The American Community Survey: Quality of Response by Mode of Data Collection in the Bronx Test Site

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Background

As plans currently stand, the long-form census questionnaire will not be part of the 2010 Census. In its place will be the American Community Survey or ACS, which will provide key socioeconomic data more than once a decade for all areas of the nation, large and small.[2] The ultimate success of the ACS will be measured by its capacity to provide users with reliable sub-county level data. Given the important role for the ACS, especially to small area data users, steps need to be taken to increase what has been a scarcity of research aimed at evaluating the quality of estimates, especially regarding non-response issues. Such research can be very useful in helping to define the role of the ACS, its strengths and weaknesses, and how it fits in as part of the nation's data collection system.

The ACS represents a significant departure from the decennial census in the methods used for collection of long-form data. To begin with, the ACS does not use the "usual residence" concept employed in the census (people living in a unit "most of the time"), but a concept of "current residence." Members of the household eligible for the ACS had to reside in the household at the time of interview; if they claimed to live some other place, they needed to reside in the household for at least two months around the point of contact. Second, while the ACS uses what is essentially the census long-form to collect data on nativity, language, migration, education, occupation, income and other characteristics, estimates are derived from successive monthly samples collected over time, as opposed to data collected using a single point-in-time reference. This means that items like income represent averages taken over a period, which may influence the conceptual basis for the measure. Finally, the form and scale of the data collection are very different. The current plan is for the ACS to contact about 3 million housing units annually (250,000 per month) starting in 2003, with a one-in-three personal visit followup on units not responding by mail or CATI.[3] Monthly samples are accumulated to produce sufficient sample size for smaller areas. In contrast, the 1990 census was done in almost 92 million households over a period lasting about six months (using an April 1 reference point), where follow-up was done on all non-responding households using a huge group of temporary workers.[4]

Data users have become concerned about the effects these differences may have on the form and quality of small area data, especially given the lack of substantive research. This study seeks to help fill this void by examining the quality of data in one of the ACS test sites relative to data from the 1990 Census. Comparisons are made with the 1990 Census because the operational data are available and understood. Such is not yet the case with the 2000 Census operational data, which have yet to be fully developed and interpreted.

Data Accuracy: Nonresponse Issues in the ACS and Census

The definition of survey accuracy relates to errors associated with sampling and nonsampling issues (Office of Information and Regulatory Affairs, 2001:1-2). Sampling error is quantifiable and represents the variance associated with creating estimates from a sample rather than from the full universe of respondents. Less quantifiable but equally formidable is non-sampling error, which refers to errors of coverage, measurement, nonresponse, data capture and processing. In every survey, tradeoffs occur between different forms of error. In the ACS, the most salient tradeoff is the acceptance of slightly higher levels of sampling variability in exchange for more timely data for small areas (U.S. Census Bureau, 2002:27-29).

A major form of non-sampling error is nonresponse, which refers to an unsuccessful attempt to obtain information from respondents and is frequently considered a proxy for data quality (Office of Information and Regulatory Affairs, 2001:4-1). Nonresponse error can be subdivided into a complete failure to obtain information from sample units such as households and nonresponse associated with individual items in a survey. Drawing distinctions between unit and item nonresponse can be difficult because their definitions are not exact (Madow, et.al., 1983:18-20).

Measures Used in this Study and Study Area

This study focuses on three measures of non-response:

the *mail return rate*, a measure of *minimal questionnaire acceptability* (a form of unit nonresponse) and *item imputation*. The Bronx, the study area for this analysis and one of five counties (i.e., boroughs) comprising the City of New York, is one of the most populated urban counties in the nation, with more than 1.3 million persons and 491,000 housing units in 2000.[5] The Bronx contains some of the hardest-to-enumerate places in the nation. Moreover, the Bronx contains variations in race, ethnicity, nativity, tenure and language that run the gamut. In an effort to get a handle on these differences, the analysis subdivides the Bronx into 10 areas using the Public Use Microdata Area (PUMA) boundaries from the 1990 Census.

Gauging Nonresponse in the ACS and the Census

Mail Return Rates

The first measure of nonresponse used in this study was the mail return rate or the percent of occupied housing units receiving a long-form that responded by mail.[6] The overall 1990 Census mail return rate for long-forms in the Bronx was 55.8 percent, significantly higher than the rate from the 2000 ACS of 36.4 percent.[7] Mail return rates are shown separately for the 10 PUMA subareas (hereafter referred to as "subareas") in Figure 1. These subareas have large populations, encompass many neighborhoods each, and vary substantially in their socioeconomic status, housing and race and ethnic composition (Table A-1). The most critical of these differences, for the purposes of this study, is socioeconomic level. In order to independently gauge socioeconomic differences, a measure was created using local administrative data on public assistance recipiency for October of 2000. This measure uses the broadest definition, namely persons who were receiving public assistance, were Medicaid-eligible or who were receiving Supplemental Security Income (SSI) benefits. Expressed as a percentage of 2000 population, this statistic was used in the analysis to rank order the PUMAs. The large variation, from 46 percent in the case of PUMA 502 to just 11 percent for PUMA 508, is indicative of the wide range of distress in the borough. Thus, the areas in Figure 1 are sorted to reflect the level of poverty, as gauged by administrative data, with areas to the left having higher levels of public assistance recipiency per unit of population than areas to the right.

