Evaluating the Age Dimension at the PUMA Level in the Three-Year Estimates from the American Community Survey

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Abstract
This research examines the utility of age/sex distributions below the county level in Bronx, New York. The focus is on the county's 10 Public Use Microdata Areas (PUMAs), areas with a population of at least 100,000. While the ACS controls by age, sex, race, and Hispanic origin are determined at the county level, they are used uniformly across potentially heterogeneous PUMAs within the county. An important issue in a heterogeneous county is whether county controls reflect nonresponse among individual PUMAs. The key question examined is whether the age/sex distributions that are a product of this process are useful at the PUMA level. We also examine the validity of ACS public assistance recipiency by age at the PUMA level using administrative data on recipients and assess the reliability and utility of selected ACS variables by age/sex. We conclude that sub-county controls should be pursued in the ACS, especially in counties that exhibit high levels of heterogeneity, since they would benefit from weights based on PUMA-specific attributes. More indirectly, the weighting for nonresponse and other issues would more closely reflect the PUMA itself and not the overall county totals. Understanding the improvements that would result from such actions needs to be high on the Bureau's research agenda for the ACS, as we move forward.

Key Words: ACS population controls, age/sex distribution, sub-county controls.

1. Introduction

There has been much research on the viability of the ACS as the new source of socio-economic data for the nation. A more limited number of studies have focused on the validity, reliability, and overall usefulness of small area estimates based on data from ACS test counties for small governments, neighborhoods, and census tracts (Salvo et al., 2004, 2007; Gage, 2007; Swanson and Hough, 2004; Van Auken et al., 2004). However, when it comes to age and sex (age/sex), most discussions have been confined to the Census Bureau's population estimates program, given the fact that age/sex are used as controls for the ACS at the county level. This research examines the utility of the 2005-2007 ACS multi-year age/sex distributions below the county level, with the focus on Bronx County in New York City and its 10 Public Use Microdata Areas (PUMAs), which are sub-county areas with a population of at least 100,000.

2. Objectives and Data Sources

While ACS controls by age, sex, race, and Hispanic origin are determined at the county level, they are used uniformly across PUMAs within a county that may be potentially heterogeneous racially, ethnically, and economically. Thus, at the PUMA level, estimates are largely driven by the ACS survey and influenced by county controls only to the extent that PUMA geographies need to aggregate up to the county level. An important issue in a heterogeneous county is whether county controls reflect nonresponse among individual

PUMAs and whether the age/sex distributions that are a product of this process are useful at the PUMA level.

This paper's primary objective is to evaluate the age/sex distribution by PUMA and the age/sex distribution for key characteristics. It first evaluates the age/sex distribution for the total population. It then examines the validity of the public assistance variable and assesses the age distribution of public assistance at the PUMA level, using administrative data on recipients. Finally, it examines the reliability of selected socioeconomic variables, again focusing on their age/sex dimension.

Data for these analyses come from three sources: the 2005-2007 ACS, the 2000 decennial census, and local administrative data on births, deaths and public assistance recipients. In addition, data from New York City's ongoing population projections program are used as points of comparison with the 2005-2007 ACS age/sex distributions.

3. Evaluating Age/Sex Distributions at the PUMA Level

3.1 Deriving an Independent Estimate Using a Cohort-Component Model

ACS age/sex estimates by PUMA were first compared to age/sex estimates from a cohort-component model. This model used fertility and mortality rates from 1999-2001, and the 1990-2000 migration experience, to move the population forward by age/sex from 2000 to 2006, the mid-year comparison point for the 2005-2007 ACS.

There were three stages in the creation of these 2006 cohort-component estimates:
· Adjusting for population undercount & removing the group quarters population;
· Creating the baseline – fertility, mortality, and migration rates by age/sex;
· Calibrating the baseline estimates to the 2005-2007 ACS PUMA population by sex.

3.1.1 Adjusting for Undercount and Removing the Group Quarters Population

Reasonable estimates of population change can only be obtained when errors in census coverage are relatively constant from one census time point to the next. Therefore, before assessing change from 1990 to 2000, we had to evaluate census undercount for both time points. Indeed, since the Bronx undercount for 1990 was high (58,000 persons or 4.8 percent), compared to a negligible number for 2000, reported growth over the period related to migration was likely to be overstated. In order to determine the real contribution of migration, it was necessary to adjust the 1990 population upward to correct for the undercount.[1] We also followed the common practice of initially removing those in group quarters from the general population and placing the same number back in after the estimation was completed.

3.1.2 Creating the Baseline

Fertility – So as not to subject births to any one-year anomaly, we averaged births in 1999, 2000, and 2001 and calculated age-specific rates based on the 2000 population. Birth data were obtained from the New York City Department of Health and Mental Hygiene, while population data by age were from the decennial census.

Mortality – In order to project deaths into the future, we averaged deaths occurring in 1999, 2000, and 2001 to calculate age-specific death rates based on the 2000 population. Data on deaths were obtained from the New York City Department of Health and Mental Hygiene, while population data by age were from the decennial census. These age-specific death rates were then used as the foundation for a life table that calculated survival rates by age. These rates represent the percentage of persons who are likely to survive over the next five years. This cohort-component model actually uses rates that are age- *and* sex-specific, permitting us to derive estimates by age/sex.

