.0%	8.8%	-3.8%	± 0.5%
	3	4.7%	8.5%	-3.8%	± 0.4%
	4	6.5%	15.6%	-9.1%	± 1.0%
	5	5.4%	12.4%	-7.0%	± 0.7%

N – Note, group 1 contains 207 tracts, group 2 contains 592 tracts, group 3 contains 580 tracts, group 4 contains 401 tracts, and group 5 contains 470 tracts.

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

Table 7 shows that more than 10 percent of the tract differences in groups 1, 3, and 5 are statistically significant for the sample unit nonresponse rates. For group 1, 22.0 percent (45 out of 207) of the tract differences are statistically significant. For group 2, 3.9 percent (23 out of 592) of the tract differences are statistically significant. For group 3, 12.1 percent (70 out of 580) of the tract differences are statistically significant. For group 4, 3.2 percent (13 out of 401) of the tract differences are statistically significant. For group 5, 16.6 percent (78 out of 470) of the tract differences are statistically significant. So, we see the most statically significant differences for the tracts in small counties (group 1), tracts with large populations in medium counties (group 3), and the tracts with large populations in counties with large populations (group 5). In addition, for all of the statistically significant differences for groups 2, 4, and 5, the Census 2000 sample unit nonresponse rates were larger than the ACS three-year average rates. For group 1, for 42 out of the 45 statistically significant differences, the census sample unit nonresponse rate was larger than the ACS sample unit nonresponse rate. For group 3, for 69 out of the 70 statistically significant differences, the census sample unit nonresponse rate was larger than the ACS sample unit nonresponse rate. So, for groups 1, 3, and 5, the ACS obtained more information during followup operations.

Table 7 also shows that for the occupied sample unit nonresponse rate, the only group to yield more than 10 percent of their tract differences statistically significant is group 5. For group 1, 6.8 percent (14 out of 207) of the tract differences are statistically significant. For group 2, 2.0 percent (12 out of 592) of the tract differences are

statistically significant. For group 3, 8.1 percent (47 out of 580) of the tract differences are statistically significant. For group 4, 2.2 percent (9 out of 401) of the tract differences are statistically significant. For group 5, 15.3 percent (72 out of 470) of the tract differences are statistically significant. So, we see the most statistically significant differences occur for the tracts with large populations in counties with large populations (group 5). In addition, for all of the statistically significant differences for groups 1, 2, 4, and 5, the Census 2000 occupied sample unit nonresponse rates were larger than the ACS three-year average rates. For group 3, for 45 out of the 47 statistically significant differences, the census occupied sample unit nonresponse rate was larger than the ACS occupied sample unit nonresponse rate. So, for group 5, the ACS obtained more information during followup operations.

Table 8 shows that for all five groups the ACS, on average, received more information during followup operations. The average tract census sample unit nonresponse rate and occupied sample unit nonresponse rate for all five groups is larger than the average tract ACS sample unit nonresponse rate and occupied sample unit nonresponse rate. The margin of error for each rate and each of the five groups was less than the absolute value of the difference between the averages. So, the difference between the average is statistically significantly different for all five groups for both rates.

Figures D-2 and D-3 in Appendix D display tract-level sample unit nonresponse rate and occupied sample unit nonresponse rate differences through the use of one-dimensional scatter plots. We grouped all of the tract-level differences by tract group. For these plots, differences between the ACS three-year average and Census 2000 sample quality measures are located on the vertical axis; tracts and tract groups are on the horizontal axis. We sorted tracts within each tract group by their 100 percent count of census housing units. The sorts were in ascending order, from left to right, within each tract group. For example, the difference for the tract with the smallest count is the left-most point within each tract group, while the difference for the tract with the largest count is the right-most point within each tract group. We used a "jittering" process so that we could plot the differences in this way. Within each tract group, the "jittering" process assigned a unique integer to each tract so as to achieve this sort, where the tract with the smallest count received the smallest integer, etc.

Figure D-2 shows that a majority of the sample unit nonresponse rates for the ACS three-year averages are lower than the Census 2000 sample estimates. The majority of the differences are between –30 and 10. Statistically significant differences are indicated by an "X" on this plot.

Figure D-3 shows that, for each tract group, a majority of the occupied sample unit nonresponse rates for the ACS three-year averages are lower than the Census 2000 sample estimates. The majority of the differences are between –30 and 10. Statistically significant differences are indicated by an "X" on this plot.

The results presented in Table 7, Table 8, Figure D-2, and Figure D-3 show that on average, the ACS collected information from a higher percentage of the units in its sample than the census. This difference in unit nonresponse could be a signal of higher

nonresponse error in the census. These results were anticipated due to the design of ACS operations as discussed at the end of section 3.2.1.

3.3 Item Allocation Rates

We measure item nonresponse to help determine potential nonsampling error. Item nonresponse is the extent to which a required answer to an individual questionnaire item is missing. Items on a questionnaire can be left unanswered for a variety of reasons. Respondents may choose not to answer an item because they do not see the need to cooperate, view the item as too personal, do not have time to answer all items on the questionnaire, misunderstand the wording on the questionnaire, misunderstand the various paths in a questionnaire, etcetera. In addition, items left blank on a questionnaire may differ between the housing units with mailed in forms, and housing units whose data has to be collected through field operations. For whatever reason an item is left blank, blank items can affect the quality of the final survey estimates.

To measure item nonresponse, we calculated item allocation (or imputation) rates. They are the percent of the total number of persons or housing units required to respond to the item for which the value of that item was allocated (that is, imputed). When an item on a questionnaire is missing or inconsistent, that item is edited and its value imputed from a different housing unit or person record. Both the ACS and the census used "nearest neighbor" hot deck matrices to identify the housing unit or person record whose value for a particular item on the questionnaire was assigned to the missing or inconsistent item on the other questionnaire. If the actual values of the missing characteristics differ from the responses used in the imputation, the resulting data can be biased.

Summary item allocation rates are provided for each of the 36 ACS counties, and for tracts in the 34 ACS tract-level comparison counties. At the county level, the summary item allocation rates are also broken out by response mode. They are not broken out by response mode at the tract level because of small sample sizes at the tract level. The county-level comparison results are presented in section 3.3.1, and the tract-level comparison results are presented in section 3.3.2.

The response modes are self-response or interviewer-response. Self-response means that the household data came from a mail return, and interviewer-response means that an interviewer or enumerator obtained the data with the use of a follow-up form or instrument. For Census 2000, the follow-up operations were Nonresponse Follow-Up and Coverage Improvement Follow-up. For the ACS, the follow-up operations were Computer Assisted Telephone Interviewing (CATI) and Computer Assisted Personal Interviewing (CAPI).

Item allocation rates were calculated for items that appeared on both the ACS and Census 2000 long form questionnaires (54 population items, 29 occupied housing unit items, and 12 vacant housing unit items). While the questions may not all have been identical, they were comparable. The Census 2000 sample item allocation rates are based on the final-weighted allocations made by the census edit and allocation process on all records placed in the Census 2000 sample (on the Census 2000 Sample Census Edited File). The ACS three-year average item allocation rates are based on the final-weighted allocations made

by the ACS edit and allocation process. The universe for the census and ACS item allocation rates are all persons or housing units who were required to respond to the item.

Summary item allocation rates provide overall measures of item nonresponse, and summarize the population and housing item allocation rates. They show overall patterns in the data. However, they also obscure differences among the individual items.

We calculated the summary item allocation rates by adding the numerators of the item allocation rates, adding the denominators of the item allocation rates, and then dividing the sum of the numerators by the sum of the denominators. We used these summary item allocation rates instead of averaging the item allocation rates to ensure that the proportion of respondents required to respond to that item weighted each item. The first summary item allocation rate summed the 54 population item allocation rate numerators and denominators. The second summed the 29 occupied housing unit item allocation rate numerators and denominators. The third summed the 12 vacant housing unit item allocation rate numerators and denominators. The fourth summed the 54 population item allocation rate and 29 occupied housing unit item allocation rate numerators and denominators.

The Census 2000 sample item allocation rates are:

- Total = (Census 2000 sample final weighted total persons or housing units with that item allocated / Census 2000 sample final weighted total persons or housing units in the universe) × 100

- Self-response = (Census 2000 sample final weighted persons in self-responding households or occupied housing units with that item allocated / Census 2000 sample final weighted persons in self-responding households or occupied housing units in the universe) × 100

- Interview-response = (Census 2000 sample final weighted persons in households or housing units enumerated by field operations with that item allocated / Census 2000 sample final weighted persons in households or housing units enumerated by field operations in the universe) × 100

The ACS three-year average sample item allocation rates are:

- Total = (ACS final weighted total persons or housing units with that item allocated / ACS final weighted total persons or housing units in the universe) × 100

- Self-response = (ACS final weighted persons in self-responding households or occupied housing units with that item allocated / ACS final weighted persons in self-responding households or occupied housing units in the universe) × 100

- Interview-response = (ACS final weighted persons in households or housing units interviewed by CATI or CAPI with that item allocated / ACS final weighted

persons in households or housing units interviewed by CATI or CAPI in the universe) × 100

3.3.1 County Comparisons

This section contains the summary item allocation rate comparison results for the counties. In this section we compare the ACS three-year average and Census 2000 sample summary item allocation rate differences for each of the 36 counties, and then compare the differences when the values are averaged across all the counties.

Table 9 shows the number of counties with statistically significantly different item allocation rates for the ACS three-year average and Census 2000 sample. Table 10 shows the results of comparing the summary item allocation rates averaged across the 36 counties.

Table 9. Number of Counties with Statistically Significantly Different Summary Item Allocation Rates [C]

Quality Measure	Number of 36 Counties Not Statistically Significantly Different	Number of 36 Counties Statistically Significantly Different with ACS > Census	Number of 36 Counties Statistically Significantly Different with Census > ACS
Summary population item allocation rates			
Total	2	0	34
Self-response	17	0	19
Interviewer-response	3	0	33
Summary housing unit item allocation rates			
Total occupied housing unit	0	0	36
Total vacant housing unit	24	10	2
Self-response occupied housing unit	2	0	34
Interviewer-response occupied housing unit	1	0	35
Summary population and occupied housing unit item allocation rates			
Total	0	0	36
Self-response	5	0	31
Interviewer-response	1	0	35

C – Comparisons are based on a non-random sample of counties

Table 10. Comparison of Summary Item Allocation Rates: ACS Three-year Averages and Census 2000 Sample Estimates, County Averages

Quality Measure	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Summary population item allocation rates				
Total	6.5%	11.2%	-4.7%	± 0.6%
Self-response	8.9%	10.2%	-1.3%	± 0.8%
Interviewer-response	4.2%	14.0%	-9.8%	± 1.1%
Summary housing unit item allocation rates				
Total occupied housing units	7.7%	15.8%	-8.0%	± 0.8%
Total vacant housing units	23.2%	19.8%	3.4%	± 2.8%
Self-response occupied housing unit	7.5%	15.0%	-7.5%	± 1.0%
Interviewer-response occupied housing units	8.8%	18.9%	-10.1%	± 1.3%
Summary population and occupied housing unit item allocation rates				
Total	6.9%	12.8%	-5.9%	± 0.6%
Self-response	8.5%	11.9%	-3.5%	± 0.9%
Interviewer-response	5.8%	15.7%	-10.0%	± 1.1%

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

Table 9 and Table 10 show that except for the summary total vacant housing unit item allocation rates, the ACS had lower item allocation rates.

Table 9 shows that, for most of the quality measures, over 80 percent of the 36 counties exhibited statistically significantly higher Census 2000 summary item allocation rates. There were two exceptions. One exception was for summary population item allocation rates, self-response mode; almost half of the counties (17 of 36) showed no statistically significant differences between the ACS and Census 2000 rates. The second exception was for summary housing unit item allocation rates for total vacant housing units. Two-thirds of the counties (24 of 36) exhibited no statistically significant differences between ACS and Census 2000 summary housing unit item allocation rates. Additionally, 10 of the remaining 12 counties exhibited statistically significantly higher ACS summary housing unit item allocation rates. Table A-2 in Appendix A contains the summary population item allocation rates for the ACS three-year averages and Census 2000 sample for each of the 36 counties. Table A-3 in Appendix A contains the summary housing unit item allocation rates for the ACS three-year averages and Census 2000 sample for each of the 36 counties. Table A-4 in Appendix A contains the summary population and occupied housing unit item allocation rates for the ACS three-year averages and Census 2000 sample for each of the 36 counties. In each of these tables, the counties whose differences are not statistically significant are marked with an "NS".

Table 10 shows, that for all of the summary item allocation rates, except the average summary vacant housing unit item allocation rate, the census average rate is larger than the ACS average rates. For the average summary vacant housing unit item allocation rates, the ACS average rate is larger than the census average rate. In addition, none of the margin of errors are greater than the absolute values of the differences. So, all of the average differences are statistically significantly different.

Figures C-4, C-5, and C-6 in Appendix C display the county-level summary population item allocation rate, summary housing unit item allocation rate, and summary population and occupied housing unit item allocation rate differences, respectively, for all 36 counties. The figures display these differences through the use of one-dimensional scatter plots. For these plots, differences between the ACS three-year averages and the Census 2000 sample quality measures are located on the vertical axis; counties by quality measure are on the horizontal axis. We sorted counties by their We sorted counties within quality measure by their 100 percent count of census housing units. The sorts were in ascending order, from left to right. For example, the difference for the county with the smallest count is the left-most point in each quality measure in each graph, while the difference for the county with the largest count is the right-most point in each quality measure in each graph. We used a "jittering" process so that we could plot the differences in this way. Within each quality measure, the "jittering" process assigned a unique integer to each county so as to achieve this sort, where the county with the smallest count received the smallest integer, etc.

Figures C-4, C-5, and C-6 show that, except for the summary vacant housing unit item nonresponse rates, the census rates are almost always larger than the ACS rates. The statistically significant differences are identified by an "X" on these plots.

The results presented in Table 9, Table 10, Appendix A and Appendix C show that for population and occupied housing unit items, the ACS had less item nonresponse as measured by the item allocation rates. For the vacant housing unit items, the census had less item nonresponse. These higher rates can indicate possible nonresponse error and bias in the estimates.