As expected, mail return rates rise as poverty level declines for both the census and ACS. Although mail return rates rise in lower poverty areas, the differences between the 1990 Census and the ACS are largely maintained across the poverty spectrum. PUMA 502 is in the south central Bronx has the highest level of poverty in the borough as measured by the administrative data (46 percent). According to the ACS, it is primarily a Hispanic (59 percent) and black nonhispanic (36 percent) subarea, consisting heavily of Puerto Rican and African-American residents (Table A-1). Only 9 percent of the population lives in owner-occupied housing, with most of the rental units in large multi-story buildings. The mail return rate in 1990 was 51 percent compared to 29 percent in the 2000 ACS, a difference of 22 percentage points. According to the administrative data, PUMA 508 has the lowest poverty level in the borough, 11 percent. It is located in the eastern section of the borough and, based on the 2000 ACS, about half of its population is either black or Hispanic. The largest Hispanic group is Puerto Rican and the black population is heavily African-American; 45 percent of residents own their own homes. In 1990, 68 percent of households mailed back their census questionnaires, compared to 48 percent in the ACS, a difference of 20 percentage points. Clearly, mail return rates were lower in the 2000 ACS relative to the 1990 Census, irrespective of poverty level.

Minimal Questionnaire Completeness

Another measure focuses on minimal questionnaire completeness or the dividing line established by the Census Bureau between questionnaires that are usable or minimally acceptable and those that contain so little information that they are akin to blank questionnaires. The minimal completeness threshold for 1990 was defined as two completed 100 percent items and two completed sample count items for at least one person in the census household. Households with at least one person who met these minimum thresholds were labeled as "sample data-defined," (hereafter referred to as SDD), and were included by the Census Bureau in the long-form sample and subject to the weighting and edit processes that include imputation of long-form items where required. Cases Not SDD were dropped from the sample because they were considered to be "too far gone" for any form of sample data imputation.

In an effort to derive a more comprehensive measure for the ACS, the Census Bureau created a minimal completeness concept in the form of an "acceptability index." This measure examines responses for all persons in the household and creates a composite index that rates the level of information present. Unlike the 1990 census measure, which required one person within a household of any size to meet the minimum data requirement, the "acceptability index" is calculated at the household level by adding up the number of 100 percent data items and dividing by the number of persons in the household. An index of

2.5 or more is considered by the Census Bureau to constitute an interview; any household that fails to make this threshold is deemed a "non-interview" and is adjusted for in the weighting as if the ACS had not received a questionnaire.

Acceptability indices for both the 1990 Census and the 2000 ACS were constructed using special data compiled by the ACS staff at the Census Bureau for the Bronx test site. The percent of households responding by mail that failed to achieve acceptability was small for both the 2000 ACS and the 1990 Census, 1.7 and 0.3 percent respectively (Figure 2A). A large difference, however, was apparent for households enumerated in non-response follow-up, with unacceptable returns constituting 4 percent of census households versus more than 14 percent for households in the ACS. Given the fact that the acceptability index is based on just 100 percent items, it is not surprising that the 1990 Census achieved a higher level of minimal completeness relative to the ACS in follow-up. The primary goal of the decennial census is to achieve the most complete count of population possible, a focus that seeks to maximize response to the 100 percent questions.

Turning to the SDD criteria of minimal completeness, which includes sample data, a very different picture emerges (see Figure 2B). As with the acceptability index, the large majority of self-response households met the SDD requirements (two 100 percent and two sample count items for at least one household member). For enumerator returns, however, a much larger portion of households failed to meet the SDD threshold in the 1990 census compared to the 2000 ACS. More than 49 percent of households enumerated in nonresponse follow-up in the census failed the SDD test, compared to just 14 percent for the ACS, a huge difference that reflects both the census's emphasis on the 100 percent data items and the high quality of non-response follow-up in the ACS. The Census is, first and foremost, an enumeration of the population, where priority is given to obtaining responses to the 100 percent questions. When an enumerator seeks to obtain information from a long-form household that failed to respond by mail and repeated attempts to obtain an enumeration fail, last resort measures are employed that focus on obtaining information for the 100 percent items.[8] The ACS, on the other hand, does not incorporate these distinctions into its data collection process. There is no prioritization of content in CAPI and proxy responses are not permitted in the ACS. While the "count" is important to ensure the coverage necessary to maintain the integrity of the sample, the entire questionnaire is incorporated as a single entity in the ACS, which explains why the percent not "acceptable" and the percent not SDD were virtually identical for 2000 ACS households. It also explains why, for the 100 percent data, the ACS is indeed not a substitute for the "short-form" decennial census.

The differences in the ACS and census process become apparent when all long-forms are examined by mode of data collection and minimal completeness, using the SDD measure (Figure 2C). In the chart, the red area represents the percentage of households enumerated in the mailout-mailback phase of census and ACS operations in the Bronx; note the much higher mail-return rate in the 1990 Census and the fact that virtually all of the households that mailed-back their questionnaires were SDD for both the census and the ACS. The blue area of the chart shows all households that were enumerated via follow-up and illustrates the higher reliance on this operation in the ACS. Most important was the much higher percentage of households in follow-up that were not SDD in the census, 22 percent of all long-forms compared to just 8 percent in the ACS. Thus, more than one of every five long-form questionnaires from the 1990 Census in the Bronx was unusable because of ineffective nonresponse follow-up.

Extending this analysis of minimal completeness to hard-to-enumerate areas, Figure 2d presents the percent of households in the census and ACS that were SDD in subareas with high and low poverty. Poverty is gauged by the administrative data on public assistance recipiency.[9] As seen earlier, those areas with high levels of poverty have lower mail return rates, in the census and ACS, thus increasing the contribution of nonresponse follow-up to the total data collection effort. For the Bronx, less than one-half of all occupied housing units in high poverty areas mailed back their census questionnaires in 1990, compared to 62 percent in areas with low poverty. In the 2000 ACS, high poverty areas had a mail return rate of just 30 percent compared to 46 percent for low poverty areas. The degree of questionnaire completeness among mail returns varied little by poverty level, with the large majority of questionnaires from the census and ACS meeting or exceeding the SDD threshold. Therefore, for mail returns, differences between high and low poverty areas were evident in the levels of mail response and not in the degree of completeness of those responses.