Migration – Age-specific migration rates were calculated by applying survival rates to the 1990 adjusted decennial census household population for five year intervals, then subtracting that result from the mid-year estimate (the average population of 1990 and 2000). The difference between the two is the total number of net migrants by age for that five year interval. Assume, for example, a 1990 population of 20-24 year olds totaling 5,000 and a mid-decade estimate of 25-29 year olds totaling 5,500. If the population of 20-24 year olds was survived 5 years resulting in a population of 4,900 25-29 year olds in 1995, this would imply a net inflow of 600 from 1990-1995. Net migrants were divided by the initial population to create age-specific migration rates for 1990-1995 and 1995-2000, and then averaged to arrive at the rate for the entire decade.

3.1.3 Calibrating results to the ACS PUMA population by sex

Using the baseline rates and the 2000 Census as a launch point, 2005 age/sex estimates were created by PUMA and then extrapolated to 2006 (baseline estimates). For 5 out of the 20 total PUMA male and female estimates, the ACS and baseline estimates were significantly different. Since our focus was on age/sex groups and not on the total PUMA population, we adjusted PUMA crude migration rates by sex so as to have the 2006 total baseline population for males and females in each PUMA match the 2005-2007 ACS estimates. We chose to adjust migration, as opposed to fertility or mortality, since the latter components are reasonably accurate, and thus migration accounts for most of the difference between the ACS and DCP estimates. By adjusting the crude migration rate, and not selected age-specific migration rates, the baseline pattern of migration is maintained though the level is adjusted. For most PUMAs, the adjusted PUMA age/sex estimates aggregate almost exactly to the ACS PUMA total.

3.2 Comparing ACS Age/Sex Estimates with Cohort-Component Estimates

The number of persons in the ACS survey is controlled to estimates by age/sex and race/Hispanic origin at the county level. At the PUMA level, however, estimates vary as a function of the survey sample itself and the weighting that is employed to adjust for the limitations of the sample, especially with respect to nonresponse. To evaluate overall ACS population estimates by age/sex at the PUMA level, we compare them to the independently derived DCP estimates. Special attention is given to two age/sex groups: males and females 0 to 4 and those 65 years of age and over.

3.2.1 Overall

We divided up the population into five age groups for males and females in each of the 10 Bronx PUMAs: 0-4, 5-19, 20-44, 45-64, and 65 and over. Of the 100 age/sex estimates across the 10 PUMAs, there were 27 significant differences between the ACS and DCP estimates. Table 1 presents summary statistics – mean absolute differences and mean absolute percent differences – for each age/sex subgroup in the ACS vis-à-vis DCP estimates. For females, the percent difference for 20-44 year olds was smallest, while the differences in estimates for those 0 to 4 years (11 percent), and for those 5 to 19, and 65 and over were the largest (7 percent). Among males, the smallest percent difference was also among 20 to 44 year olds, and the highest percent difference (10 percent) was among those 5 to 19 years of age. In fact, among males 5 to 19, 6 out of the 10 PUMAs in the Bronx showed statistically significant differences.

3.2.2 Persons 0 to 4 Years of Age

Figure 1 shows the population ages 0 to 4 by sex from the 2005-2007 ACS estimates, the 2006 baseline estimates, and the 2006 DCP estimates. The baseline and DCP estimates for the 0 to 4 populations were very similar, so we focus on just the DCP and ACS estimates. For the 10 PUMAs, there were 20 ACS estimates of the 0 to 4 population by sex, and 4 estimates were significantly different from the DCP estimates. We focus on these differences and explain why we think the DCP estimates are more accurate. Even when differences between the ACS and DCP estimates were not statistically significant, the ACS sex ratios were substantially different from three other points of comparison: the 2000 Census full count data, sex ratios based purely on births over the 2001-2006 period, and the 2006 DCP estimates. The skewed ACS sex ratios lend greater credence to the DCP age/sex estimates.

In PUMA 3701, the ACS estimate of males 0 to 4 was virtually identical to the DCP estimate. The ACS estimate for females 0-4, however, was significantly higher, a difference of 18 percent. This results in an abnormally low sex ratio of 87 for this age group in the ACS. It is likely that females in this PUMA are overestimated in the ACS, since the ACS and DCP estimate for males are nearly identical. The reverse was true in PUMA 3705, where the ACS male estimate was significantly higher (14 percent) than the DCP estimate, while there was no significant difference among females. Thanks to the higher estimate of males, the sex ratio stood at 113 in the ACS, compared to DCP and census sex ratios of 102.

In PUMA 3702, the ACS population 0-4 for both sexes is significantly different from the DCP estimates, the only PUMA where this occurs. The ACS estimate for females was 21 percent higher than the DCP estimate (5,344 vs. 4,408), while it was 48 percent higher for males (6,906 vs. 4,653). The exceedingly high ACS estimate for males results in an implausible sex ratio of 129, compared to 106 using DCP estimates, and 105 in 2000. (The DCP estimate for males shows a decline in this population from 2000 – primarily a result of net out-migration of this group – while the ACS shows net inflows,[2] which results in a dramatic one-third increase in this age group, the highest of any PUMA.)