Given the operational differences between the ACS and census, the larger Census 2000 sample summary item allocation rates would have been expected. The ACS procedures are designed to minimize the item nonresponse and subsequently the need for item allocation. The main emphasis of the decennial census is to enumerate the U.S. population, and only secondarily to collect long form sample data. In addition, temporary enumerators collect census data while permanent, professional interviewers collect ACS data. Census 2000 enumerated the nations' population and collected detailed demographic information via the census long form over the span of six months, and did not followup on items left blank on mail returned questionnaires. In contrast, the sole focus of the ACS is collecting "long form" data, using monthly samples with three-month collection cycles, and conducting a followup of items left blank on mail returned questionnaires. The census follows up on all non-responding units in the country in a tight time frame, making it difficult for the census to obtain complete long form information, especially if it is necessary to obtain information from neighbors. The ACS, on the other hand, follows-up on only a sample of nonresponding units, and does not

allow information to be collected from neighbors. All these differences between the census and ACS could contribute to the differences in summary item allocation rates. The reasons for the differences in the vacant summary item allocation rates will need to be explored further.

3.3.2 Tract Comparisons

This section contains the tract level summary item allocation rate comparison results. In this section we compare the ACS three-year average and Census 2000 sample summary item allocation rate differences for the tracts in the 34 counties by tract group, and then compare the differences when the values are averaged across all counties by tract group. We only compared the total summary item allocation rates for the tracts. We did not compare the self-response or interviewer-response summary item allocation rates because of small sample sizes.

Table 11 shows the number of tracts with statistically significantly different ACS three-year average and Census 2000 sample summary item allocation rates for each of the five tract groups. Table 12 shows the results of comparing the average of the tract summary item allocation rates for each group.

Table 11. Number of Tracts with Statistically Significantly Different Summary Item Allocation Rates, by Tract Group [C]

Quality Measure	Tract Group[N]	Number of Tracts Not Statistically Significantly Different	Number of Tracts Statistically Significantly Different with ACS > Census	Number of Tracts Statistically Significantly Different with Census > ACS
Summary total population item allocation rate	1	174	0	33
	2	504	0	88
	3	453	0	127
	4	310	0	91
	5	327	0	143
Summary total occupied housing unit item allocation rate	1	145	0	62
	2	558	0	34
	3	474	0	106
	4	380	0	21
	5	415	0	55
Summary total vacant housing unit item allocation rate	1	201	1	2
	2	507	1	1
	3	545	1	0
	4	348	3	0
	5	449	0	2
Summary total population	1	128	0	79

Table 11. Number of Tracts with Statistically Significantly Different Summary Item Allocation Rates, by Tract Group [C]

Quality Measure	Tract Group[N]	Number of Tracts Not Statistically Significantly Different	Number of Tracts Statistically Significantly Different with ACS > Census	Number of Tracts Statistically Significantly Different with Census > ACS
and occupied housing unit item allocation rate	2	463	0	129
	3	374	0	206
	4	269	0	132
	5	275	0	195

N – Note, group 1 contains 207 tracts, group 2 contains 592 tracts, group 3 contains 580 tracts, group 4 contains 401 tracts, and group 5 contains 470 tracts. For vacant units, group 1 contains 204 tracts, group 2 contains 509 tracts, group 3 contains 546 tracts, group 4 contains 351 tracts, and group 5 contains 451 tracts.

C – Comparisons are based on a non-random sample of counties

Table 12. Comparison of Summary Item Allocation Rates: ACS Three-year Averages and Census 2000 Sample Estimates, Tract Group Averages

Quality Measure	Tract Group[N]	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Summary total population item allocation rate	1	6.9%	11.7%	-4.8%	0.5%
	2	6.5%	10.6%	-4.1%	0.3%
	3	6.6%	10.9%	-4.3%	0.3%
	4	7.4%	13.8%	-6.4%	0.5%
	5	7.1%	12.3%	-5.2%	0.4%
Summary total occupied housing unit item allocation rate	1	7.7%	15.7%	-8.0%	0.5%
	2	6.7%	13.3%	-6.6%	0.3%
	3	7.3%	14.1%	-6.8%	0.3%
	4	7.5%	16.9%	-9.4%	0.6%
	5	7.4%	15.9%	-8.5%	0.5%
Summary total vacant housing unit item allocation rate	1	22.0%	20.3%	1.7%	[NS] 1.8%
	2	15.7%	14.3%	1.4%	1.2%
	3	16.2%	13.9%	2.3%	1.1%
	4	14.9%	15.6%	-0.7%	[NS] 1.5%
	5	13.0%	14.8%	-1.7%	1.0%
Summary total population and occupied housing unit item allocation rate	1	7.2%	13.1%	-5.9%	0.5%
	2	6.5%	11.5%	-5.0%	0.3%
	3	6.9%	12.0%	-5.2%	0.3%
	4	7.4%	14.9%	-7.4%	0.5%
	5	7.2%	13.5%	-6.4%	0.4%

N – Note, group 1 contains 207 tracts, group2 contains 592 tracts, group 3 contains 580 tracts, group 4 contains 401 tracts, and group 5 contains 470 tracts. For vacant units, group 1 contains 204 tracts, group 2 contains 509 tracts, group 3 contains 546 tracts, group 4 contains 351 tracts, and group 5 contains 451 tracts.

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

NS – The ACS three-year average and Census 2000 sample quality measure are not statistically significantly different for this county.

Some tracts were excluded from the summary total vacant housing unit item allocation rate comparison. For these tracts, there is no summary total vacant housing unit item allocation rate for the Census 2000 sample because the denominator or universe of the census rate is zero. For these tracts, the ACS had at least one vacant housing unit in one of the three years. For group 2, 16 tracts were removed from the comparison. For group 4, 14 tracts were removed.

Table 11 shows that for the summary population item allocation rates, summary occupied housing unit item allocation rates, and the summary population and occupied housing unit item allocation rates, tracts in each group had ACS and Census 2000 rates that were either not statistically significantly different or had statistically significantly higher Census 2000 rates. The proportion of tracts in each group with statistically significantly higher Census 2000 rates ranged from 5.2 percent (summary total occupied housing unit item allocation rate, tract group 4) to 41.5 percent (summary total population and occupied housing unit item allocation rate, tract group 5). In addition, Table 12 shows that all of the average Census 2000 sample rates for these groups and summary item allocation rates are statistically significantly larger than the average ACS three-year average rate.

For the summary vacant housing unit item allocation rates, Table 11 shows that almost all of the tracts within all five tract groups exhibited no statistically significant differences between the ACS and Census 2000 rates. Of the tracts with statistically significant differences, six exhibited higher ACS rates while five exhibited higher Census 2000 rates. Table 12 shows no statistically significant differences between the average ACS and Census 2000 summary vacant housing unit item allocation rates for tract groups 1 and 4. Table 12 also shows that the average ACS rates are statistically significantly higher for tract groups 2 and 3 while the average Census 2000 rates are statistically significantly higher for tract group 5.

Figures D-4, D-5, D-6, and D-7 in Appendix D display tract-level summary item allocation rate differences rate differences through the use of one-dimensional scatter plots. We grouped all of the tract-level differences by tract group. For these plots, differences between the ACS three-year average and Census 2000 sample quality measures are located on the vertical axis; tracts and tract groups are on the horizontal axis. We sorted tracts within each tract group by their 100 percent count of census housing units. The sorts were in ascending order, from left to right, within each tract group. For example, the difference for the tract with the smallest count is the left-most point within each tract group, while the difference for the tract with the largest count is the right-most point within each tract group. We used a "jittering" process so that we could plot the differences in this way. Within each tract group, the "jittering" process assigned a unique integer to each tract so as to achieve this sort, where the tract with the smallest count received the smallest integer, etc.

Figure D-4 displays the tract-level summary population item allocation rate differences, by tract group. It shows that for each group, for a majority of the summary population item allocation rates, the ACS three-year averages are lower than the Census 2000 sample estimates. The majority of the differences are between –15 and 5. Statistically significant differences are indicated by an "X" on these scatter plots.

Figure D-5 displays the tract-level summary occupied housing unit item allocation rate differences, by tract group. It shows that for each group, for a majority of the summary occupied housing unit item allocation rates, the ACS 3-year averages are lower than the Census 2000 sample estimates. The majority of the differences are between –15 and 0 with a few outliers in groups 4 and 5. Groups 4 and 5 are the tracts in large counties. Statistically significant differences are indicated by an "X" on these scatter plots.

Figure D-6 displays the tract-level summary vacant housing unit item allocation rate differences, by tract group. The differences for the five groups are centered on zero. Statistically significant differences are indicated by an "X" on these scatter plots.

Figure D-7 displays the tract-level summary population and occupied housing unit item allocation rate differences, by tract group. It shows that for each group, for a majority of the summary population and occupied housing unit item allocation rates, the ACS 3-year averages are lower than the Census 2000 sample estimates. For groups 1, 2, and 3 the majority of the differences are between –10 and 0. For groups 4 and 5, a majority of the differences are between –20 and 0. Statistically significant differences are indicated by an "X" on these scatter plots.

The results presented in Table 11, Table 12, and Appendix D show that the ACS had fewer allocations than the census for occupied housing unit and population items. This could be a sign of potentially higher item nonresponse error for census occupied housing unit and population item estimates. Since the census did not have a content edit to followup on missing or incomplete items on a mail returned questionnaire, and the ACS does have a content edit, these results are not unexpected.

3.4 Sample Completeness Rates

We calculated sample completeness rates to measure how well the ACS and Census 2000 sample represent their target area's population or housing. The rates are 100 times the ratio of the survey's estimate of population or housing units to the target area's count of population or housing units. For both the ACS and Census 2000 sample completeness rates, the 100 percent Census 2000 counts were used for the target area's population and housing unit counts. We computed these rates for each of the 36 ACS counties. They cannot be computed at the tract level because the final housing and population controls are used in the denominator of the ACS rates. We compute a housing unit completeness rate, and a household population completeness rate. The county-level comparison results are presented in section 3.4.1.

These rates measure nonresponse and coverage errors. Survey nonresponse and undercoverage can introduce bias if they result in certain groups of people or units with specific characteristics being excluded from the sample estimates. Survey overcoverage can result in bias if those included in the survey more than once share specific characteristics to a higher degree than those included in the survey only once. Since the completeness rates are 100 times the ratio of the survey's estimate to the target area's count, a rate of 100 is desired. A rate greater than 100 represents overcoverage of the target area by the survey, and a rate less than 100 represents undercoverage of the target area by the survey.

The Census 2000 sample completeness rates are 100 times the ratio of the Census 2000 weighted count of long form sample data defined housing units or their residents to the 100 percent Census 2000 total housing unit or household population count. The numerator of these rates are weighted by the reciprocal of the sampling fraction used to designate long form sample units for the block in which they were enumerated. This

weight is equal to 2, 4, 6 or 8. The denominators of these rates are the 100 percent Census 2000 housing units or household population counts, which are constants, so they are not weighted.

The ACS three-year average sample completeness rates are 100 times the ratio of the ACS total housing units or household population weighted by their probability of selection (base weight) to the ACS final housing and population controls. Census data are used for the final housing and population controls, so the denominators of these rates are constants.

The sample completeness rate formulae are below.

The Census 2000 Sample Completeness Rates are:

- Housing unit = (Census 2000 weighted count of long form sample data defined housing units / Census 2000 total housing units) × 100

- Household population = (Census 2000 weighted count of long form household population in sample data defined housing units / Census 2000 total household population) × 100

The ACS three-year Average Sample Completeness Rates are:

- Housing unit = (ACS base weighted total housing units / ACS final total housing units) × 100

- Household population = (ACS base weighted household population / ACS final household population) × 100

3.4.1 County Comparisons

This section contains the county level sample completeness comparison results. In this section we compare the ACS three-year average and Census 2000 housing unit sample completeness rates and the household population sample completeness rates. We first compare the differences for each of the 36 counties, and then compare the differences when the values are averaged across all the counties.

Table 13 shows the number of counties with statistically significantly different ACS three-year average and Census 2000 sample completeness rates. Table 14 shows the results of comparing the average of the 36 county housing unit sample completeness rates and household population sample completeness rates.

Table 13. Number of Counties with Statistically Significantly Different Sample Completeness Rates [C]

Quality Measure	Number of 36 Counties Not Statistically Significantly Different	Number of 36 Counties Statistically Significantly Different with ACS > Census	Number of 36 Counties Statistically Significantly Different with Census > ACS
Housing unit sample completeness rate	11	21	4
Household population sample completeness rate	22	8	6

C – Comparisons are based on a non-random sample of counties

Table 14. Comparison of Sample Completeness Rates: ACS Three-year Averages and Census 2000 Sample Estimates, County Averages

Quality Measure	ACS Average	Census Average	Difference[D] of Averages	Margin of Error[C]
Housing unit sample completeness rate	92.9	90.3	2.6	± 2.1
Household population sample completeness rate	90.4	91.1	-0.7	[NS] ± 2.1

D – The difference is the ACS average minus the Census 2000 average.

C – This comparison is based on a non-random sample of counties

NS – the ACS and Census averages are not statistically significantly different for this quality measure.

Table 13, Table 14, and Table A-1 together show that the ACS sample represents more of its target housing unit population than does the census sample. Table 13 shows that 25 out of the 36 county housing unit sample completeness rates were statistically significantly different. For 21 counties with statistically significantly different housing unit sample completeness rates, the ACS three-year average housing unit sample completeness rate was larger and, as shown in Table A-1, closer to one than the Census 2000 sample estimate. Table A-1 in Appendix A contains the ACS three-year average and Census 2000 housing unit sample completeness rates (HCR) for each of the 36 counties. The counties whose differences are not statistically significant are marked with an "NS" in the table. Table A-1 also shows that the 21 statistically significantly larger ACS housing unit sample completeness rates are closer to one than the census rates, and the four statistically significantly larger census housing unit sample completeness rates are closer to one than the ACS rates. The housing unit sample completeness rates are all less than one except for the ACS rate for two counties. Table 14 shows that, on average, the housing unit sample completeness rate for the ACS three-year average was larger and closer to one than the Census 2000 sample estimate by 2.6. Since the margin of error for the difference is only 2.1 percent, the resulting confidence interval would not contain zero. So, the average difference is statistically significant.

Figures C-7 and C-8 in Appendix C display the housing unit sample completeness rate and household population sample completeness rate differences, respectively, for all 36 counties through the use of one-dimensional scatter plots. For these plots, differences between the ACS three-year averages and the Census 2000 sample quality measures are

located on the vertical axis; counties are on the horizontal axis. We sorted counties by their 100 percent count of census housing units. The sorts were in ascending order, from left to right. For example, the difference for the county with the smallest count is the left-most point in the plots, while the difference for the county with the largest count is the right-most point. We used a "jittering" process so that we could plot the differences in this way. The "jittering" process assigned a unique integer to each county so as to achieve this sort, where the county with the smallest count received the smallest integer, etc.