About one-half of both high poverty and low poverty households enumerated via nonresponse follow-up were SDD in the 1990 Census. Since mail return rates were much lower in high poverty households, this translates into a larger deficit of SDD long-forms in high poverty areas, 24 percent, compared

to 17 percent in low poverty areas. As was the case overall, a much higher percentage of ACS households enumerated in nonresponse follow-up met or exceeded the SDD threshold irrespective of poverty level. This results in a much smaller percentage of ACS households that failed to meet the SDD standard; 8 percent in high poverty areas and 7 percent in those designated as low poverty.

While thresholds for minimal completeness provide one picture of differences in data quality, the final statement about data quality rests with the level of item-specific imputation. Regardless of mode of collection or type of survey, the proclivity of respondents to answer survey questionnaire items can vary dramatically. Therefore, the final portion of our study turns to an examination of allocation rates for selected variables.

Item Imputation

Another measure of survey quality is the percent of an item's data values that was allocated, using known values from completed responses to impute values for missing items. Table 1 presents allocation rates for selected variables from 1990 Census long-forms and compares these rates to those calculated from the 2000 ACS.[10] This includes several social background variables, including birthplace of the foreign born (birthplace); English language Proficiency of those persons 5 years and over who spoke a language other than English at home (English); and place of residence – five years ago from the census and one year ago from the ACS (mobility). Economic variables that ask about occupation (occupation), income from wages and salaries (wages), and income from public assistance (PA) are included. Finally, two 100 percent items were included, units in structure (units) and contract rent (rent). Regardless of differences, the 100 percent items have low levels of allocation, which is indicative of their relatively high levels of response.

Overall, imputation levels were significantly higher in the 1990 Census compared to the 2000 ACS for seven of the eight items (Table 1). Among the items examined, the economic variables displayed the highest allocation rates in the 1990 Census – for occupation (22 percent), wages (19 percent), and public assistance income (18 percent). Differences were marked for occupation and public assistance, but not for wages, which had the highest allocation rate of the items examined in the 2000 ACS. Only for contract rent was allocation significantly higher in the ACS than in the Census, but the difference, while significant, was less than two percentage points.

While the overall allocation rates provide a general idea of differences in data quality between the ACS and the 1990 Census, examining data by mode of collection is key to understanding why rates differ. Table 1 shows that the picture of differences varies dramatically by mode of data collection. For questionnaires that were obtained via self-response, allocation rates were actually higher in the ACS than in the census. For example, for self-response households, the income source question on public assistance had an allocation rate of 14 percent in the 1990 Census compared to a rate of 23 percent in the ACS. Allocation for self-response households in the 2000 ACS for occupation (21 percent), wages (20 percent), mobility and English proficiency (11 percent) were all significantly higher than in the 1990 Census.

In contrast, for data obtained via enumerator response, allocation rates were much lower in the ACS than in the census. One-third of the occupation data elicited via enumerator-response in the 1990 Census was allocated, compared to less than 10 percent in the ACS. Double-digit differences also occurred for wages, public assistance, birthplace, mobility and English proficiency. Only for units in structure and for contract rent – the two 100 percent items – were differences small.[11]

Conclusions

The Federal Committee on Statistical Methodology reminds researchers that the concept of survey accuracy goes well beyond the measurement and reporting of sampling error, encompassing a broad spectrum of errors associated with non-sampling issues, such as nonresponse (Office of Information and Regulatory Affairs, 2001. The shift from the decennial census to the American Community Survey as *the* single source of small area data for the nation involves a series of complex tradeoffs that only become apparent when operational data from the two surveys are examined by mode of data collection.

The decennial census depends on high mail return rates to keep nonresponse errors in check because of the high level of error associated with sample items in nonresponse follow-up. Of all the 1990 Census long-forms in the Bronx, more than one-in-five failed to meet the sample data-defined threshold for minimal completeness, rendering them useless for the estimation of characteristics. Thus, the emphasis in the decennial census nonresponse follow-up operation is not on the sample items, but on the 100 percent questions, a result of the priority given to the count (as opposed to characteristics) and testimony to the difficulties encountered in obtaining responses to sample count questions during the final stages of the

census enumeration.

The primary objective of the ACS is to estimate characteristics. The reluctance of respondents to provide information is addressed through the use of intensive follow-up using professional interviewers for a sub-sample of households. With fewer households to cover and a greater emphasis on eliciting responses for the entire questionnaire, the ACS operational data showed higher levels of sample data-defined households and lower levels of item allocation. Moreover, this advantage was maintained in more difficult-to-enumerate areas. The quality of nonresponse follow-up is key to the success of the ACS, especially since its mail return rates, thus far, have been well below levels found in the decennial census.

The ACS dependence on nonresponse follow-up has its pitfalls, however. While the quality of nonresponse follow-up has been shown in this study to be relatively high in the ACS, too much follow-up can make small area estimates overly dependent upon the one-in-three CAPI sub-sample. The dependence of the ACS on relatively high levels of nonresponse follow-up, especially for hard-to-enumerate areas raises concerns regarding the reliability of estimates. This has prompted data users to express fears that future budget constraints may force cuts in sample size that will seriously degrade the sample base for small area estimates (Hernandez, 2001; 3-4). The Census Bureau needs to provide data users with more information about the reliability trade-off between mail retums and CAPI, especially in hard-to-enumerate areas. The Bureau needs to help data users identify that point where the balance of mail returns and CAPI interviews becomes unfavorable and seriously compromises estimates. Of course, the ideal situation would be to increase the visibility of the ACS, thereby fostering civic involvement and a concomitant rise in mail return rates, making the survey less CAPI dependent.