In PUMA 3703, the ACS estimate for males is unchanged from 2000, but the estimate for females is 23 percent lower; DCP estimates are 6 percent and 8 percent lower, respectively. The dramatic decline in females in the ACS leads to a sex ratio of 132, compared to 104 using the DCP estimates, and 102 in 2000. The CV (or coefficient of variation, which is the standard error of an estimate percentaged on the estimate) for females in the ACS is a relatively high 16, compared to 12 for males. However, differences between the ACS and DCP estimates were not statistically significant. On the other hand, in PUMAs 3708 and 3709 sex ratios in the ACS were over 11 points lower vis-à-vis DCP, but again there were no significant differences in the population estimates.

3.2.3 Persons 65 Years and Over

Population projections to 2030 performed by the Population Division of the New York City Department of City Planning show that the aging of large baby boom cohorts, a decline in fertility, and improvements in life expectancy will all contribute to a general aging of the population in the Bronx. However, in the first decade of this century, these projections show that the elderly population in the Bronx will decline slightly, from 133,900 in 2000 to 132,700 in 2010, but then rise to 172,700 in 2030. For Bronx elderly males, the population ages 65 and over stood at over 48,800 in 2000 and the 2005-2007

ACS estimate indicates that this population increased 9 percent, to 53,000, while the DCP projection shows this population declined 2 percent, to 47,800. Among females as well, ACS estimates show a post-2000 increase of 5 percent, while DCP projections show a 4 percent decline. Thus the elderly population for the Bronx as a whole in the ACS is significantly different from DCP projections. This is a result of DCP estimates using a net out-migration for this group (-68 per 1,000 for males, -82 per 1,000 for females), which is consistent with the experience of the 1990s), while the ACS estimates a net in-migration for this age group (12.3 for males and 47.8 for females).

Of the 20 PUMA level age/sex ACS estimates for the population 65 and over, 6 were significantly different from DCP estimates (Table 1 and Figure 2). The overall Bronx pattern, with DCP estimates projecting a post-2000 decline, and ACS estimates reflecting growth, can be seen in PUMA 3703. As a result, the ACS estimates are significantly higher than DCP projections – by 15 percent for males and 12 percent for females. A similar pattern for males is seen in PUMA 3706 – the ACS estimate is 16 percent higher than the census, compared to an 8 percent post-2000 decline in the DCP estimate. Among females in PUMA 3706, the ACS is 1 percent lower than the census, compared to a post-2000 DCP decline of 14 percent. As a result, the ACS estimates in PUMA 3706 are significantly higher than DCP, for both males and females 65 and over. In PUMAs 3704 and 3709, the ACS estimates for females 65 and over are also significantly higher from the DCP estimate. In PUMA 3704, the ACS indicates post-2000 growth of less than 1 percent, compared to a DCP decline of 20 percent; in PUMA 3709, the ACS shows post-2000 growth of 20 percent, while DCP shows a decline of 13 percent.

Assuming that vital statistics data are accurate for these PUMAs, it is instructive to take a look at the migration scenario posited by the ACS and DCP in PUMAs where these estimates differ. With just one exception, DCP has net out-migration in every PUMA for both males and females ages 65 and over. However, the ACS has net gains in this cohort in PUMAs 3701, 3703, 3704, and 3705 for males, and PUMAs 3701, 3703, 3704, 3706, and 3709 for females. Moreover, as noted earlier, when all these values are aggregated, the Bronx net migration patterns for those 65 and over trend positive for the ACS, in direct contrast to the negative DCP rates.

3.2.4 Percent Distributions by Age/Sex

While differences in absolute terms are important, it is equally essential to examine the *relative* share of age/sex groups at the PUMA level. Indeed, the ACS encourages users to focus on percent distributions, as opposed to absolute numbers. Table 2 examines the share by sex for the five broad age groups used in this analysis. For the Bronx overall, the ACS numbers have a small degree of sampling variability, but the comparison with DCP estimates is essentially between controls from the population estimates program at the Census Bureau and the DCP population estimates. For the most part, differences are in the range of one percentage point. Once again, the 5 to 19 year old males stand out, with a difference of 2.5 percentage points. Thus, the large absolute difference between the estimates, cited earlier, manifests itself in the form of a sizable difference in the percentage in this age group.

In addition to the overall age/sex percent distributions in the Bronx for the ACS and DCP estimates, Table 2 also shows the 100 age/sex distributions for its 10 PUMAs. There were significant differences in every PUMA and significant differences in 41 of the 100 age/sex groups.[3] Considering the size of these PUMAs, a difference of just a few percentage points in an age group represents a potential shift of several thousand people.

Of the 41 significant age/sex differences between the ACS and DCP, 24 were 2 percentage points or greater, including 10 that were 3 percentage points or greater. Once again, it is the 5 to 19 year old males who stand out the most, where 12 of the PUMA differences were statistically significant, including 5 that were 3 percentage points or more. Thus, even when the focus is on age/sex percent distributions, there are significant differences between the ACS and DCP.

4. EXAMINING THE VALIDITY OF PUBLIC ASSISTANCE RECIPIENCY BY AGE/SEX AT THE PUMA LEVEL

While earlier work has examined the reliability and validity of ACS public assistance data for the Bronx (Salvo et al., 2007), comparisons have neither been done at the PUMA level, nor by age of recipients. This section gauges the validity of ACS public assistance data by PUMA, focusing on the age dimension.

Administrative records on persons receiving public assistance were obtained from the New York City Human Resources Administration; these records were geo-coded to census tracts and then aggregated to the PUMA level. To get data comparable to the ACS 2005-2007 period, administrative data were averaged over the 2004-2007 period.