Figure C-7 shows that the majority of counties have larger ACS housing unit sample completeness rates than census sample completeness rates. In addition, for the counties with the largest number of census housing units, the ACS housing unit sample completeness rates are statistically significantly larger than the census housing unit sample completeness rates. Statistically significant differences are identified by an "X" on these plots.

Table 13, Table 14, and Table A-1 also show that the ACS sample and census sample represent their target area's household population about equally well. Table 13 shows that 14 out of the 36 county sample completeness rates for household population were statistically significantly different. For eight counties with significantly different household population sample completeness rates, the ACS three-year average was larger and as shown in Table A-1 closer to one than the Census 2000 sample estimate. Table A-1 in Appendix A contains the ACS three-year average and Census 2000 household population sample completeness rates for each of the 36 counties. The counties whose differences are not statistically significant are marked with an "NS" in the table. Table A-1 also shows that the eight statistically significantly larger ACS sample completeness rates for household population (PCR) are closer to one than the census rates, and the six statistically significantly larger census sample completeness rates for household population are closer to one than the ACS rates. The household population sample completeness rates are all less than one except for the ACS rate for one county. Table 14 shows that the average household population sample completeness rates were not statistically significantly different.

Figure C-8 shows that the household population sample completeness rate differences are spread nearly evenly about zero. In addition, as the number of census housing units in the county increases, the differences seem to get smaller. Statistically significant differences are identified by an "X" on these plots.

The results presented in Table 13, Table 14, Appendix A, Figure C-7, and Figure C-8, show that, in general, the ACS had housing unit sample completeness rates slightly closer to one than the census sample, but their household population sample completeness rates were about equally close to one. The sample completeness rates measure nonresponse error and coverage error, and a rate of one is optimal. So, the difference in the housing unit sample completeness rates could signal that the census has somewhat more of these errors.

4. CONCLUSIONS

We observed overall significant differences between the quality measures for the ACS three-year averages and the Census 2000 sample estimates. The results show that the census had more respondents mailback their questionnaires (the census had a generally higher self-response rate) while the ACS obtained more information from respondents during followup operations (respondents in follow-up operations included households who did not mailback their forms or who returned their forms via mail but left some items blank). As a whole, a higher proportion of households responded in the ACS (the ACS had a generally lower nonresponse rate). The ACS tended to obtain more information (lower item allocation rates) on sample housing units than the census, with one exception: the census tended to obtain more information on vacant housing units. The ACS exhibited better coverage of its target area's housing units than did the census (the ACS had housing unit sample completeness rates closer to 100 than did the census), but the two surveys covered their target area's population about equally well (the two surveys' population sample completeness ratios were comparable). These results seem to be explained by the operational and methodological differences between the ACS and the census.

We observed the overall significant differences at the county level, also. For the self-response rate, most of the counties had statistically significantly higher Census 2000 long form rates - this indicated that the census performed better than the ACS with respect to this quality measure. However, for the sample unit nonresponse and summary item allocation rates, a majority (if not all) of the counties had statistically significantly lower ACS three-year average rates - this indicated that the ACS performed better than the census for these quality measures. For the sample completeness rates, the number of counties with statistically significant differences and the number of counties without statistically significant differences is about even.

For the most part, we observed the same significant differences above at the tract level. The census seemed to collect more forms through the mail in tracts for all five tract groups. On average, the census collected more information on vacant housing units in tracts in medium counties (tract groups 2, 3) and large counties with tract populations greater than 4,000 persons (tract group 5). The ACS, on the other hand, obtained more information for units that did not respond through the mail for tracts in all five tract groups. The ACS also tended to obtain more information for units in tracts in all five tract groups, as well.

These quality measures suggest that the ACS multi-year averages are at least as good as the estimates from the long form. When we also consider the enhanced timeliness of information from the ACS, the superiority of reengineering the 2010 Census over retaining traditional methods is clear. In addition, while further study is needed, it appears that the permanent, on-going nature of the ACS program contributes to lower ACS nonresponse rates, and hence less chance for nonresponse error and bias in the estimates.

5. REFERENCES

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Appendix A
County Level Quality Measures

Table A-1. Comparison of Self-response Rates, Sample Unit Nonresponse Rates, and Sample Completeness Rates: ACS Three-year Averages and Census 2000 Long Form Sample Estimates, by County

County	ACS SRR[1]	Census SRR[1]	ACS UNR[2]	Census UNR[2]	ACS OUNR[3]	Census OUNR[3]	ACS HCR[4]	Census HCR[4]	ACS PCR[5]	Census PCR[5]
Pima County, AZ	62.1	69.7	5.7	11.7	6.3	11.4	94.7	88.3	91.0	88.5
Jefferson County, AR	50.6	67.6	4.4	17.1	5.0	14.3	93.5	82.9	NS 88.1	NS 84.9
San Francisco County, CA	57.9	65.7	6.0	12.4	6.4	12.0	92.9	87.6	NS 88.3	NS 88.0
Tulare County, CA	50.1	63.4	3.6	11.4	3.9	10.1	94.5	88.7	NS 88.4	NS 89.4
Broward County, FL	56.4	60.9	3.9	9.5	4.5	11.7	97.8	90.5	92.9	88.6
Upson County, GA	56.0	69.7	3.2	8.9	3.5	7.1	NS 95.9	NS 91.1	NS 89.8	NS 92.5
Lake County, IL	65.3	72.0	3.9	6.8	4.1	6.4	98.1	93.2	NS 94.0	NS 93.8
Miami County, IN	59.8	70.6	4.3	21.4	4.8	17.1	95.4	78.6	96.2	81.9
Black Hawk County, IA	69.6	76.6	3.5	9.4	3.7	7.9	96.4	90.6	NS 93.5	NS 92.9
De Soto Parish, LA	49.3	62.8	NS 6.5	NS 6.7	NS 7.5	NS 7.8	NS 87.1	NS 93.3	83.1	94.9
Calvert County, MD	63.0	71.5	2.9	5.2	3.2	4.8	NS 93.2	NS 94.8	NS 91.6	NS 95.2
Hampden County, MA	61.9	69.1	5.0	11.3	5.4	10.0	96.0	88.7	92.8	90.1
Madison County, MS	54.5	71.6	4.3	12.5	4.7	11.3	95.4	87.5	NS 90.4	NS 89.7
Iron County, MO	48.4	70.2	NS 3.8	NS 4.4	NS 4.6	NS 4.5	NS 93.0	NS 95.6	NS 91.2	NS 96.5
Reynolds County, MO	38.2	71.9	NS 2.9	NS 1.4	NS 4.1	NS 2.6	NS 91.8	NS 98.6	NS 86.6	NS 98.1
Washington County, MO	40.8	66.1	4.4	1.8	5.3	1.3	88.6	98.2	84.0	98.6
Flathead County, MT	60.1	72.9	NS 3.8	NS 3.7	NS 4.4	NS 4.4	NS 94.8	NS 96.3	NS 93.7	NS 95.1
Lake County, MT	52.4	74.6	6.0	12.2	NS 7.7	NS 9.2	NS 89.5	NS 87.8	NS 87.5	NS 88.5
Douglas County, NE	67.2	72.5	3.9	6.6	4.2	5.9	95.5	93.4	NS 93.8	NS 93.7
Otero County, NM	59.3	65.0	4.8	7.2	6.0	9.8	85.3	92.8	82.9	89.5
Bronx Borough, NY	36.0	52.9	9.7	22.2	10.5	21.0	92.0	77.8	83.4	79.8
Rockland County, NY	57.6	65.3	3.5	5.5	3.6	5.2	01.2	94.5	NS 97.1	NS 94.6
Franklin County, OH	64.2	69.3	1.9	5.8	2.1	5.9	97.6	94.2	NS 94.6	NS 94.2
Multnomah County, OR	65.0	70.4	3.6	5.0	3.8	5.1	96.3	95.0	NS 93.9	NS 94.4
Fulton County, PA	57.4	75.0	NS 3.9	NS 4.6	NS 4.7	NS 4.8	NS 94.0	NS 95.4	NS 94.9	NS 94.4
Schuylkill County, PA	69.5	77.3	3.8	5.6	NS 4.3	NS 5.3	NS 95.0	NS 94.4	NS 93.7	NS 95.6
Sevier County, TN	58.7	65.2	NS 4.9	NS 6.2	NS 5.9	NS 5.6	83.4	93.8	88.2	94.1
Fort Bend County, TX	NS 56.7	NS 66.9	NS 4.8	NS 6.1	NS 5.0	NS 6.2	NS 90.6	NS 93.9	84.4	93.4
Harris County, TX	47.9	60.6	NS 4.2	NS 10.1	NS 4.6	NS 10.2	94.6	89.9	NS 90.7	NS 90.1
Starr County, TX	21.7	54.0	6.0	11.9	NS 7.4	NS 10.1	NS 86.9	NS 88.1	78.5	90.6

Table A-1. Comparison of Self-response Rates, Sample Unit Nonresponse Rates, and Sample Completeness Rates: ACS Three-year Averages and Census 2000 Long Form Sample Estimates, by County

County	ACS SRR[1]	Census SRR[1]	ACS UNR[2]	Census UNR[2]	ACS OUNR[3]	Census OUNR[3]	ACS HCR[4]	Census HCR[4]	ACS PCR[5]	Census PCR[5]
Zapata County, TX	25.7	62.5	6.8	13.0	[NS] 10.0	[NS] 11.6	74.4	87.0	[NS] 73.6	[NS] 86.9
Petersburg City, VA	52.1	62.8	2.4	19.1	2.9	13.8	99.1	80.9	92.1	82.9
Yakima County, WA	58.4	65.8	3.7	10.6	3.9	9.5	94.4	89.4	[NS] 89.2	[NS] 88.9
Ohio County, WV	[NS] 69.1	[NS] 72.6	[NS] 3.4	[NS] 4.7	[NS] 3.8	[NS] 3.9	00.2	95.3	[NS] 99.5	[NS] 96.5
Oneida County, WI	[NS] 71.6	[NS] 78.0	3.9	19.3	5.9	12.2	87.3	80.7	96.1	87.4
Vilas County, WI	[R] 56.6		5.5	18.4	10.7	14.2	87.3	81.6	06.5	86.4

1 – SRR = Self-response rate

2 – UNR = sample unit nonresponse rate

3 – OUNR = occupied sample unit nonresponse rate

4 – HCR = Housing unit sample completeness rate

5 – PCR = Household population sample completeness rate

NS – The ACS three-year average and Census 2000 sample quality measure are not statistically significantly different for this county.

R – This county was removed from the county comparison for this quality measure because the Census 2000 sample quality measure was undefined.

Table A-2. Comparison of Summary Allocation Rates for Population Items: ACS Three-year Averages and Census 2000 Sample Estimates, by County

County	ACS Total	Census Total	ACS Self-response	Census Self-response	ACS Interviewer-response	Census Interviewer-response
Pima County, AZ	6.2	9.9	7.5	8.4	4.5	13.8
Jefferson County, AR	7.4	13.8	[NS] 11.4	[NS] 11.6	3.5	20.1
San Francisco County, CA	7.5	12.3	8.8	10.3	6.0	17.6
Tulare County, CA	7.1	13.2	9.8	12.0	4.9	15.7
Broward County, FL	6.9	11.1	8.7	9.8	5.1	13.2
Upson County, GA	8.1	11.7	[NS] 11.1	[NS] 12.3	4.7	11.0
Lake County, IL	6.1	10.3	7.1	8.5	4.8	15.3
Miami County, IN	5.9	12.9	7.9	10.8	3.2	23.7
Black Hawk County, IA	6.0	9.6	[NS] 7.5	[NS] 8.0	3.9	15.8
De Soto Parish, LA	7.6	13.0	[NS] 12.1	[NS] 13.6	3.0	11.5
Calvert County, MD	5.4	8.9	6.6	8.2	3.6	11.2
Hampden County, MA	6.7	11.7	8.4	10.6	4.3	14.6
Madison County, MS	6.0	13.0	8.0	10.0	3.9	25.9
Iron County, MO	6.9	11.8	[NS] 11.0	[NS] 11.0	3.7	13.5
Reynolds County, MO	6.1	13.6	[NS] 11.3	[NS] 12.8	3.7	16.7
Washington County, MO	6.4	12.0	[NS] 10.3	[NS] 11.2	3.5	13.7
Flathead County, MT	6.8	11.6	[NS] 9.0	[NS] 9.5	3.9	17.9
Lake County, MT	6.3	7.6	[NS] 7.7	[NS] 8.1	[NS] 4.8	[NS] 7.5
Douglas County, NE	5.6	9.3	[NS] 7.2	[NS] 7.6	3.2	14.8
Otero County, NM	6.2	9.5	[NS] 8.4	[NS] 7.9	3.1	12.8
Bronx Borough, NY	8.5	16.3	13.7	15.8	5.5	17.4
Rockland County, NY	6.8	10.8	8.1	9.7	5.3	13.1
Franklin County, OH	5.0	9.4	6.3	7.5	3.2	14.2
Multnomah County, OR	6.0	9.2	7.0	7.7	4.9	13.0
Fulton County, PA	[NS] 7.6	[NS] 10.2	[NS] 9.6	[NS] 9.9	[NS] 5.0	[NS] 11.7
Schuylkill County, PA	5.9	10.0	7.1	8.9	3.2	14.2
Sevier County, TN	6.7	11.1	[NS] 8.8	[NS] 9.5	3.9	14.2
Fort Bend County, TX	5.7	10.8	7.1	9.2	4.1	14.6
Harris County, TX	6.2	12.1	8.6	11.3	4.3	13.7
Starr County, TX	3.9	9.1	[NS] 12.5	[NS] 12.1	1.7	8.1
Zapata County, TX	4.2	13.8	8.8	17.3	2.8	7.6
Petersburg City, VA	7.3	13.9	11.5	13.7	3.2	14.6
Yakima County, WA	7.6	10.7	8.9	10.5	6.6	11.1

Table A-2. Comparison of Summary Allocation Rates for Population Items: ACS Three-year Averages and Census 2000 Sample Estimates, by County

County	ACS Total	Census Total	ACS Self-response	Census Self-response	ACS Interviewer-response	Census Interviewer-response
Ohio County, WV	7.6	10.3	[NS] 8.1	[NS] 9.5	6.3	12.3
Oneida County, WI	[NS] 6.6	[NS] 8.4	[NS] 8.0	[NS] 8.7	[NS] 3.3	[NS] 8.2
Vilas County, WI	6.5	10.5	[NS] 7.8	[NS] 5.1	4.9	10.5

NS – The ACS three-year average and Census 2000 sample quality measure are not statistically significantly different for this county.