There is little doubt that the situation with the long-form decennial census process has gotten more difficult since 1990, as indicated by the national decline in long-form mail returns. In an era when the Census has done a better job of counting residents of the Bronx, early evidence indicates that a concomitant increase has not occurred in the Census's capacity to estimate their long-form characteristics. Counting more Bronx residents poses new dilemmas for modern census taking, in the form of obtaining accurate information on characteristics from the hardest-to-enumerate populations. There are always limits to what respondents will report, especially in an era when the issue of personal privacy is in the headlines on a daily basis. Sampling variability issues notwithstanding, the higher level of data quality inherent in better ACS nonresponse follow-up represents a major advance over the increasing degradation of long-form census response.

Future work in the Bronx needs to focus on non-response errors in the 2000 Census, once the operational data become available. Further, with multiple years of data from the ACS, larger sample sizes will permit the unit of analysis to move from the PUMA to the census tract level, making it possible to examine data for neighborhoods. Only by working at a more detailed geographic level will it be possible to explain some of the patterns found in this study at the PUMA level. With 355 census tracts in 2000 and large demographic, social and economic disparities, the Bronx has the potential to become an even more fruitful source for evaluating nonresponse error in the ACS.

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[1] The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Department of City Planning or the City of New York. The authors would like to acknowledge the assistance of Alathia Ashman and Timothy Calabrese in the preparation of this manuscript.

[2] In the late 1980s, proposals for continuous measurement of the nation's social and economic characteristics for all areas first received serious consideration at the Census Bureau (Herriot et al, 1989). With increasing demands placed on local data disseminators for more timely information, especially in high-growth areas, the decennial cycle of census data was increasingly seen as inadequate. This pressure, along with congressional misgivings over the cost-effectiveness and lackluster response in the 1990 census, combined to produce a demand for better data collection tools (Prewitt, 2000). In response, the Census Bureau started planning to pilot test a continuous measurement program in 1994 (Alexander, 2000).

[3] Given that the ACS personal visits (CAPI) are only done on a 1 in 3 subsample, the data in this analysis have been weighted to reflect this. Further, those housing units that failed to respond to mail and to CATI and were not selected for follow-up were dropped from the analysis.

[4] The ACS actively employed a computer-assisted telephone follow-up operation using vendor-supplied telephone numbers associated with sample addresses. The 1990 Census used telephone follow-up from field offices to fill gaps in questionnaire content, in addition to personal visits to non-responding households.

[5] There were approximately 15,500 questionnaires mailed in the Bronx ACS over the course of 2000, about 5,000 of which were returned via the mail. Of the approximately 10,600 that remained, some 700 were enumerated via CATI. One-third or 3,300 of the remaining 9,900 questionnaires were part of the CAPI sub-sample. Therefore, unweighted, CAPI cases constituted more than four-fifths of all cases in non-response follow-up (3,300 out of almost 4,000 cases).

[6] The operational data in this analysis are for 1990 Census long-forms only. Therefore, reference to "100 percent" questions is for long-forms only (i.e., the questions that appeared at the beginning of the long-form questionnaire).

[7] We are calculating the "mail return"rate not as an operational unweighted type measure, but as a measure of public cooperation that indicates how much data are the result of self-response. Given that the ACS personal visits (CAPI) are only done on a 1 in 3 subsample, the data used in this analysis have been weighted to reflect this. Mail return rates from the 1990 Census were calculated taking into account differences in census tract level sampling rates, which in the Bronx were either one in six or one in eight.

[8] "Last resort" in the 1990 Census refers to the collection of data from neighbors, apartment managers, post office employees among other sources, when a response from a resident could not be obtained (National Research Council, 2001:168-9).

[9] For this portion of the analysis, PUMAS were combined into two groups: Those with the highest percent of recipients – 501 (44.6); 502 (45.9); 503 (43.0); 504 (40.9) and those with the lowest levels of recipients – 506 (15.9); 508 (10.9) and 509 (17.4).

[10] These allocation rates utilize initial weighting (i.e., the probability of sample selection only) and not the final weighting, which takes into account a host of other factors (e.g., coverage issues).

[11] The full paper, available from the authors, presents allocation rates for six sample items across the Bronx PUMAS