Our earlier work (Salvo et al., 2007) showed that the ACS understated the level of public assistance recipiency. This was also true for the 2005-2007 period, where the ACS estimated 48,000 persons ages 19 and over receiving public assistance in the Bronx, 54 percent lower than the 104,000 persons in the administrative records (top half of Table 3). The ACS understated the level of public assistance recipiency across *all* PUMAs, rich and poor, with the ACS estimates being lower by between 42 percent and 59 percent of the administrative counts. With only two exceptions – among those ages 45 and over in PUMAs 3703 and 3704 – there were significant differences between the ACS and the administrative data across all age groups in each PUMA.

There were also significant differences between the ACS and administrative data with respect to an age group's share of public assistance in a PUMA (bottom half of Table 3). The ACS was much more likely to underreport young persons receiving public assistance compared to their older counterparts. For the Bronx as a whole, the ACS reported that those between the ages of 19 and 24 comprised 8 percent of public assistance recipients, compared to more than twice that (18 percent) in the administrative data. These differences occurred across PUMAs, and in 8 of out 10 PUMAs these differences were significant.

5. ASSESSING THE RELIABILITY OF SELECTED ACS VARIABLES BY AGE AT THE PUMA LEVEL

Given that PUMAs have a minimum population of 100,000 and that we are dealing with 3 years of aggregated ACS data, we expect ACS estimates to be reliable at the PUMA level. However, the primary focus in this section is to examine how reliable these PUMA estimates are for selected age/sex groups. Data from both the full 2005-2007 ACS sample and Public Use Microdata Sample (PUMS) are explored. The 2005-2007 full sample is substantially less than the 9 percent the ACS hoped to start out with (National Research Council, 2007), further reduced by the high level of nonresponse in the Bronx and follow-up of only a subset of nonrespondents. Similarly, the 2005-2007 ACS PUMS for the Bronx is less than the best case scenario of a 3 percent sample. To measure the reliability of estimates that differ in size, we use the CV as a standardized measure of reliability. In general, we consider CVs of 15 percent to signal problems with reliability, though a higher CV may be considered acceptable depending on how the estimates are being applied. We begin with a survey of selected socioeconomic variables from the 2005-2007 full sample.

Seven detailed tables from American FactFinder were selected, showing socioeconomic characteristics subdivided by age/sex dimensions (Table not shown). The data are examined for Bronx PUMAs and estimates, and CVs presented are an average of the 10 Bronx PUMAs. The results show that PUMA level estimates by age/sex from the 2005-2007 ACS full sample are generally reliable. For example, the average PUMA CV for native-born females 18 and over was 2.9, workers 20 to 24 years old that used public transportation for their commute had a CV of 11.4, while 35 to 44 year old females that had a bachelor's degree had a CV of 11.7. Only when the frequency of an attribute measured was low did CVs become large enough to make the estimates unreliable. These small populations included foreign-born females under the age 18 (average PUMA CV of 24.2), 15 to 19 year old married women (74.5), 5 year old females living below poverty (56.7), and median household income for householders under 25 (17.1).

Although the tables provided through the full sample in American FactFinder usually have low CVs, these tables may not include the age breaks or other detail that may be required. In these cases the PUMS dataset can be employed. Unfortunately, since the PUMS sample is roughly one-third the size of the full sample, the general precision seen in full sample estimates drops when switching to the ACS PUMS. This can be seen in Table 4, which examines females by nativity and citizenship status for two different age groups and data sources: for those 18 years and over, we use full sample data, while data for those 25 to 44 come from the PUMS. The PUMS data, for a narrower age band, produced CVs that were much higher than those from the full sample. Still, estimates produced from the ACS PUMS are often reliable, as seen in Table 4, where only two CVs exceed our 15 percent threshold.

While 2005-2007 data from the full sample and PUMS are usually reliable enough to explore age/sex dimensions, changes in the phrasing of survey questions can produce smaller samples that make ACS data much less reliable, especially compared with census data. One such example is the migration question. The ACS questionnaire asks where the respondent lived "1 year ago," as opposed to the 2000 Census questionnaire which asked where respondents lived "5 years ago." The 1 year question results in smaller in-migrant populations in the ACS, larger CVs, and decreased data reliability. Table 5 compares ACS and Census CVs for in-migrant populations subdivided by age, race, and education. While the PUMS file from the ACS is smaller than that from the census (roughly 3 percent vs. 5 percent), CVs in the ACS are over four times larger for in-migrant subgroups. The impact on data utility is dramatic. Whereas half of the Census estimates have CVs below the 15 percent threshold, not one of the ACS estimates can be considered reliable. Even the overall ACS estimate for in-migrants has an average PUMA CV of 34, making it fairly unreliable, while the estimates for every subset of in-migrants are even less reliable.

6. DISCUSSION & CONCLUSION

Age/sex in the ACS are estimates that are derived at the county level and used as controls, making them a cornerstone of the survey. Age/sex estimates affect analyses of key socioeconomic attributes, like income by source, education, and migration, since they are better understood when stratified by age/sex. Given the pivotal role of age/sex data, imprecise ACS age/sex estimates can affect the representativeness of the whole socioeconomic package of variables in the survey. Since we already know that differences in response vary by age/sex, race and Hispanic origin, the role of independent controls is critical in the formation of weighting adjustments to compensate for nonresponse. While never perfect, the use of controls not only enhances the reliability of estimates, but it also compensates for differences in response that would likely render the data unrepresentative in many counties of the nation.