Table A-3. Comparison of Summary Allocation Rates for Housing Units Items: ACS Three-year Averages and Census 2000 Sample Estimates, by County

County	Occupied Housing Unit Items						Vacant Housing Unit Items	
	ACS Total	Census Total	ACS Self-response	Census Self-response	ACS Interviewer-response	Census Interviewer-response	ACS Total	Census Total
Pima County, AZ	7.4	13.5	6.9	12.3	9.0	18.1	[NS] 14.7	[NS] 14.4
Jefferson County, AR	8.9	18.2	8.9	16.2	9.4	25.8	[NS] 28.4	[NS] 24.5
San Francisco County, CA	9.5	17.2	9.4	15.7	9.8	22.4	[NS] 15.6	[NS] 16.1
Tulare County, CA	9.5	17.5	8.1	15.9	11.7	21.8	28.6	21.4
Broward County, FL	7.6	15.0	7.6	14.8	8.0	15.9	[NS] 13.5	[NS] 13.6
Upson County, GA	7.1	16.4	7.4	17.0	6.8	15.0	[NS] 12.7	[NS] 20.7
Lake County, IL	6.6	13.7	6.4	12.0	7.4	19.7	[NS] 16.8	[NS] 14.5
Miami County, IN	7.6	16.8	7.4	15.0	8.0	26.8	[NS] 21.3	[NS] 23.1
Black Hawk County, IA	7.3	13.5	6.6	12.2	9.9	20.3	32.0	21.5
De Soto Parish, LA	10.0	19.3	9.6	19.1	10.7	20.9	[NS] 24.8	[NS] 16.5
Calvert County, MD	6.0	12.2	6.0	11.4	6.7	15.0	[NS] 19.9	[NS] 16.7
Hampden County, MA	7.9	16.2	7.2	15.3	9.5	19.5	[NS] 20.2	[NS] 18.7
Madison County, MS	7.4	17.1	7.2	14.0	8.8	31.2	[NS] 15.5	[NS] 20.5
Iron County, MO	7.6	16.0	7.0	15.4	8.6	17.1	34.8	12.9
Reynolds County, MO	9.2	19.2	9.0	18.8	10.2	21.5	[NS] 21.0	[NS] 26.0
Washington County, MO	7.2	17.3	6.5	17.4	8.0	17.8	40.2	21.8
Flathead County, MT	6.9	14.9	7.4	13.2	6.6	20.5	[NS] 16.1	[NS] 14.4
Lake County, MT	7.2	11.4	6.3	12.9	[NS] 8.6	[NS] 11.1	[NS] 24.7	[NS] 21.0
Douglas County, NE	6.5	12.7	6.2	11.4	7.8	17.8	[NS] 13.5	[NS] 15.5
Otero County, NM	7.5	14.0	7.3	12.3	8.3	18.8	14.7	21.8
Bronx Borough, NY	11.1	25.1	13.1	24.1	9.7	27.7	[NS] 26.7	[NS] 27.0
Rockland County, NY	8.2	15.6	6.8	14.1	11.0	19.3	38.0	16.3
Franklin County, OH	6.5	12.7	6.1	11.2	7.7	17.9	16.7	10.6
Multnomah County, OR	6.6	11.8	6.2	10.8	8.0	15.4	15.5	9.5
Fulton County, PA	7.7	15.8	7.0	15.5	8.8	17.1	[NS] 25.4	[NS] 19.1
Schuylkill County, PA	7.0	15.9	7.1	15.1	7.6	19.8	31.2	20.9
Sevier County, TN	8.4	15.6	7.6	14.8	10.0	17.8	[NS] 21.1	[NS] 18.1
Fort Bend County, TX	7.7	15.5	6.8	13.7	9.9	20.3	[NS] 18.8	[NS] 13.2
Harris County, TX	7.9	16.6	7.3	15.9	9.4	19.0	19.3	12.1
Starr County, TX	6.3	17.8	9.6	23.6	5.6	14.2	[NS] 22.9	[NS] 22.9
Zapata County, TX	6.0	18.8	[NS] 7.5	[NS] 21.4	5.7	12.9	[NS] 31.3	[NS] 25.1

Table A-3. Comparison of Summary Allocation Rates for Housing Units Items: ACS Three-year Averages and Census 2000 Sample Estimates, by County

County	Occupied Housing Unit Items						Vacant Housing Unit Items	
	ACS Total	Census Total	ACS Self-response	Census Self-response	ACS Interviewer-response	Census Interviewer-response	ACS Total	Census Total
Petersburg City, VA	9.0	17.7	9.0	16.6	10.5	21.4	[NS] 20.0	[NS] 23.0
Yakima County, WA	9.6	15.9	7.9	15.6	12.6	17.2	[NS] 21.6	[NS] 21.7
Ohio County, WV	7.4	15.4	6.5	14.6	10.4	18.4	38.8	18.1
Oneida County, WI	7.1	11.4	7.2	13.1	7.0	10.9	[NS] 26.8	[NS] 34.5
Vilas County, WI	7.1	13.3	[NS] 7.4	[NS] 7.3	7.2	13.2	31.5	43.2

NS – The ACS three-year average and Census 2000 sample quality measure are not statistically significantly different for this county.

Table A-4. Comparison of Summary Allocation Rates for Population and Occupied Housing Unit Items: ACS Three-year Average and Census 2000 Sample Estimates, by County

County	ACS Total	Census Total	ACS Self-response	Census Self-response	ACS Interviewer-response	Census Interviewer-response
Pima County, AZ	6.6	11.1	7.3	9.8	6.1	15.3
Jefferson County, AR	7.9	15.3	10.5	13.2	5.5	22.1
San Francisco County, CA	8.2	14.0	9.0	12.2	7.3	19.3
Tulare County, CA	7.9	14.7	9.2	13.3	7.3	17.9
Broward County, FL	7.2	12.4	8.3	11.6	6.1	14.1
Upson County, GA	7.8	13.4	9.8	13.9	5.5	12.4
Lake County, IL	6.3	11.5	6.9	9.7	5.7	16.4
Miami County, IN	6.5	14.3	7.8	12.3	4.9	24.8
Black Hawk County, IA	6.5	11.0	7.2	9.5	6.0	17.4
De Soto Parish, LA	8.4	15.2	11.3	15.5	5.7	14.8
Calvert County, MD	5.6	10.1	6.4	9.3	4.6	12.5
Hampden County, MA	7.1	13.3	8.0	12.3	6.1	16.3
Madison County, MS	6.5	14.4	7.7	11.4	5.6	27.8
Iron County, MO	7.1	13.3	[NS] 9.6	[NS] 12.5	5.4	14.8
Reynolds County, MO	7.2	15.5	[NS] 10.5	[NS] 14.9	5.9	18.4
Washington County, MO	6.6	13.9	9.0	13.3	5.1	15.1
Flathead County, MT	6.9	12.8	8.4	10.8	4.9	18.8
Lake County, MT	6.6	8.9	7.2	9.8	[NS] 6.1	[NS] 8.8
Douglas County, NE	6.0	10.5	6.9	8.9	4.8	15.8
Otero County, NM	6.5	11.1	8.0	9.4	4.9	14.9
Bronx Borough, NY	9.4	19.4	13.5	18.7	7.0	21.0
Rockland County, NY	7.3	12.4	7.6	11.3	7.3	15.3
Franklin County, OH	5.5	10.6	6.2	8.8	4.8	15.5
Multnomah County, OR	6.2	10.1	6.7	8.8	6.0	13.9
Fulton County, PA	7.6	12.1	[NS] 8.7	[NS] 11.8	6.4	13.6
Schuylkill County, PA	6.3	12.0	7.1	11.1	4.8	16.1
Sevier County, TN	7.3	12.7	8.4	11.4	6.0	15.5
Fort Bend County, TX	6.4	12.5	7.0	10.7	6.1	16.6
Harris County, TX	6.8	13.7	8.1	12.9	6.1	15.5
Starr County, TX	4.7	12.1	11.5	16.1	3.0	10.2
Zapata County, TX	4.9	15.6	8.4	18.8	3.8	9.4
Petersburg City, VA	7.9	15.2	10.6	14.7	5.7	17.0

Table A-4. Comparison of Summary Allocation Rates for Population and Occupied Housing Unit Items: ACS Three-year Average and Census 2000 Sample Estimates, by County

County	ACS Total	Census Total	ACS Self-response	Census Self-response	ACS Interviewer-response	Census Interviewer-response
Yakima County, WA	8.3	12.5	8.6	12.3	8.7	13.2
Ohio County, WV	7.6	12.1	7.5	11.3	7.7	14.4
Oneida County, WI	6.8	9.5	[NS] 7.7	[NS] 10.2	4.6	9.2
Vilas County, WI	6.7	11.5	[NS] 7.6	[NS] 5.9	5.7	11.5

NS – The ACS three-year average and Census 2000 sample quality measure are not statistically significantly different for this county.

Appendix B
Design Factors Used for Standard Errors of Census Quality Measures

For the self-response rates, unit nonresponse rates, and housing unit completeness rate, the largest design factor (see Summary File 3 Technical Documentation, released in 2003 at http://www.census.gov/prod/cen2000/doc/sf3.pdf) from the following housing unit characteristics was used to calculate the census standard errors.

- Race of householder
- Age of householder
- Type of residence

For the population completeness rate, the largest design factor from the following population characteristics were used to calculate the census standard errors.

- Race
- Age
- Household type and relationship
- Family type

For the item allocation rates, the following table lists the items for which an allocation rate was calculated, and the population/housing characteristic group which most relates to that item. The design factor for the population/housing characteristic group listed was applied to the item allocation rate standard errors. The bold housing unit allocation rate items are vacant housing units items.

Table B-1. Design Factors used to Calculate Standard Errors of Census 2000 Sample Item Allocation Rates

Group Number	Design Factor Population/Housing Characteristic Group	Allocation Rate Item
Population Characteristics and Groups		
P1	Age	Age
P6	Household type and relationship	Relationship
P2	Sex	Sex
P3	Race	Race
P4	Hispanic or Latino	Hispanic
P5	Marital Status	Marital Status
P15	School enrollment	School enrollment
		Grade attending
P14	Educational attainment	Educational attainment
P13	Language spoken at home and ability to speak English	Non-English language
		Language spoken
		English ability
P9	Place of birth	Place of birth
P10	Citizenship status	Citizenship
P12	Year of entry	Year of entry
P11	Residence in 1995	Mobility status
		Migration – state
		Migration – county

Group Number	Design Factor Population/Housing Characteristic Group	Allocation Rate Item
	Residence in 1995 (cont'd)	Migration – place
P7	Disabled and employment disability	Vision or hearing difficulty
		Physical difficulty
		Mental difficulty
		Self-care difficulty
		Difficulty going out
		Difficulty working at a job
P37	Grandparent status and responsibility for grandchild	Grandparent living at home
		Responsible for grandchildren
		Months responsible for grandchildren
P36	Military service and veteran status	Served in armed forces
		Periods of military service
		Years of active duty
P20	Employment status	Employment status
P26	Place of work	Place of work - state
		Place of work - county
		Place of work - place
P27	Means of transportation to work	Transportation to work
P29	Time leaving home to go to work	Time of departure
P30	Private vehicle occupancy	Carpool size
P28	Travel time to work	Commuting time
P24	Usual hours worked per week and weeks worked in 1999	When last worked
		Weeks worked last year
		Hours worked each week
P21	Industry	Industry
P22	Occupation	Occupation
P23	Class of worker	Class of worker
P31	Type of Income in 1999	Wages & salary income
		Self-employment income
		Interest, dividend, etc. income
		Social security/railroad retirement
		Supplemental security income
		Public assistance
		Retirement income
		Other income
		All income allocated
Housing Unit Characteristics and Groups		
H5	Tenure	Tenure
		Year moved in
H4	Units in structure	**Units in structure/building size**
H10	Year structure built	**Year built**
H11	Rooms, bedrooms	**Rooms**
		Bedrooms
H13	Plumbing facilities	**Complete plumbing**

Group Number	Design Factor Population/Housing Characteristic Group	Allocation Rate Item
H12	Kitchen facilities	**Complete kitchen**
		Telephone
H14	House heating fuel	Heating fuel
		Electricity cost
		Gas cost
		Water and sewer cost
		Other fuel cost
H16	Vehicles available	Number of vehicles
H22	Type of residence	**Business on property**
		Lot size
		Agricultural sales
H8	Gross rent	**Monthly rent**
		Meals in rent
H19	Mortgage status and selected monthly owner costs	Mortgage
		Mortgage payments
		Payment includes property taxes
		Payment includes insurance
		Second mortgage payment
		Yearly real estate taxes
		Yearly property insurance
		Total cost on mobile home
H7	Value	**Value**
H6	Occupancy status	**Vacancy status**

Appendix C
Quality Measures Scatter Plots for Counties

This Appendix contains one dimensional scatter plots of the county-level differences between the quality measures for the ACS three-year averages and Census 2000 sample estimates.

Differences between the ACS three-year averages and the Census 2000 sample quality measures are located on the vertical axis; counties and, in Figures C-4, C-5, and C-6, quality measures, are on the horizontal axis. We sorted counties by their 100 percent count of census housing units (for Figures C-4, C-5, and C-6, we sorted counties within each quality measure). The sorts were in ascending order, from left to right. For example, the difference for the county with the smallest count is the left-most point in each graph (or quality measure), while the difference for the county with the largest count is the right-most point in each graph (or quality measure). We used a "jittering" process so that we could plot the differences in this way. The "jittering" process assigned a unique integer to each county so as to achieve this sort, where the county with the smallest count received the smallest integer, etc.

Counties with statistically significant differences are indicated by an "X" on the scatter plots; counties whose differences are not statistically significantly different are indicated by a circle. A difference is defined to be the ACS three-year average quality measure minus the Census 2000 sample quality measure. These graphs were produced in SAS using data from the Quality Measures Comparison Files.