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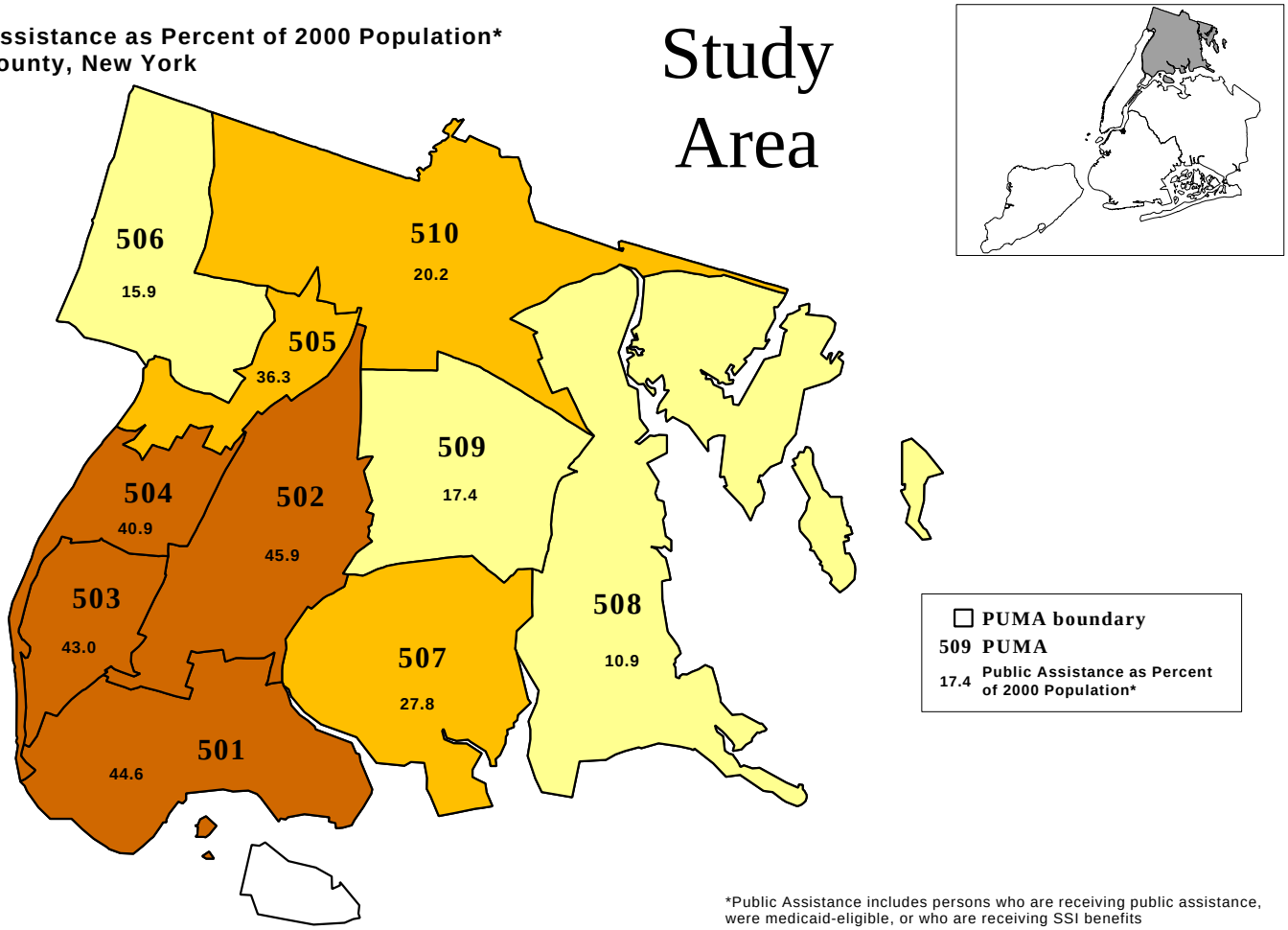
Map 1
Public Assistance as Percent of 2000 Population*
Bronx County, New York



*Public Assistance includes persons who are receiving public assistance, were medicaid-eligible, or who are receiving SSI benefits

Figure 1 – Mail Return Rates

Bronx, NY PUMAS

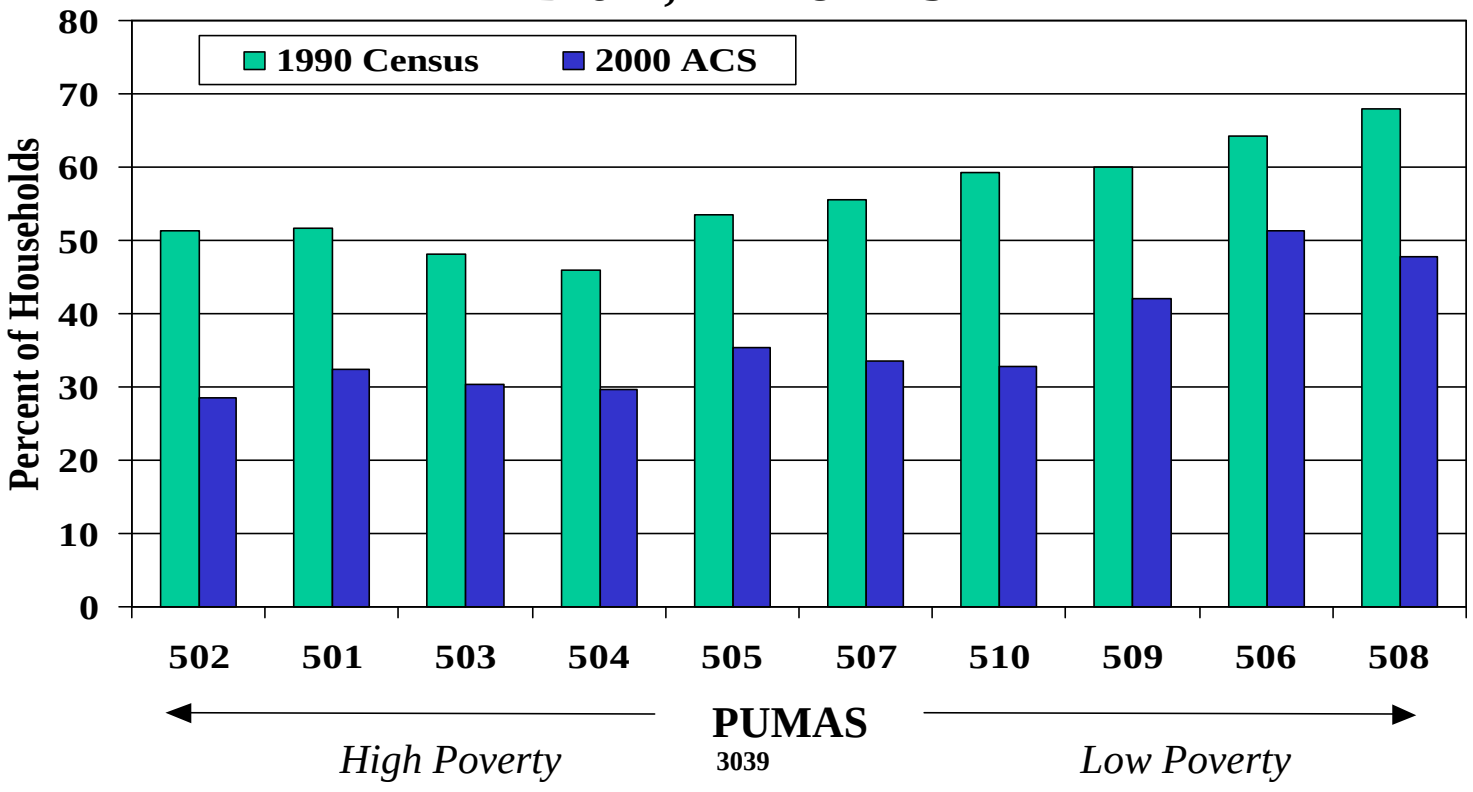


Figure 2A – Percent "Unacceptable"