Of course, the degree to which the controls act to curb problems with response is a function of how well the independent estimates used in the ACS actually represent the survey universe. The standard we have chosen here consists of population estimates using a cohort-component method that used the 1990 to 2000 migration experience, and fertility and mortality schedules from the 1999-2001 period, to move the population forward by age/sex from 2000 to 2006 for the 10 PUMAs in the Bronx.

We have confidence in the use of a short-term cohort-component methodology as a standard in this analysis. With the exception of catastrophic events that may cause a sudden displacement of population, changes in the number and distribution of persons by age/sex are usually gradual over time. This is especially the case here, given the fact that the population estimates that serve as our standard are just six years out from the 2000 Census. It is reasonable to argue that differences are to be expected and that some of these differences may represent the relative advantage that the ACS has of actually surveying the “current” population of Bronx PUMAs. It may be that the ACS is measuring change that the cohort-component model cannot detect because the projection is based on a set of obsolete assumptions. So how do these ACS estimates compare with the DCP estimates?

Since we combined the estimates of males and females each into 5 age groups (0-4, 5-19, 20-44, 45-64, and 65 and over), there were 100 age/sex estimates across 10 PUMAs – for 27 of these age/sex estimates, there were significant differences between the ACS and DCP. Differences among males 5 to 19 years of age are especially a cause for concern because the results are so consistent, with the ACS understating males in this age group in 6 of the 10 PUMAs; among females, the ACS significantly understated this age group in 3 PUMAs. Even when PUMA differences were not widespread, as in the case of 0 to 4 year olds, the skewed ACS sex ratios do not inspire confidence. Among those ages 65 and over, ACS PUMA estimates often imply a migration scenario at odds with patterns of the very recent past. When age/sex percent distributions were examined, there were significant differences in 41 of the 100 age/sex groups, including 10 PUMA differences that were 3 percentage points or greater.

Are the age/sex data in the ACS for 2005-2007 acceptable at the PUMA level, based on a comparison with the DCP estimates? The answer varies depending on the application at hand. For example, in terms of differences across PUMAs, ACS age/sex data are more than adequate to compare populations in the north and south Bronx. Or if the focus is an age/sex percent distribution within a PUMA, most percent differences between the ACS and DCP were 2 percentage points or fewer, a difference that may still deliver a useful portrait of the area. On the other hand, if one is in charge of a program that serves the population of young people in a neighborhood where absolute numbers matter, the differences between ACS and the DCP estimates can have a serious effect. While the ACS program emphasizes that users focus on percent distributions, most users are likely to use absolute values.

Given that the ACS age/sex estimates were often at odds with DCP estimates, it was interesting to focus on public assistance, where we had excellent administrative data, to not only test the validity of public assistance in the ACS, but to also to examine how this plays out by age.

Past research comparing administrative records to ACS one-year and multi-year averages showed that the ACS understates public assistance recipiency. The results of this study reaffirm this finding with the 2005-2007 three-year averages, with the ACS level of recipiency at less than one-half the level found in the administrative records. The ACS understated the level of public assistance recipiency across *all* PUMAs, whether rich or poor, but the ACS PUMA level estimates varied from between 42 percent to 59 percent of the administrative counts. The ACS PUMA picture of recipiency is consistent with the administrative records, with the north Bronx communities showing far lower recipiency than their south Bronx counterparts. However, differences in reporting of public assistance income varied significantly by age, with 19-24 year olds significantly less likely to report than those in the older age groups. Because this finding was consistent across most PUMAs, the effect on the age distributions across PUMAs is fairly uniform, once again maintaining a relative picture of differences between areas with high recipiency and those with low levels.

However, when the focus is on a single PUMA, the underreporting among the youngest age groups could be problematic. For programs aimed at curbing the level of public assistance recipiency, the actual number of persons who are receiving benefits by age is important, since programmatic responses are often based on the life-cycle position of recipients. Moreover, we cannot judge whether the ACS age/sex estimates have had an impact on differential public assistance recipiency by age.

For the variables examined by age at the PUMA level, the three-year averages generally provide a strong basis for examining characteristics of the population. In the absence of any administrative data to check the veracity of the data, we confined our analysis to an examination of CVs for data items. The key question concerns whether the three-year averages provided a large enough sample to examine key characteristics by broad age group at the PUMA level to inform local decision making. The answer is generally "yes." Estimates for educational attainment, migration and poverty by age generally had acceptable CVs that permitted meaningful distinctions by broad age group.

From the standpoint of reliability and representativeness, the litmus test for controls is not whether they make the data perfect, but whether they make the estimates better. It is likely that the use of appropriate controls at the county level reduces the volatility of estimates and helps compensate for differences in response by age/sex, race and Hispanic origin. At the PUMA level, however, the capacity of county controls to reduce sampling variance and the bias associated with differential nonresponse may be more limited, at least from this examination of the ACS data. Counterintuitive changes in the age groups and sex ratios at the PUMA level when compared with data from the 2000 Census enumeration, suggests that weighting adjustments that occur as a result of the implementation of county controls may fail to compensate adequately for differences between PUMAs. This is especially true in the Bronx, where PUMAs differ markedly in their age/sex distributions and in their socioeconomic characteristics. It would be extremely difficult for any weighting adjustments that are county-based to compensate fully for biases that result from nonresponse in specific PUMAS. Bronx PUMAs have big differences in race, ethnic, nativity, economic and housing characteristics that cannot be captured in a single set of county controls.