Figure C-1. Self – Response Rates
Scatter Plot of Differences by County
Difference = ACS quality measure – Census quality measure
X represents a significant difference

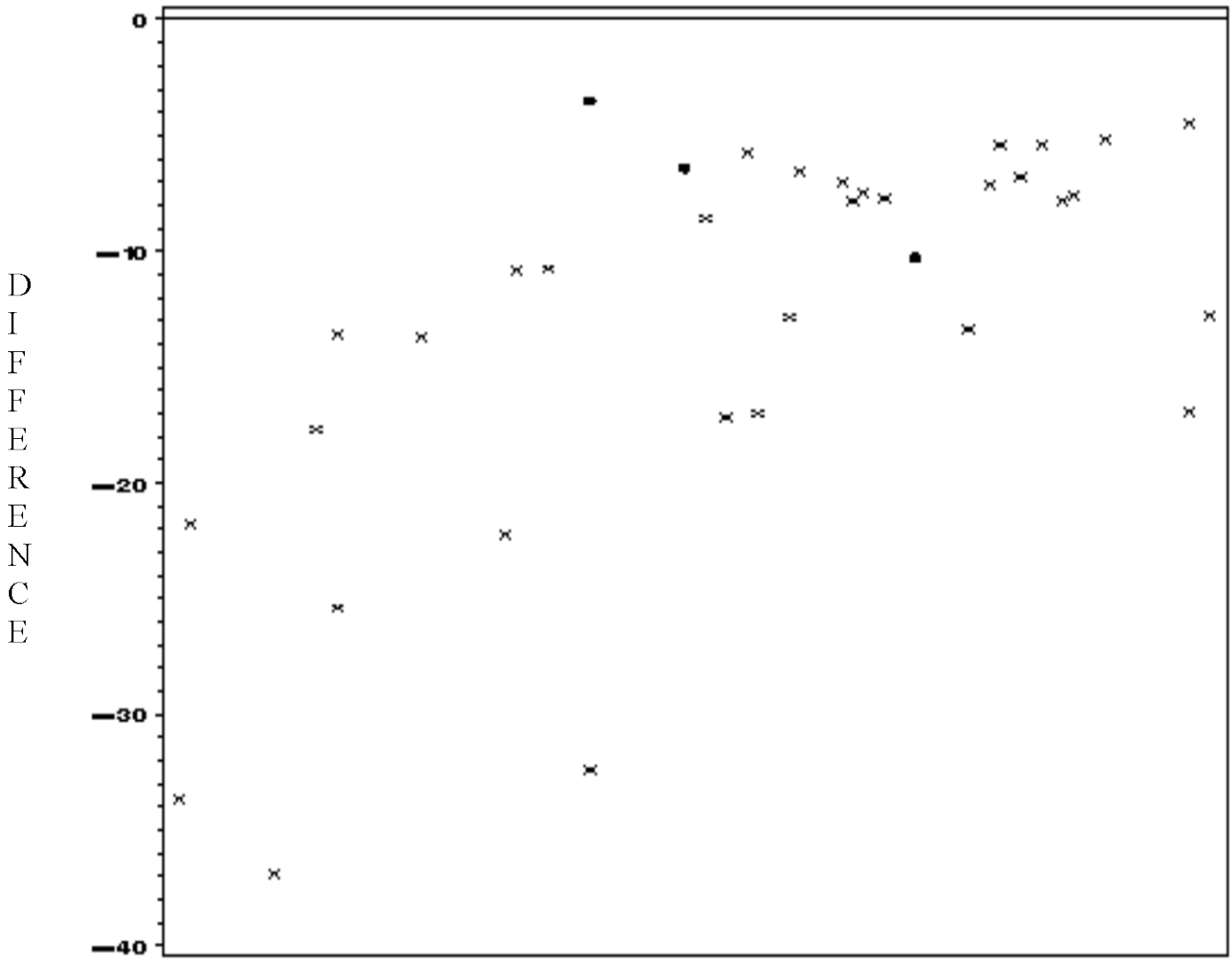


Figure C-2. Sample Unit Nonresponse Rates
Scatter Plot of Differences by County
Difference = ACS quality measure – Census quality measure
X represents a significant difference

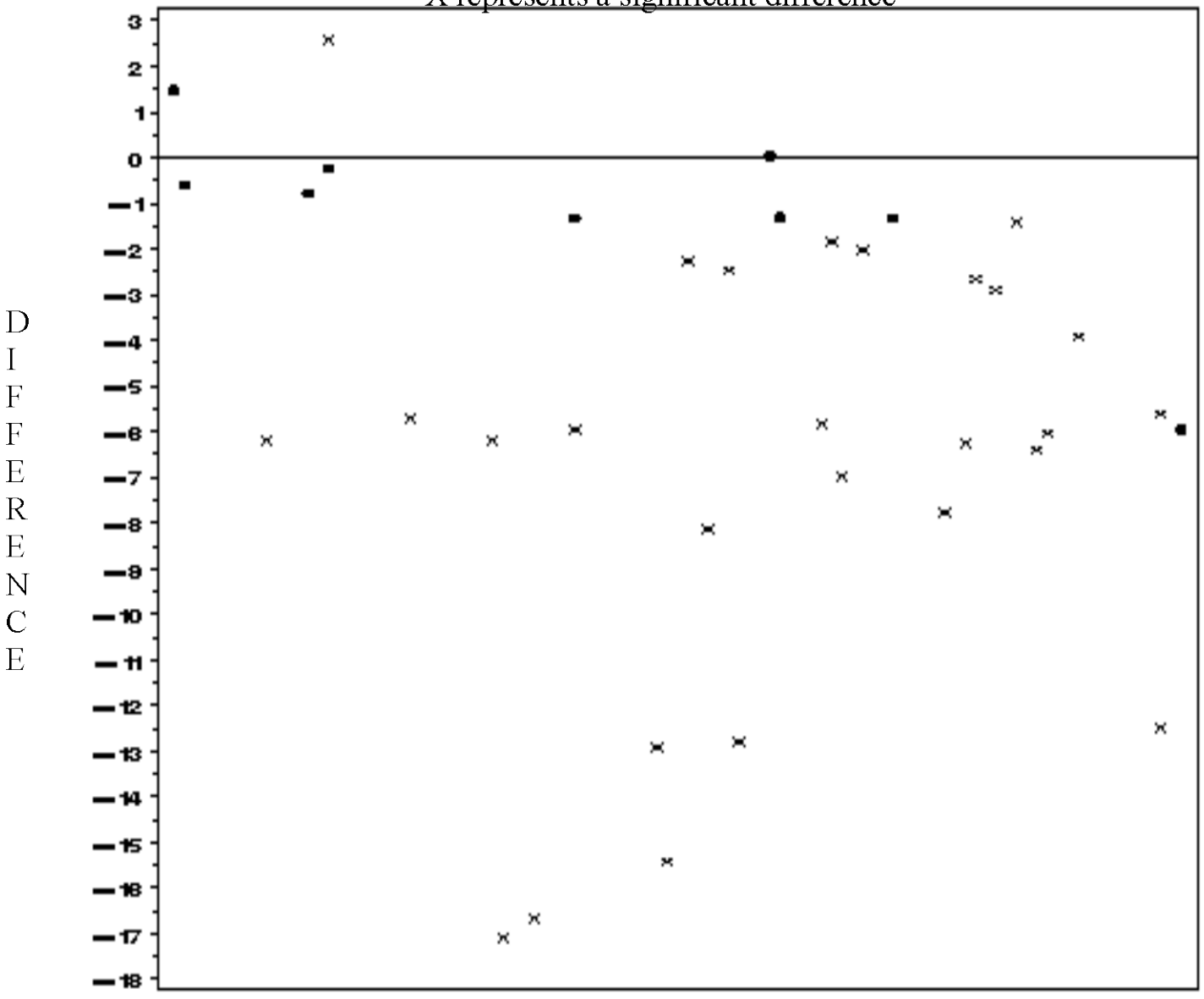


Figure C-3. Occupied Sample Unit Nonresponse Rates
Scatter Plot of Differences by County
Difference = ACS quality measure – Census quality measure
X represents a significant difference

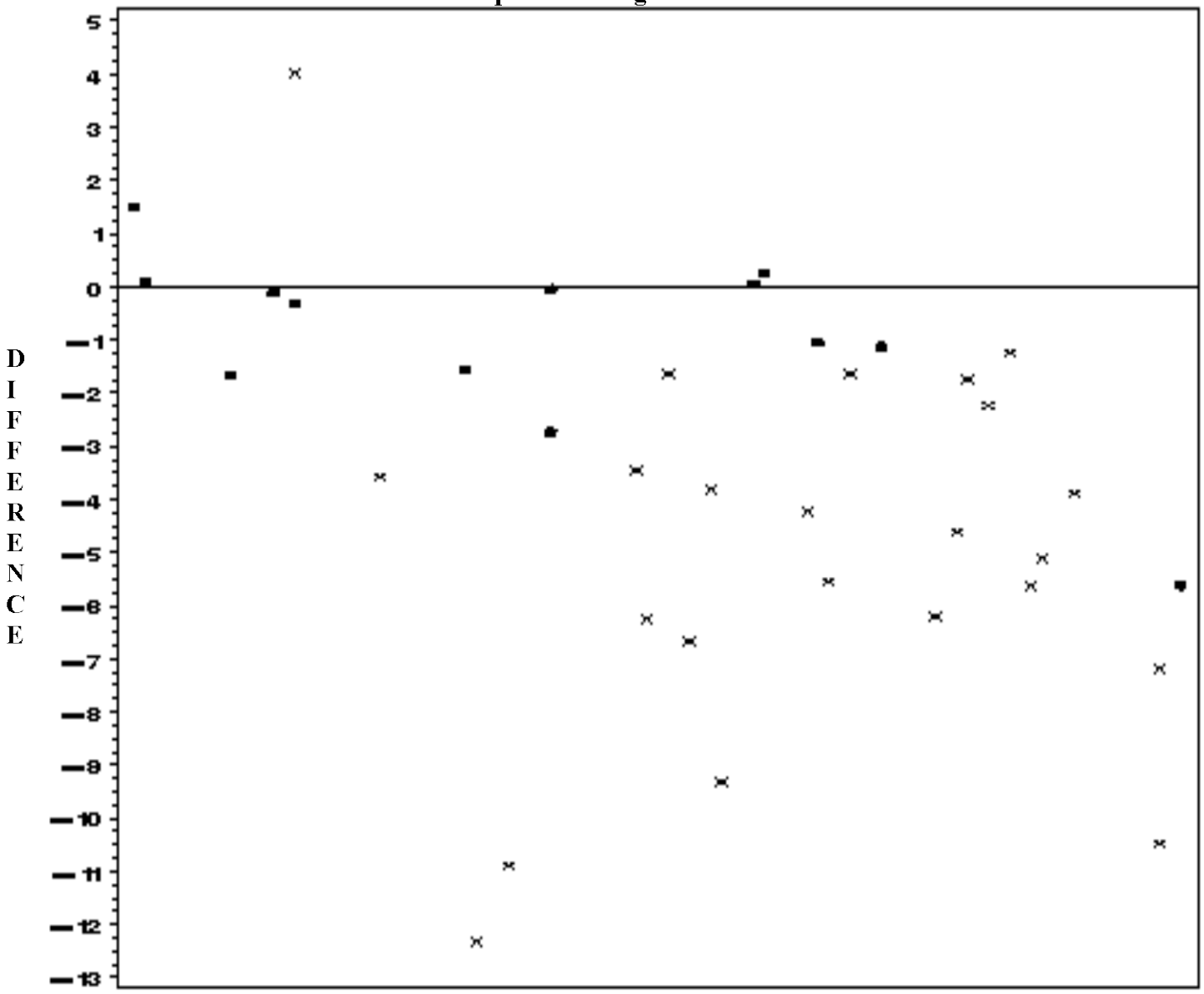


Figure C-4. Summary Allocations Rates for Population Items: Scatter Plot of Differences by County
Difference = ACS quality measure – Census quality measure
X represents a statistically significant difference

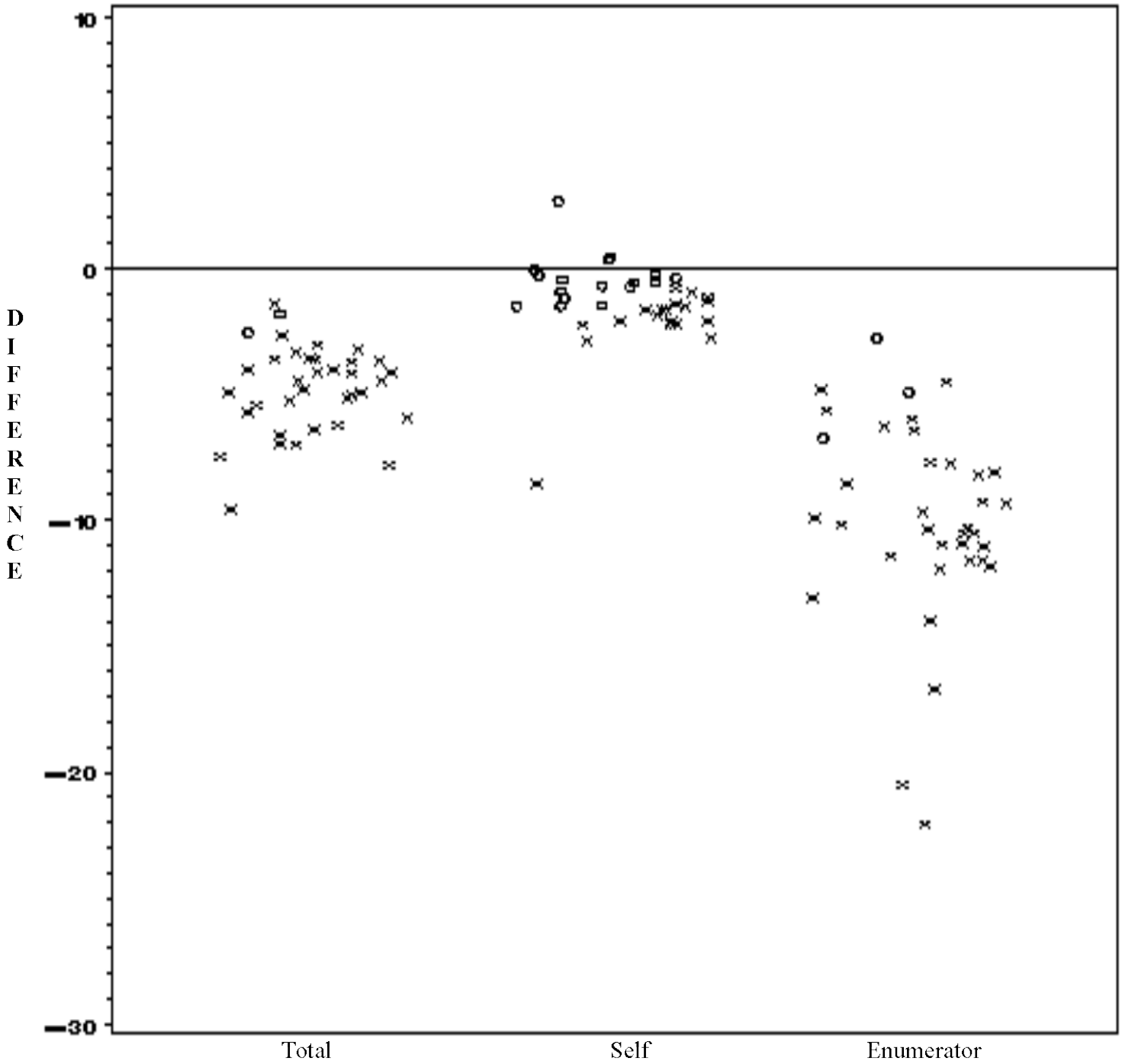


Figure C-5. Summary Allocation Rates for Housing Unit Items
Scatter Plot of Difference by County
Difference = ACS quality measure – Census quality measure
X represents a statistically significant difference