By Mode of Data Collection, Bronx, NY

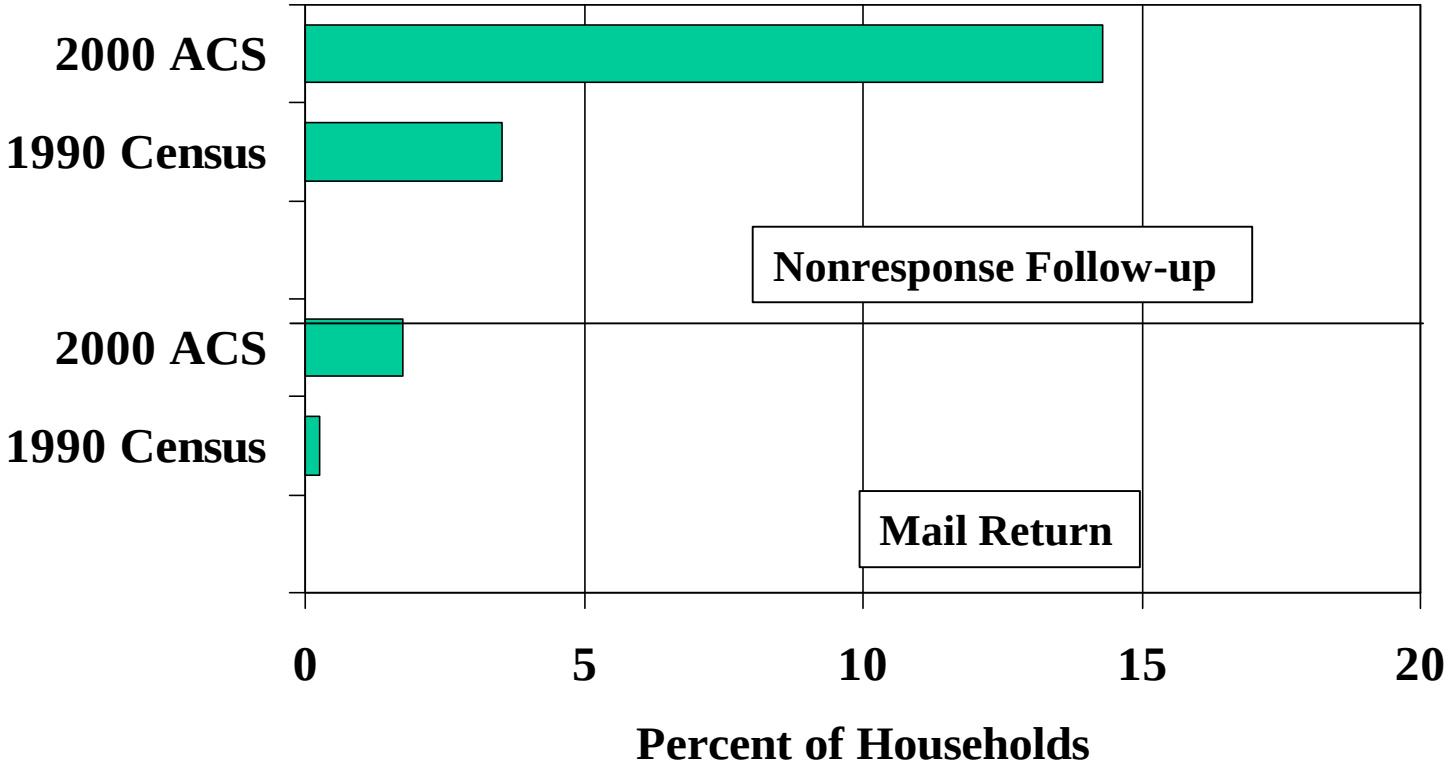


Figure 2B – Percent Not SDD

By Mode of Data Collection, Bronx, NY

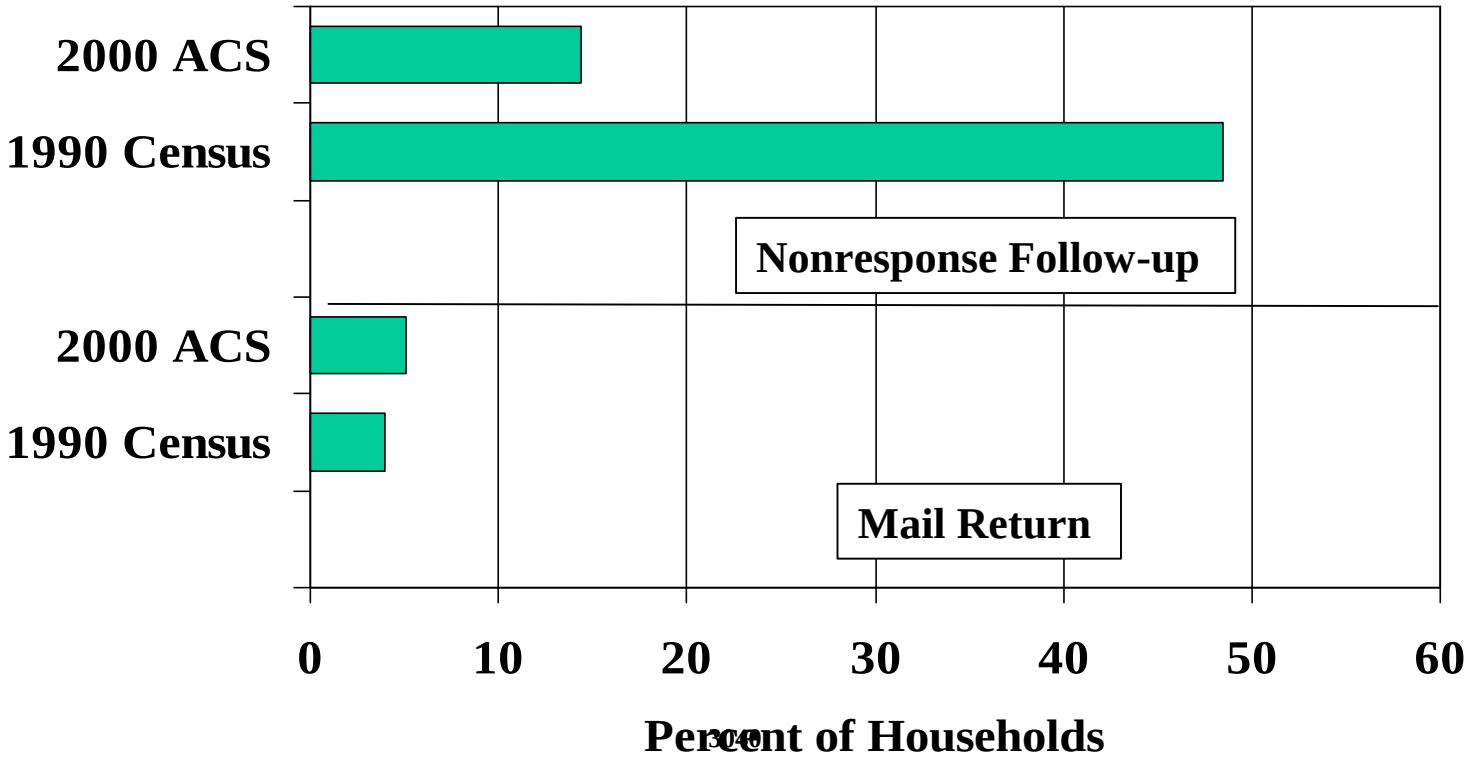


Figure 2C – Sample Data-Defined Households

By Mode of Data Collection, Bronx, NY

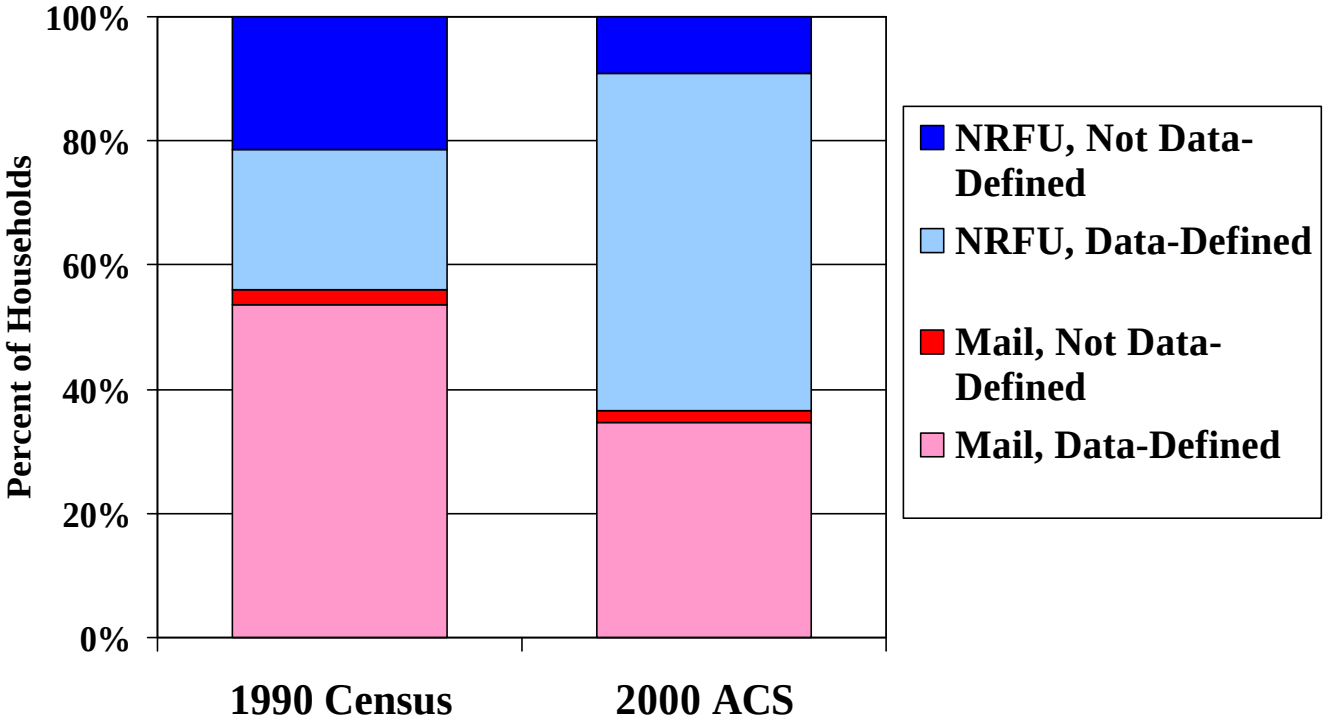


Figure 2D – Sample Data-Defined Households

By Mode and Poverty Level, Bronx, NY

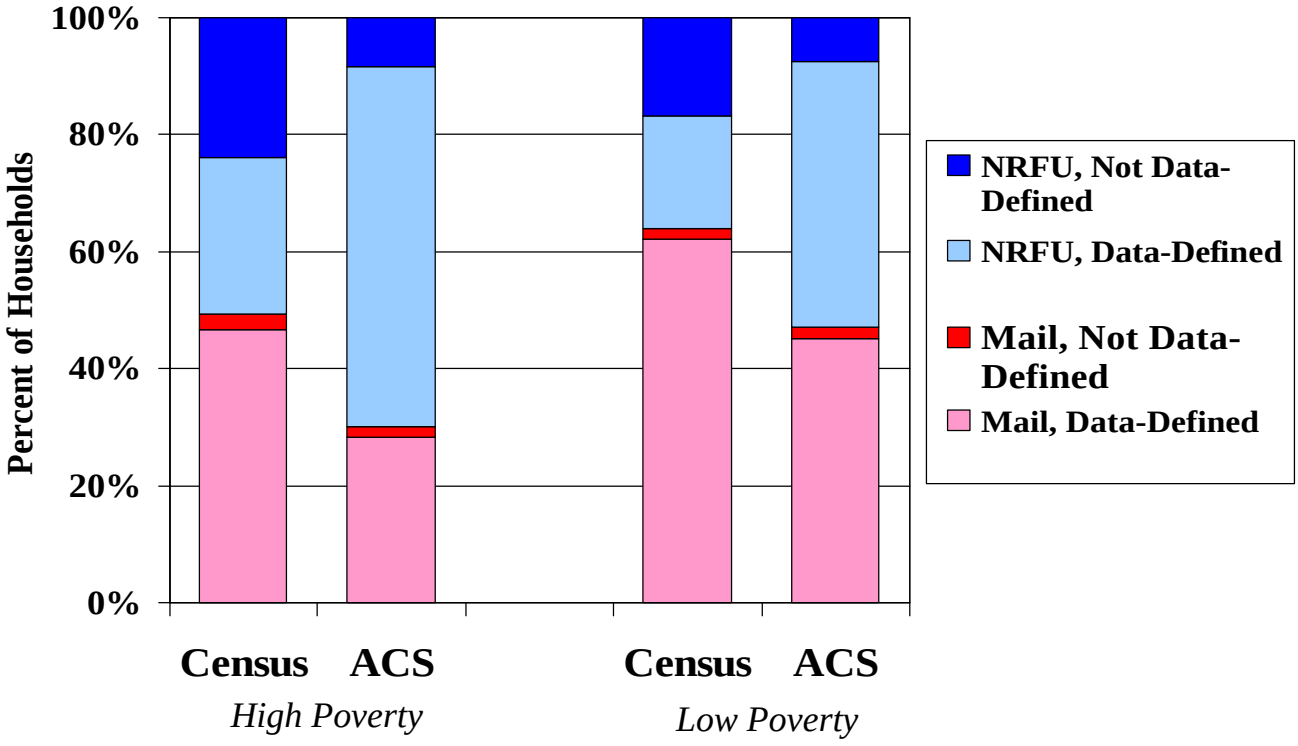


Table 1
Percent Allocated for Selected Variables by Mode of Data Collection*
Bronx, New York
1990 Census and 2000 American Community Survey (ACS)

	Total			Self-Response			Enumerator Response		
	ACS	Census	ACS-Census	ACS	Census	ACS-Census	ACS	Census	ACS-Census
Occupation	14.2	21.8	-7.6	21.2	17.3	3.9	9.4	33.1	-23.6
Wages	17.9	19.2	-1.3	19.9	15.1	4.9	16.5	29.0	-12.5