Thus, this analysis leads to the conclusion that sub-county controls are required in the ACS, especially in counties that exhibit high levels of heterogeneity, which would benefit from weights based on PUMA-specific attributes. Would estimates of age be enhanced, or could the estimates of public assistance recipients be more complete when employing PUMA level controls? This is a question that the Census Bureau needs to address. From a theoretical standpoint, using PUMA-specific information from the most recent decennial census enumeration would enhance age directly because the enumeration itself is the best gauge of an age distribution. More indirectly, the weighting for nonresponse and other issues would more closely reflect the PUMA itself and not the overall county totals. Understanding the improvements that would result from such actions needs to be high on the Bureau's research agenda for the ACS, as we move forward.

Producing sub-county estimates by age/sex, race and Hispanic origin would be a major undertaking, especially in light of the recent past, when *county* estimates were sometimes questionable. But this formidable challenge needs to be met if the ACS is to be a true replacement for the decennial census long form.

References

Electronic versions of some of the references below are available online at
http://www.census.gov/acs/www/AdvMeth/Multi_Year_Estimates/presentations.html
and at http://www.census.gov/acs/www/AdvMeth/acs_census/report.htm

Gage, Linda. "Thoughts on Using Multi-Year ACS Estimates for San Francisco and Tulare Counties, California." 2007.

Hough, George C., David A. Swanson. "The 1999-2001 American Community Survey and the 2000 Census Data Quality and Data Comparisons Multnomah County, Oregon." 2004.

National Research Council. Using the American Community Survey: Benefits and Challenges. Panel on the Functionality and Usability of Data form the American Community Survey, Constance Citro and Graham Kalton, editors. Committee on National Statistics, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press, 2007.

Salvo, Joseph J., Arun Peter Lobo, Timothy Calabrese. "Small Area Data Quality: A Comparison of Estimates 2000 Census and the 1999-2001 ACS Bronx, New York Test Site." 2004.

Salvo Joseph J., Arun Peter Lobo, Adam L. Willett, Joel A. Alvarez. "An Evaluation of the Quality and Utility of ACS Five Year Estimates for Bronx Census Tracts and Neighborhoods." 2007.

Van Auken, Paul, Roger Hammer, Paul Voss, and Daniel Veroff. "American Community Survey and Census Comparison -Final Analytical Report -Oneida and Vilas Counties, Wisconsin - Flathead and Lake Counties, Montana." 2004.

Endnotes

[1] The age/sex distribution of the undercounted population in the Bronx was not available. At the national level, undercount rates by age/sex were available through demographic analysis, so we employed this distribution to make adjustments to the Bronx population.
[2] We applied our own 5 year survival rates to the 2000 population, then compared the "expected" outcome to the 2005-2007 ACS estimate, interpolated to 2005 (5/6 of change of 2005-2007 value). This gives us net migrants by age and sex for each PUMA.
[3] Generalized standard errors for age percent distributions had to be calculated; for absolute values, these standard errors were published. If standard errors had been calculated for absolute values of age/sex, there would have been 35 statistically significant PUMA differences, instead of the 27 reported in Table 2.

Table 1. Comparing 2005-2007 ACS Age/Sex Estimates
for Bronx PUMAs to DCP Estimates

	Males			Females		
	Mean Absolute Difference	Mean Absolute % Difference	PUMAs with a Significant Difference	Mean Absolute Difference	Mean Absolute % Difference	PUMAs with a Significant Difference
Under 5 years	494	7.9%	2	547	11.0%	2
5 to 19	1,582	9.6%	6	1,136	7.1%	3
20 to 44	706	2.7%	1	862	3.3%	1
45 to 64	791	6.1%	4	803	5.0%	2
65 & over	451	8.1%	2	726	6.9%	4

Table 2. Age/Sex Percent Distributions for Bronx PUMAs: 2005-07 ACS Compared to DCP Estimates