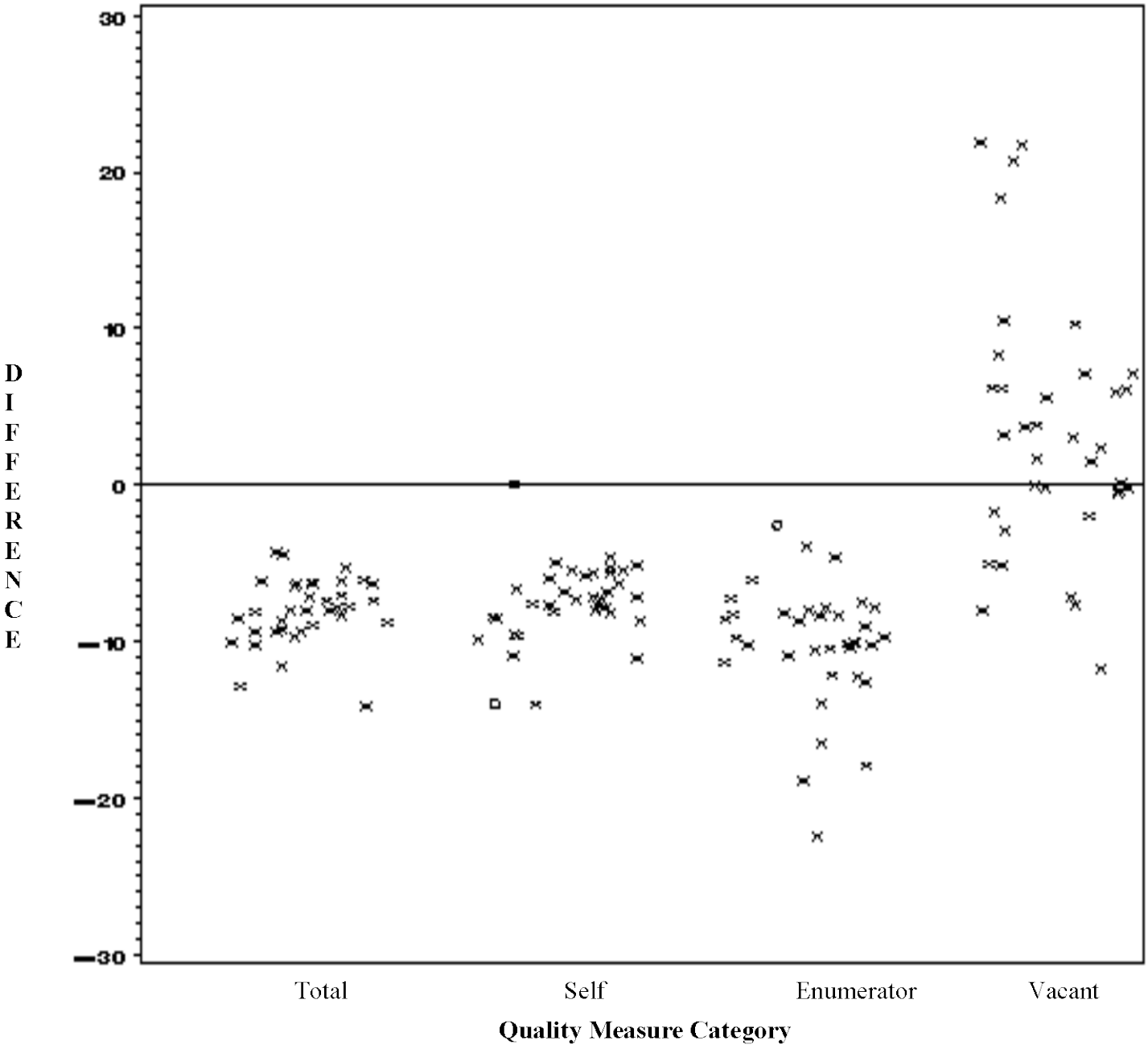


Figure C-6. Summary Allocation Rates for Population & Occupied Housing Unit Items - Scatter Plot of Differences by County
Difference = ACS quality measure – Census quality measure
X represents a significant difference

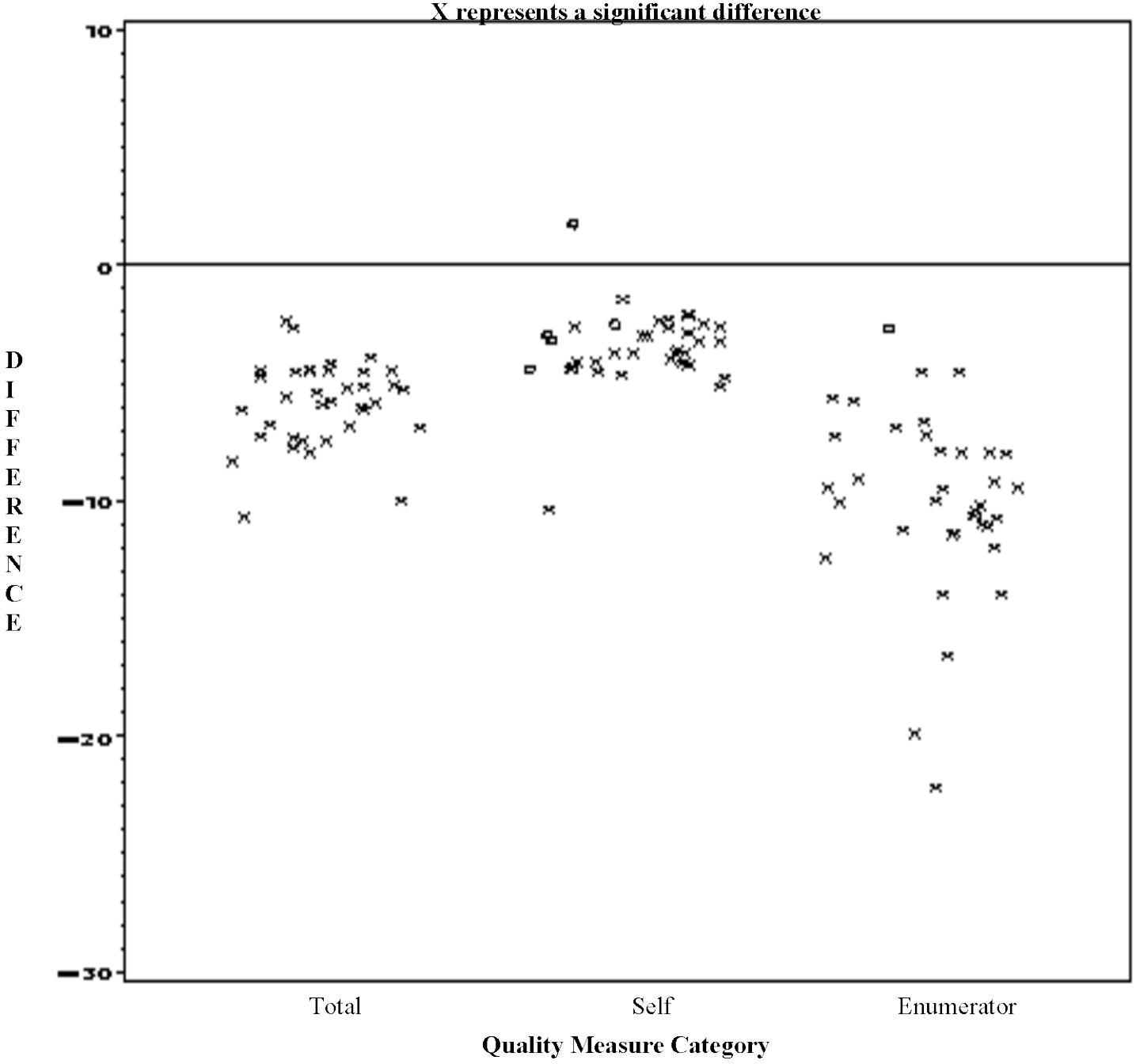


Figure C-7. Housing Unit Sample Completeness Rates
Scatter Plot of Differences by County
Difference = ACS quality measure – Census quality measure
X represents a significant difference

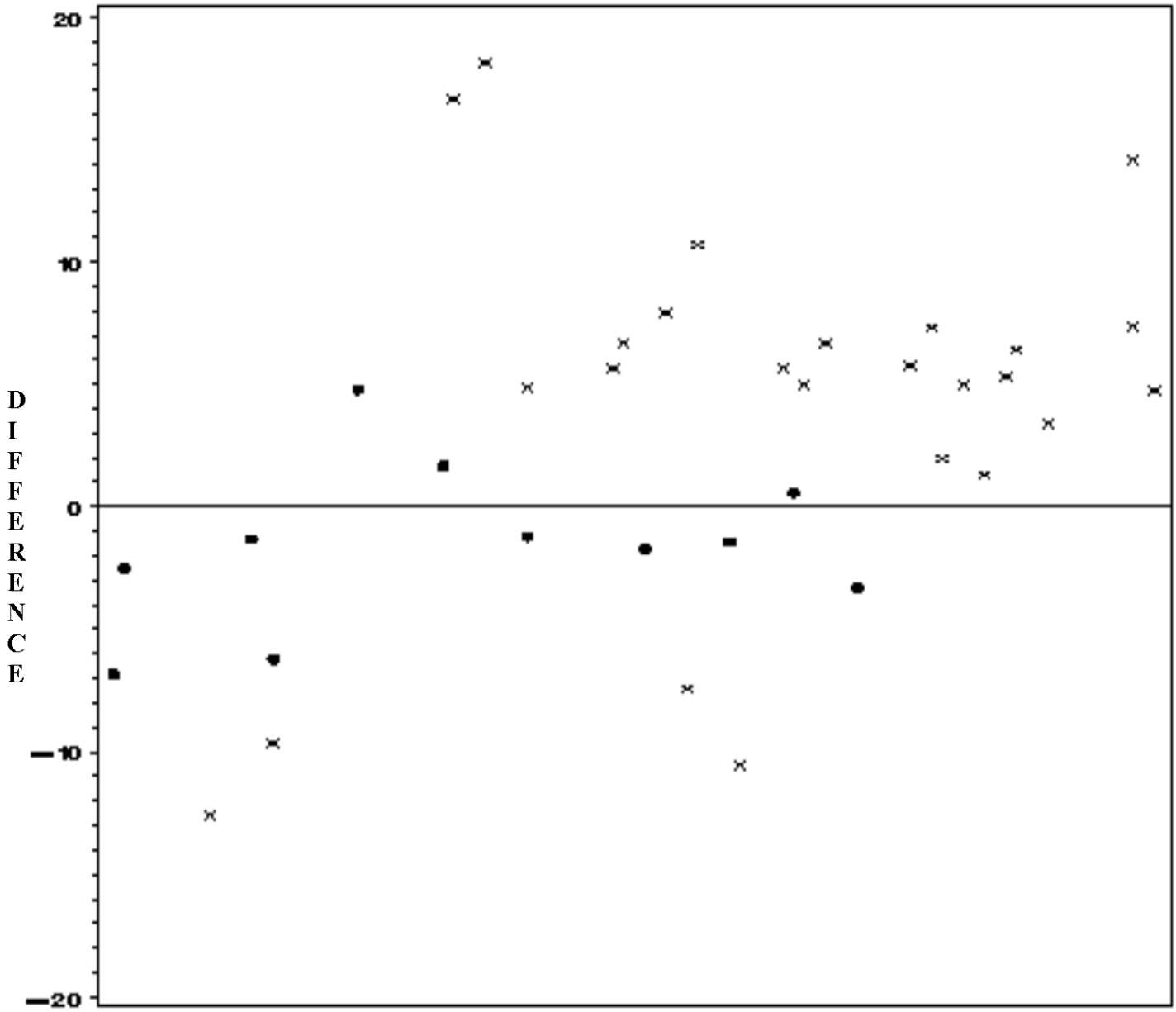
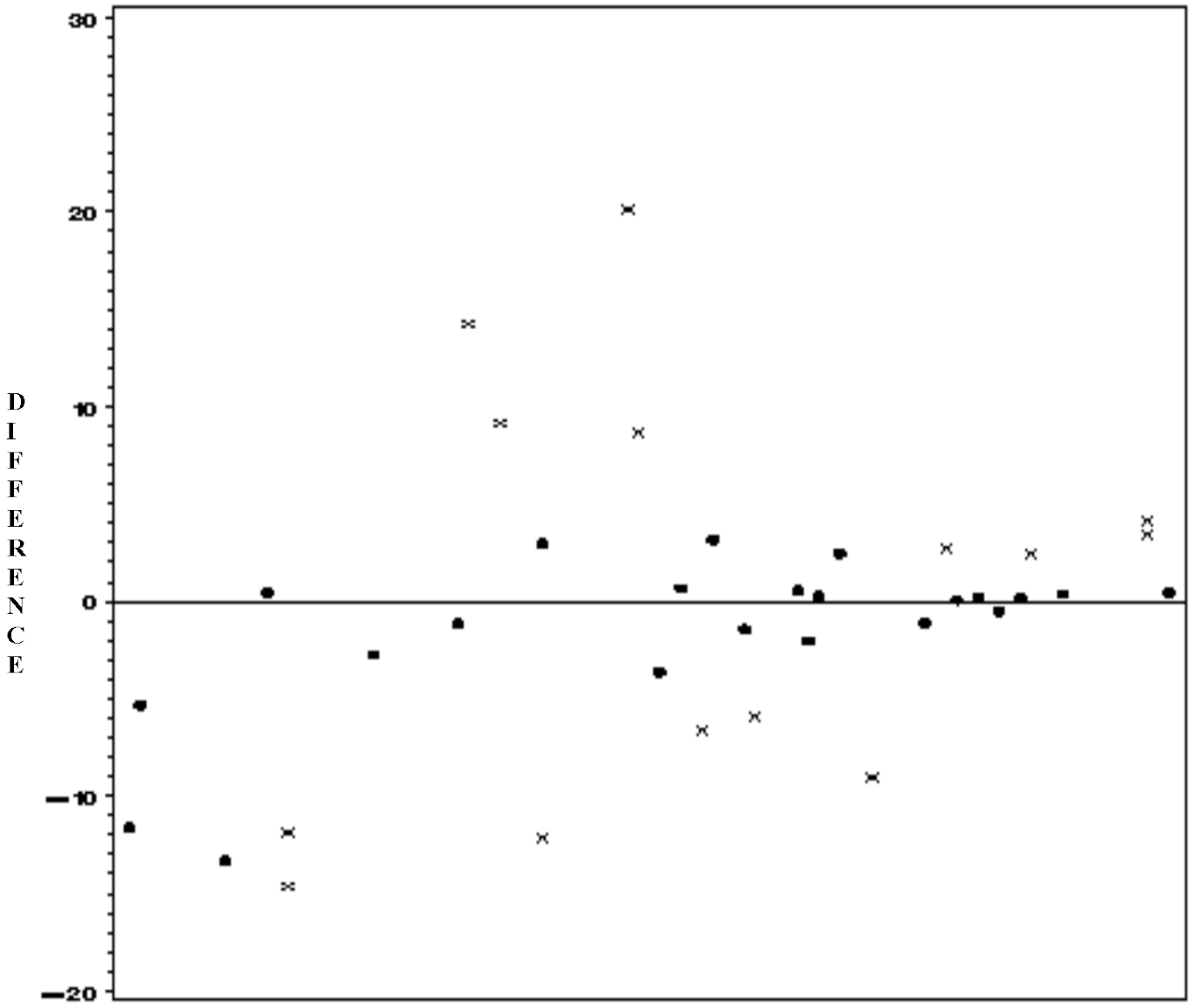