Public Assistance	11.7	17.9	-6.2	22.8	13.9	8.9	4.5	27.2	-22.7
Birthplace	7.1	14.6	-7.5	11.5	10.4	1.1	4.6	23.8	-19.2
Mobility	5.7	12.8	-7.1	11.5	8.4	3.1	2.2	22.6	-20.3
English Ability	5.6	10.3	-4.7	11.4	8.1	3.3	2.5	14.8	-12.2
Units in Structure	2.3	3.7	-1.4	2.8	3.4	-0.6	1.9	4.5	-2.5
Rent	3.7	2.2	1.5	2.7	1.5	1.2	4.3	3.6	0.7

* Data from the 1990 Census are for long-forms only

Source: U.S. Census Bureau

From Salvo and Lobo, "The American Community Survey: Quality of Response by Mode of Data Collection in the Bronx Test Site"

Table A-1
Selected Characteristics of Bronx PUMAS
Bronx, New York
2000 ACS and Administrative Data on Public Assistance Recipiency

	2000 ACS Data						Administrative Data
		Percent of Population					
	Total Population	Black Nonhispanic	Hispanic	Foreign Born	Percent Owner-Occupied Households	Percent of Families with Income Below Poverty Level	Percent of 2000 Population receiving PA, MA or SSI*
Total	1,285,415	30.8	49.2	28.6	20.8	27.5	31.0
PUMA:							
501	117,625	24.4	73.1	22.0	7.3	49.3	44.6
502	125,391	35.6	59.1	20.4	9.1	38.1	45.9
503	135,890	37.4	56.3	32.9	7.5	40.3	43.0
504	120,820	30.4	65.4	34.2	5.0	43.3	40.9
505	131,476	16.6	63.7	37.2	8.5	27.3	36.3
506	93,052	13.1	34.1	32.8	28.4	11.6	15.9
507	173,880	29.8	57.4	22.9	21.2	25.5	27.8
508	122,170	25.7	26.4	14.5	45.0	10.3	10.9
509	114,967	20.0	35.7	32.1	31.2	12.9	17.4
510	150,144	63.5	19.3	37.9	37.1	16.6	20.2

* Persons receiving public assistance (PA), were medicaid-eligible (MA) or were receiving supplemental security income (SSI).

Sources:
2000 American Community Survey
New York City Human Resources Administration
New York City Department of City Planning