	PERCENT 0 to 4				PERCENT 5 to 19				PERCENT 20 to 44				PERCENT 45 to 64				PERCENT 65+			
	ACS	DCP	Diff.	Sig.	ACS	DCP	Diff.	Sig.	ACS	DCP	Diff.	Sig.	ACS	DCP	Diff.	Sig.	ACS	DCP	Diff.	Sig.
All Males	8.6	8.1	0.5		25.8	28.3	-2.5		37.2	37.3	0.0		20.1	18.9	1.2		8.3	7.5	0.8	
3701	7.0	6.8	0.2		21.6	22.5	-0.9		35.2	36.0	-0.8		23.1	22.5	0.6		13.2	12.2	1.0	
3702	10.2	6.9	3.3	♦	25.9	29.0	-3.2	♦	34.6	35.0	-0.3		20.5	20.5	0.0		8.8	8.5	0.2	
3703	6.1	5.7	0.3		19.4	22.1	-2.7	♦	33.6	33.9	-0.3		25.0	24.8	0.2		16.0	13.5	2.5	♦
3704	6.9	6.9	0.0		21.7	23.7	-2.1	♦	36.9	38.7	-1.8	♦	23.2	21.2	2.0	♦	11.3	9.5	1.8	♦
3705	10.5	9.2	1.3	♦	32.7	33.3	-0.6		35.0	36.0	-1.0		15.9	15.7	0.2		6.0	5.8	0.2	
3706	8.5	9.3	-0.8		25.6	28.2	-2.6	♦	39.6	39.7	-0.2		19.4	17.3	2.1	♦	6.9	5.4	1.4	♦
3707	9.8	9.2	0.7		29.8	31.9	-2.1	♦	36.2	37.6	-1.5		19.4	17.0	2.4	♦	4.9	4.3	0.6	
3708	10.2	9.7	0.5		28.1	29.6	-1.6	♦	37.5	37.3	0.1		18.4	17.6	0.8		5.8	5.6	0.2	
3709	7.9	8.3	-0.4		24.4	29.7	-5.2	♦	40.2	36.0	4.2	♦	19.7	19.1	0.6		7.7	6.8	0.9	♦
3710	7.8	7.8	0.0		26.0	29.0	-3.0	♦	41.6	41.8	-0.2		19.0	16.0	3.1	♦	5.5	5.4	0.1	
All Females	7.3	6.8	0.5		21.8	23.2	-1.4		36.6	37.8	-1.1		22.0	21.0	1.0		12.3	11.2	1.1	
3701	6.9	5.7	1.2	♦	16.7	17.5	-0.8		33.2	34.7	-1.5		24.3	23.2	1.0		18.9	18.9	0.0	
3702	6.5	5.4	1.1	♦	19.2	22.4	-3.2	♦	37.4	36.9	0.5		24.6	23.1	1.4	♦	12.3	12.2	0.1	
3703	3.7	4.5	-0.7	♦	16.0	17.1	-1.1		31.0	31.8	-0.8		26.2	26.5	-0.3		23.0	20.2	2.9	♦
3704	6.0	5.9	0.1		19.4	20.3	-1.0		35.8	37.9	-2.1	♦	21.9	22.5	-0.5		16.9	13.4	3.5	♦
3705	8.2	7.9	0.3		27.0	27.0	0.0		37.3	38.8	-1.4	♦	19.1	17.9	1.2		8.4	8.4	0.0	
3706	7.3	8.1	-0.8		23.6	24.0	-0.3		38.9	41.0	-2.1	♦	20.7	18.7	2.0	♦	9.5	8.3	1.3	♦
3707	8.6	7.6	1.0	♦	25.5	26.9	-1.5	♦	39.2	40.1	-0.9		20.4	19.0	1.4	♦	6.2	6.3	-0.1	
3708	9.6	8.2	1.4	♦	22.4	25.0	-2.6	♦	39.7	39.6	0.1		19.6	18.7	0.9		8.7	8.5	0.2	
3709	7.4	6.9	0.5		19.9	23.5	-3.7	♦	36.5	37.9	-1.4	♦	23.3	22.3	1.1		12.9	9.4	3.5	♦
3710	7.9	7.6	0.4		27.1	26.1	1.0		35.9	38.0	-2.1	♦	20.1	18.9	1.2		8.9	9.4	-0.5	

♦ Significant at a .10 level.

Table 3. Public Assistance Recipiency by Age for Bronx PUMAs: Comparing 2005-2007 ACS with Administrative Data

Absolute Level

	Total, 19+					19 to 24 years					25 to 44 years					45+ years				
			Difference					Difference					Difference					Difference		
	ACS	Admin	Number	Pct.	Sig.	ACS	Admin	Number	Pct.	Sig.	ACS	Admin	Number	Pct.	Sig.	ACS	Admin	Number	Pct.	Sig.
Bronx	47,628	104,154	-56,526	-54.3	♦	3,700	18,380	-14,680	-79.9	♦	27,761	54,517	-26,756	-49.1	♦	16,167	31,257	-15,090	-48.3	♦
3701	1,570	3,285	-1,715	-52.2	♦	112	535	-423	-79.1	♦	717	1,649	-932	-56.5	♦	683	1,101	-418	-38.0	♦
3702	3,017	6,825	-3,808	-55.8	♦	281	1,301	-1,020	-78.4	♦	1,671	3,671	-2,000	-54.5	♦	919	1,854	-935	-50.4	♦
3703	1,226	2,173	-947	-43.6	♦	37	355	-318	-89.6	♦	539	1,120	-581	-51.9	♦	589	698	-109	-15.7	
3704	2,698	4,661	-1,963	-42.1	♦	253	752	-499	-66.3	♦	1,136	2,301	-1,165	-50.6	♦	1,232	1,607	-375	-23.4	
3705	8,622	18,687	-10,065	-53.9	♦	622	3,479	-2,857	-82.1	♦	5,258	9,844	-4,586	-46.6	♦	2,409	5,364	-2,955	-55.1	♦
3706	5,251	9,983	-4,732	-47.4	♦	432	1,720	-1,288	-74.9	♦	2,816	5,303	-2,487	-46.9	♦	1,981	2,960	-979	-33.1	♦
3707	7,485	16,184	-8,699	-53.8	♦	394	2,750	-2,356	-85.7	♦	4,465	8,605	-4,140	-48.1	♦	2,401	4,830	-2,429	-50.3	♦
3708	5,661	13,902	-8,241	-59.3	♦	394	2,398	-2,004	-83.6	♦	3,503	7,151	-3,648	-51.0	♦	1,610	4,353	-2,743	-63.0	♦
3709	5,782	12,207	-6,425	-52.6	♦	279	2,124	-1,845	-86.9	♦	2,975	6,369	-3,394	-53.3	♦	2,411	3,715	-1,304	-35.1	♦
3710	7,647	16,247	-8,600	-52.9	♦	896	2,968	-2,072	-69.8	♦	4,681	8,505	-3,824	-45.0	♦	1,932	4,774	-2,842	-59.5	♦