Figure C-8. Household Population Sample Completeness Rates
Scatter Plot of Differences by County
Difference = ACS quality measure – Census quality measure
X represents a significant difference



Appendix D
Quality Measures Scatter Plots for Tracts

This Appendix contains one dimensional scatter plots of the tract-level differences between the quality measures for the ACS three-year averages and Census 2000 sample estimates. We grouped all of the tract-level differences in each graph by tract group. So, there are five sets of one-dimensional scatter plots in each graph, one set of plots for each tract group. Each graph represents one quality measure.

Differences between the ACS three-year averages and the Census 2000 sample quality measures are located on the vertical axis; tracts and tract groups are on the horizontal axis. We sorted tracts within each tract group by their 100 percent count of census housing units. The sorts were in ascending order, from left to right, within each tract group. For example, the difference for the tract with the smallest count is the left-most point within each tract group, while the difference for the tract with the largest count is the right-most point within each tract group. We used a "jittering" process so that we could plot the differences in this way. Within each tract group, the "jittering" process assigned a unique integer to each tract so as to achieve this sort, where the tract with the smallest count received the smallest integer, etc.

The tract groups are:

- Group 1 - tracts in small counties (under 100,000 persons) and tract population greater than 500 (207 tracts)
- Group 2 - tracts in medium counties (100,000 - 1,000,000 persons) and tract population between 500 and 4000 (592 tracts)
- Group 3 - tracts in medium counties (100,000 - 1,000,000 persons) and tract population greater than 4000 (580 tracts)
- Group 4 - tracts in large counties (1,000,000+ persons) and tract population between 500 and 4000 (401 tracts)
- Group 5 - tracts in large counties (1,000,000+ persons) and tract population greater than 4000 (470 tracts)

Tracts with statistically significant differences are indicated by an "X" on the scatter plots; tracts whose differences are not statistically significantly different are indicated by a circle. The difference is defined to be the ACS three-year average quality measure minus the Census 2000 sample quality measure. These graphs were produced in SAS using data from the Quality Measures Comparison Files.

Figure D-1. Self -Response Rates
Scatter Plot of Differences by Tract
Difference = ACS quality measure – Census quality measure
X represents a significant difference

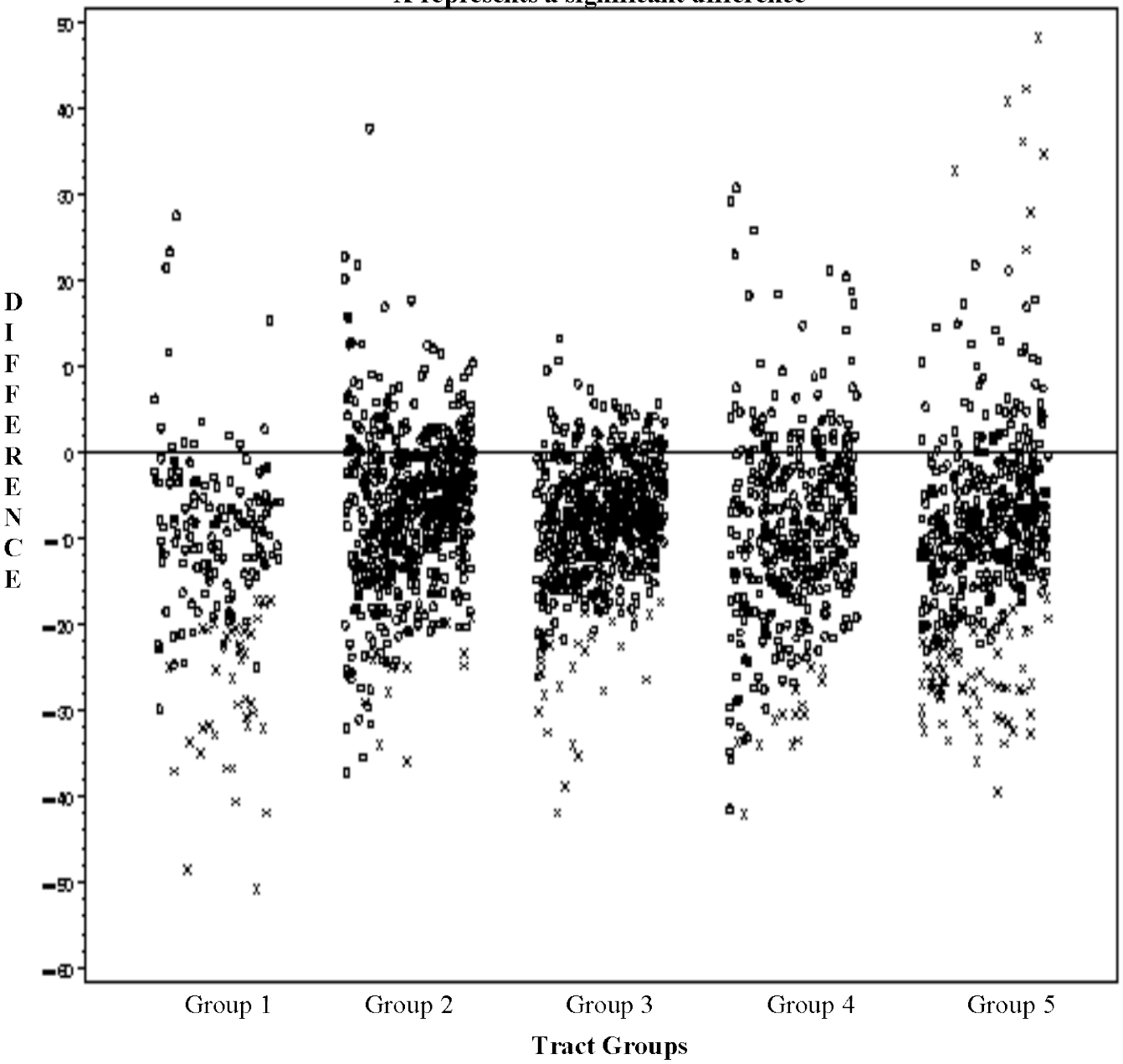


Figure D-2. Sample Unit Nonresponse Rates
Scatter Plot of Differences by Tract
Difference = ACS quality measure – Census quality measure
X represents a significant difference

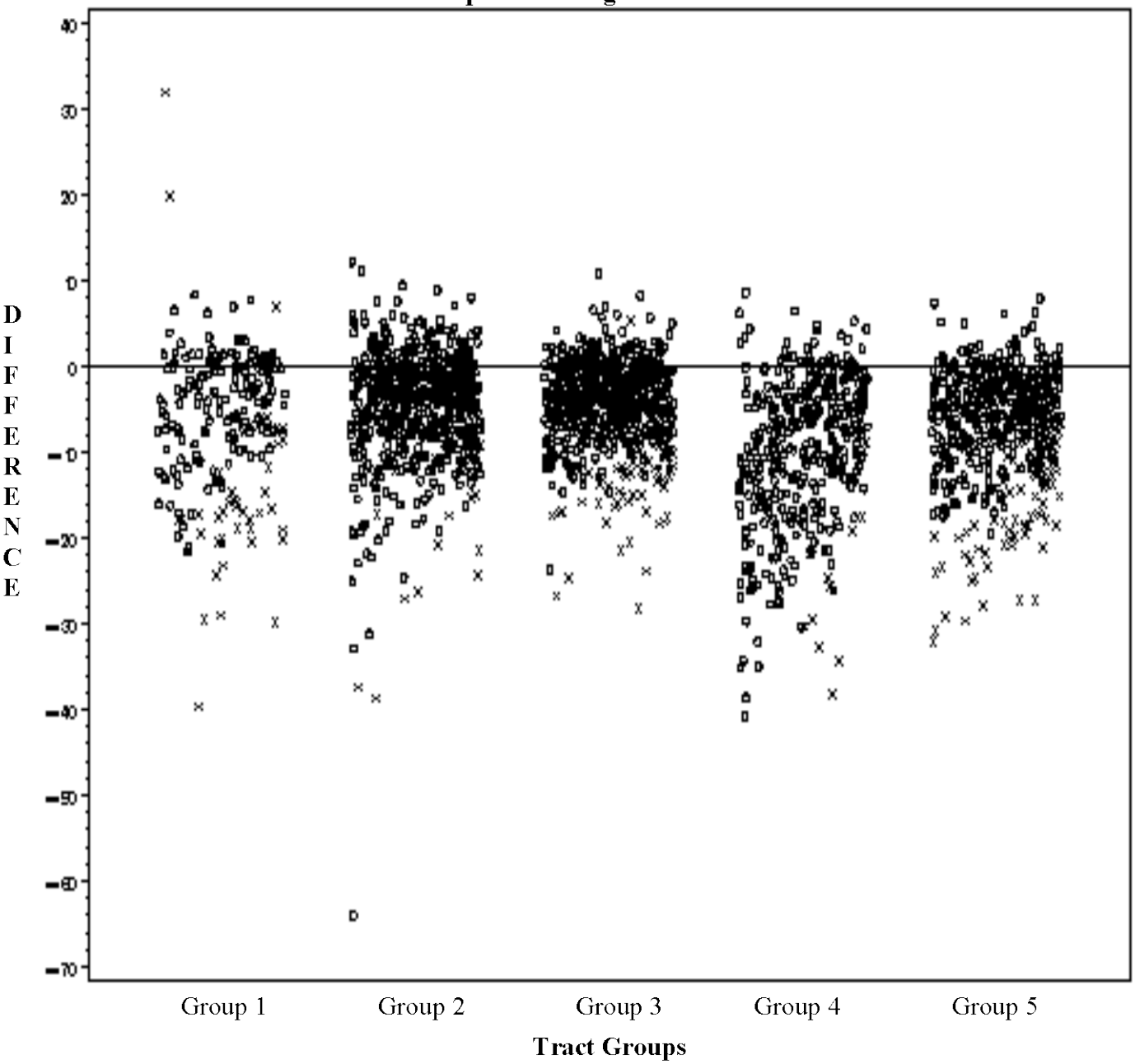


Figure D-3. Occupied Sample Unit Nonresponse Rates
Scatter Plot of Differences by Tract
Difference = ACS quality measure – Census quality measure
X represents a significant difference

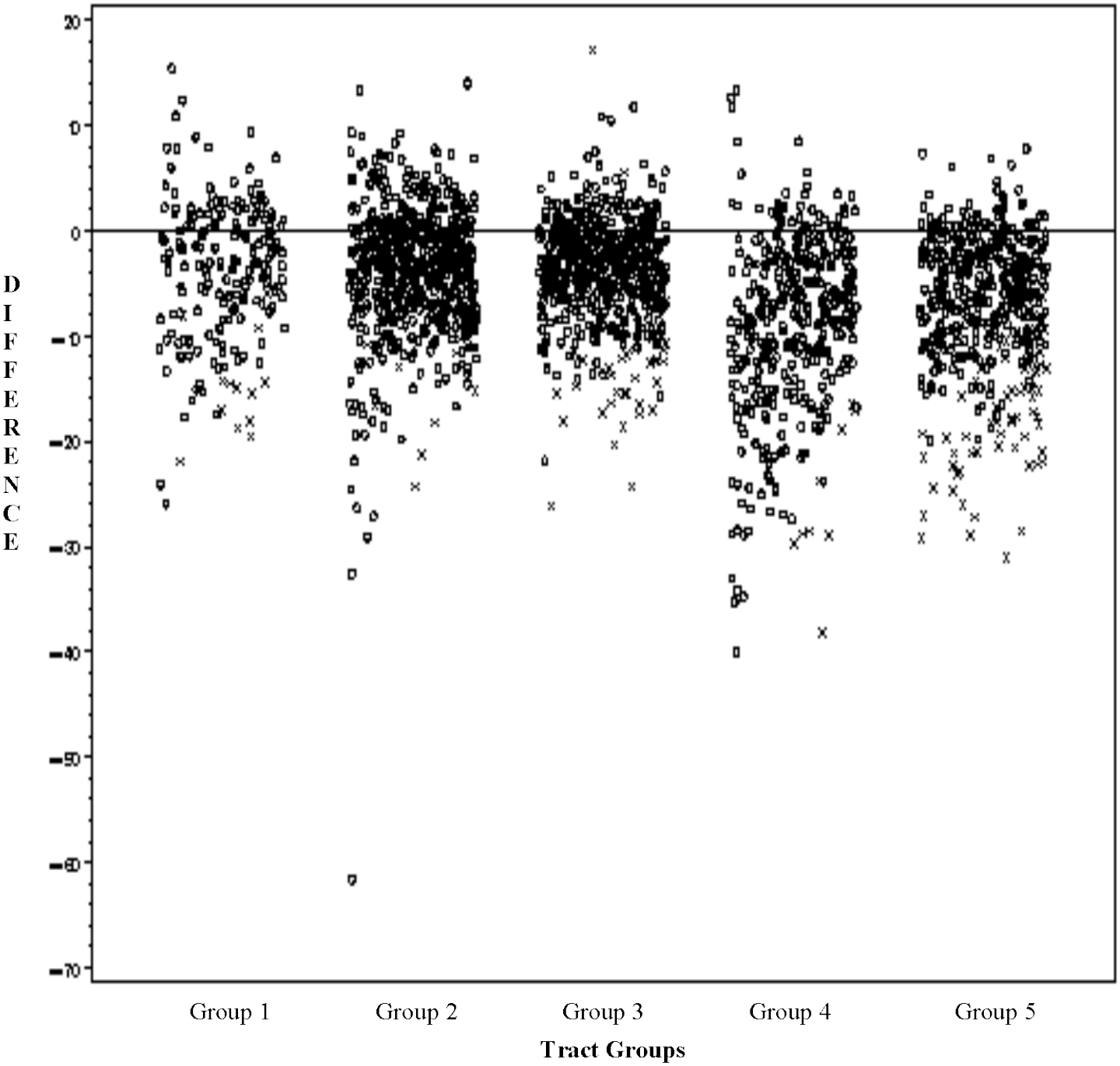


Figure D-4. Summary Allocation Rates for Population Items
Scatter Plot of Difference by Tract
Difference = ACS quality measure – Census quality measure
X represents a statistically significant difference

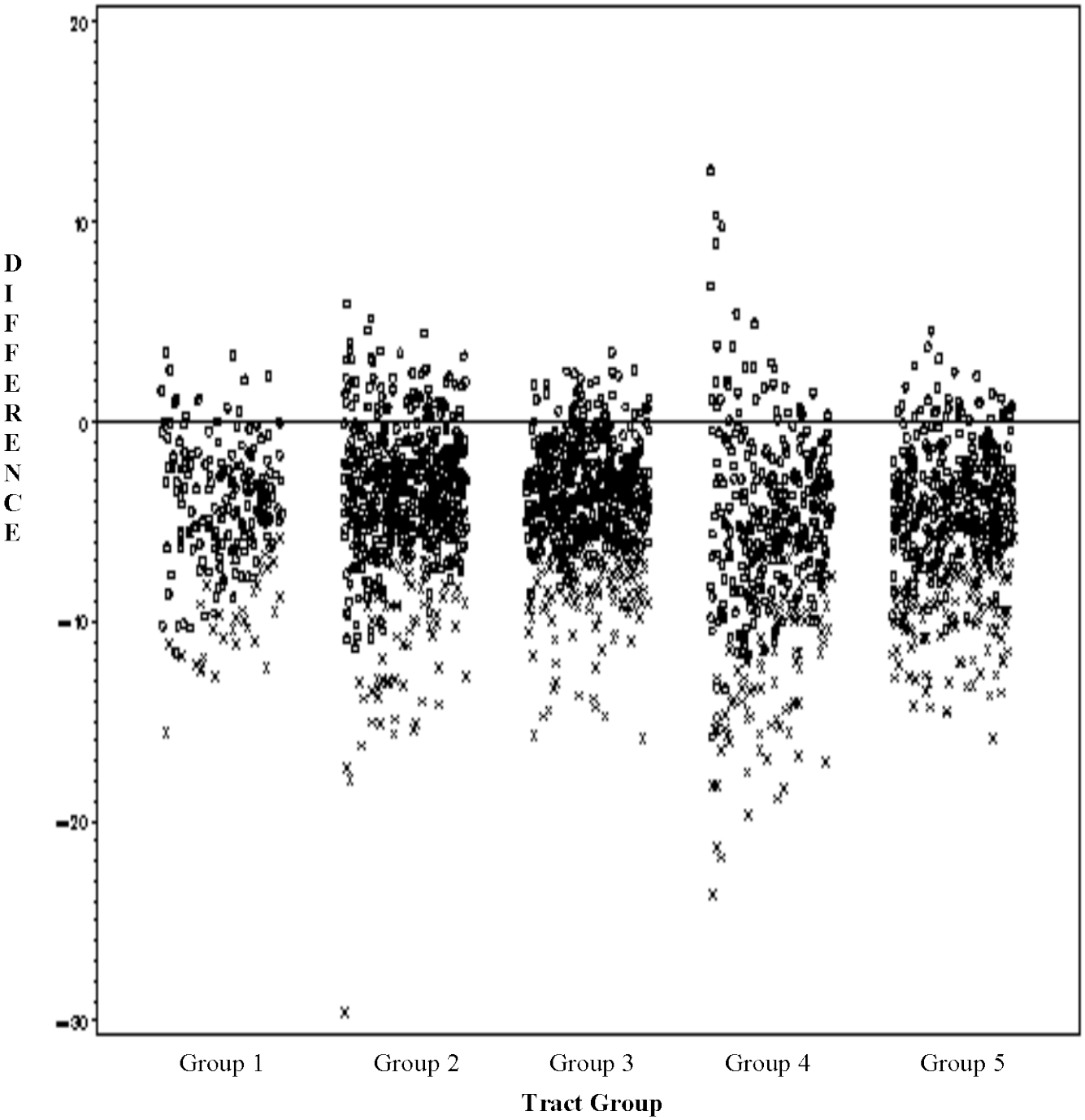


Figure D-5. Summary Allocation Rates for Occupied Housing Unit Items
Scatter Plot of Differences by Tract
Difference = ACS quality measure – Census quality measure
X represents a significant differences

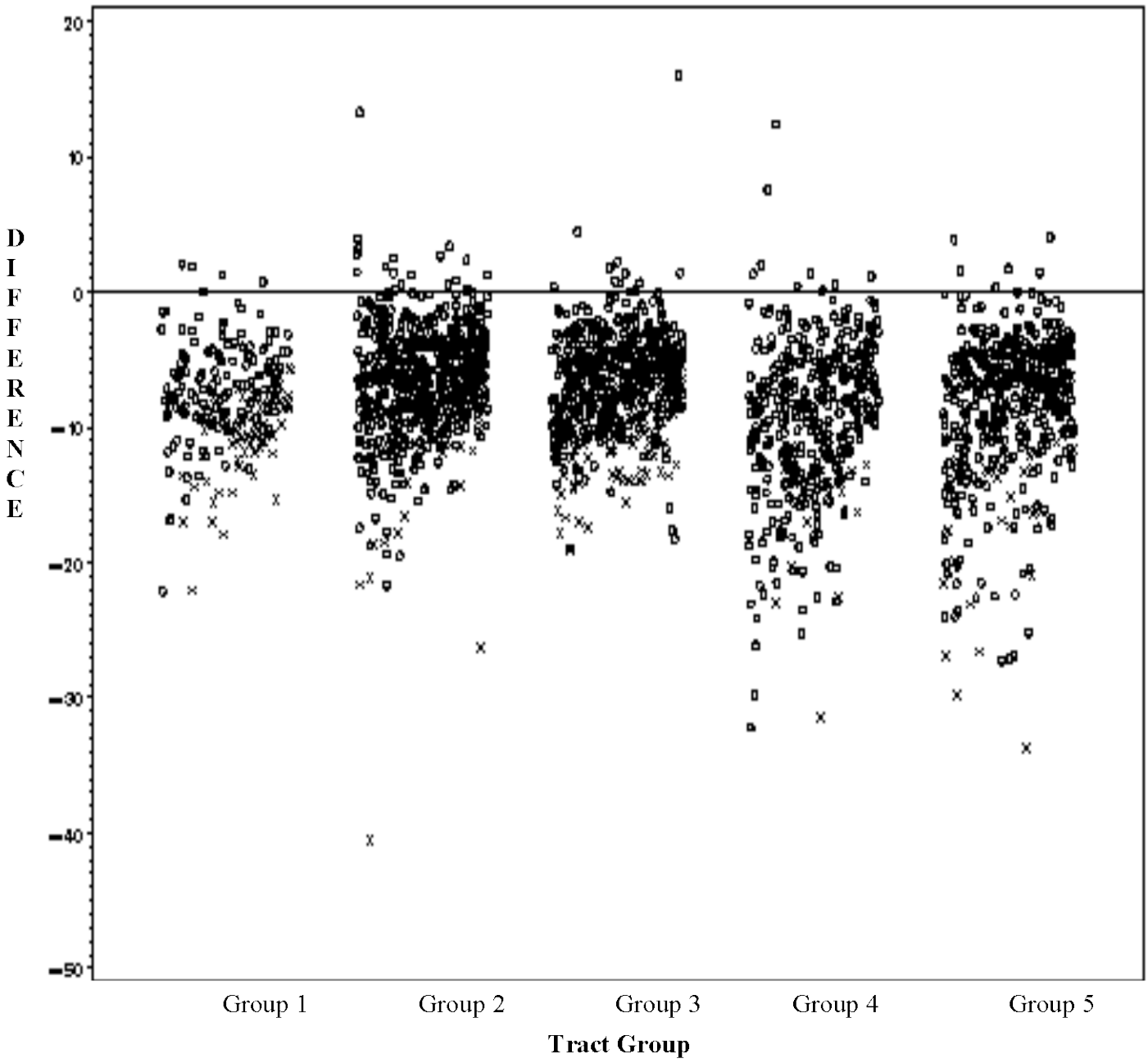


Figure D-6. Summary Allocation Rates for Vacant Housing Unit Items
Scatter Plot of Differences by Tract
Difference = ACS quality measure – Census quality measure
X represent significant differences

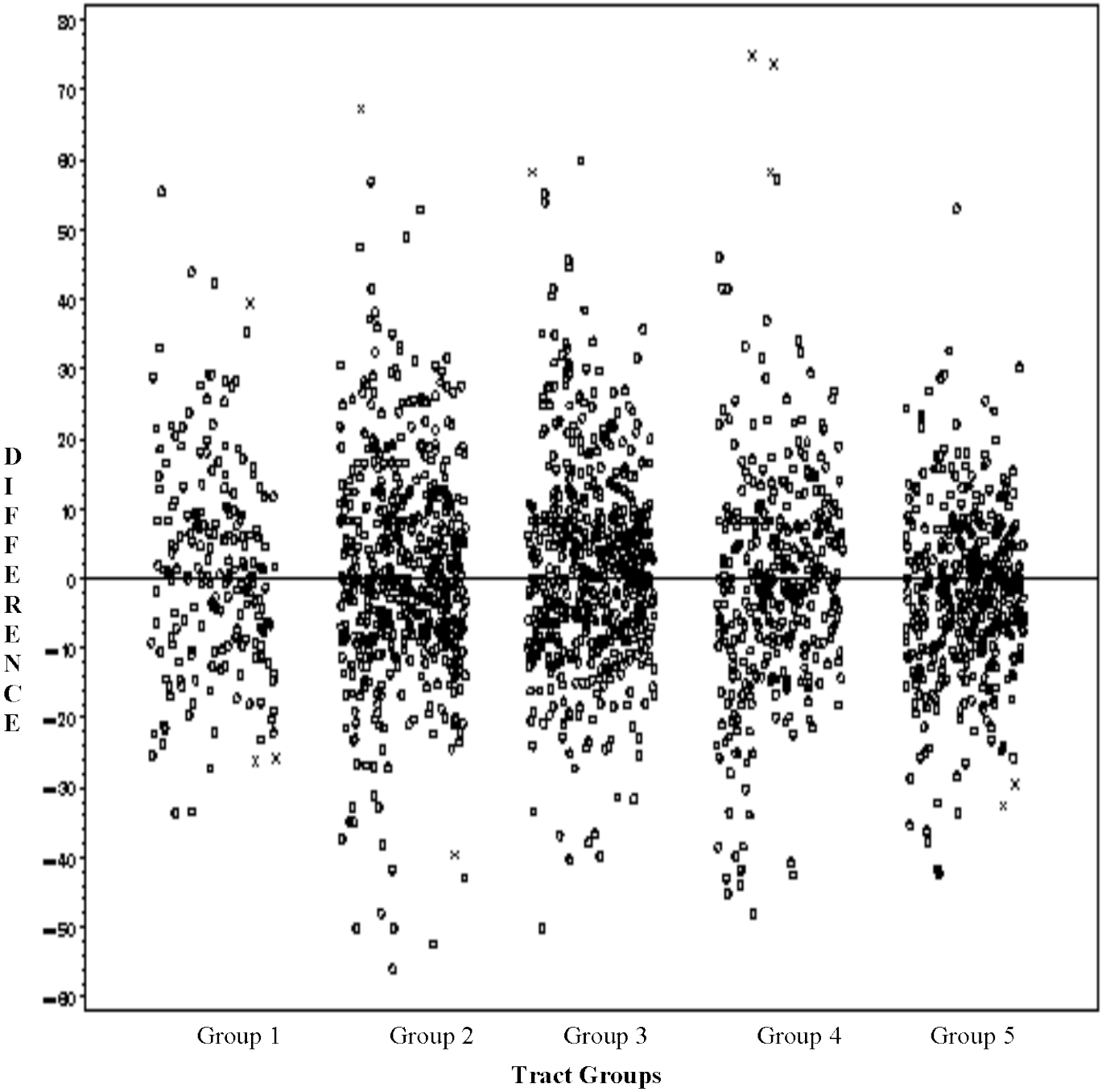


Figure D-7. Summary Allocation Rates for Population and Occupied Housing Items
Scatter Plot of Differences by Tract
Difference = ACS quality measure – Census quality measure
X represents a statistically significant difference