Distribution by Age

	Total, 19+		19 to 24 years				25 to 44 years				45+ years			
	Pct. of Total		Pct. of Total		Difference		Pct. of Total		Difference		Pct. of Total		Difference	
	ACS	Admin	ACS	Admin	Number	Sig.	ACS	Admin	Number	Sig.	ACS	Admin	Number	Sig.
Bronx	100.0	100.0	7.8	17.6	-9.9	♦	58.3	52.3	5.9		33.9	30.0	3.9	
3701	100.0	100.0	7.1	16.3	-9.1		45.7	50.2	-4.5		43.5	33.5	10.0	
3702	100.0	100.0	9.3	19.1	-9.7	♦	55.4	53.8	1.6		30.5	27.2	3.3	
3703	100.0	100.0	3.0	16.3	-13.3	♦	44.0	51.5	-7.6		48.0	32.1	15.9	
3704	100.0	100.0	9.4	16.1	-6.8		42.1	49.4	-7.3		45.7	34.5	11.2	
3705	100.0	100.0	7.2	18.6	-11.4	♦	61.0	52.7	8.3	♦	27.9	28.7	-0.8	
3706	100.0	100.0	8.2	17.2	-9.0	♦	53.6	53.1	0.5		37.7	29.7	8.1	
3707	100.0	100.0	5.3	17.0	-11.7	♦	59.7	53.2	6.5		32.1	29.8	2.2	
3708	100.0	100.0	7.0	17.2	-10.3	♦	61.9	51.4	10.4	♦	28.4	31.3	-2.9	
3709	100.0	100.0	4.8	17.4	-12.6	♦	51.5	52.2	-0.7		41.7	30.4	11.3	♦
3710	100.0	100.0	11.7	18.3	-6.6	♦	61.2	52.3	8.9	♦	25.3	29.4	-4.1	

♦ Significant at the .10 level.

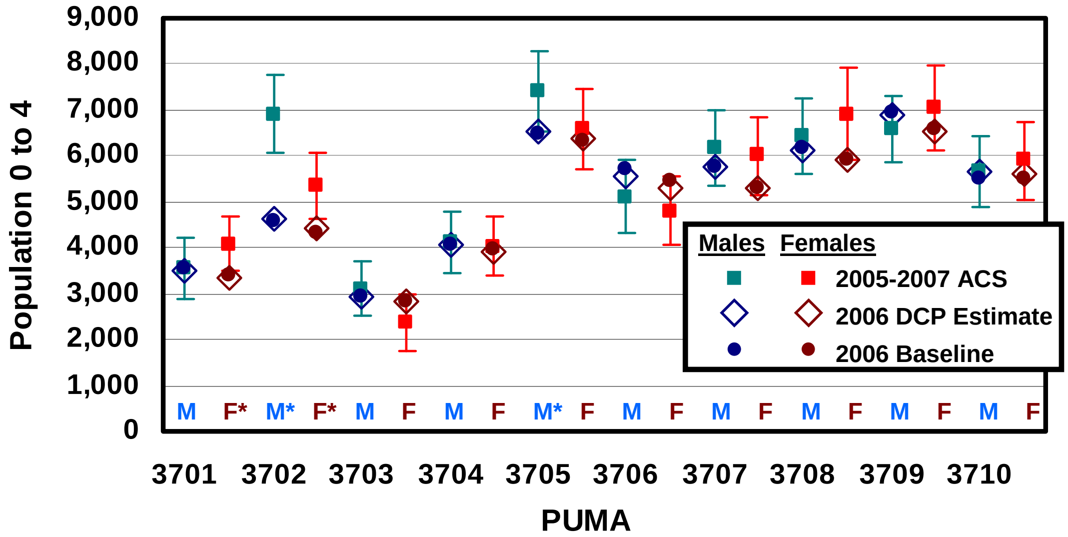
Table 4. Average Bronx PUMA Estimates and Coefficients of Variation for Females by Age,Nativity, and Citizenship Status: Comparing the ACS Full Sample to the ACS PUMS, 2005-2007

	PUMA Average			
	Full Sample - 18 yrs. & over		PUMS - 25-44 yrs.	
	Estimate	CV	Estimate	CV
Females	70,974	2.3	21,478	5.8
Native-born	47,779	2.9	11,823	11.2
Foreign-born	23,195	4.9	9,655	13.0
Naturalized US Citizen	11,230	6.9	3,561	22.5
Not a US Citizen	11,965	7.0	6,094	16.6

Table 5. Average PUMA Estimates and Coefficients of Variation for Selected Characteristics of In-migrants: Comparing the 2000 Census PUMS to the 2005-2007 ACS PUMS

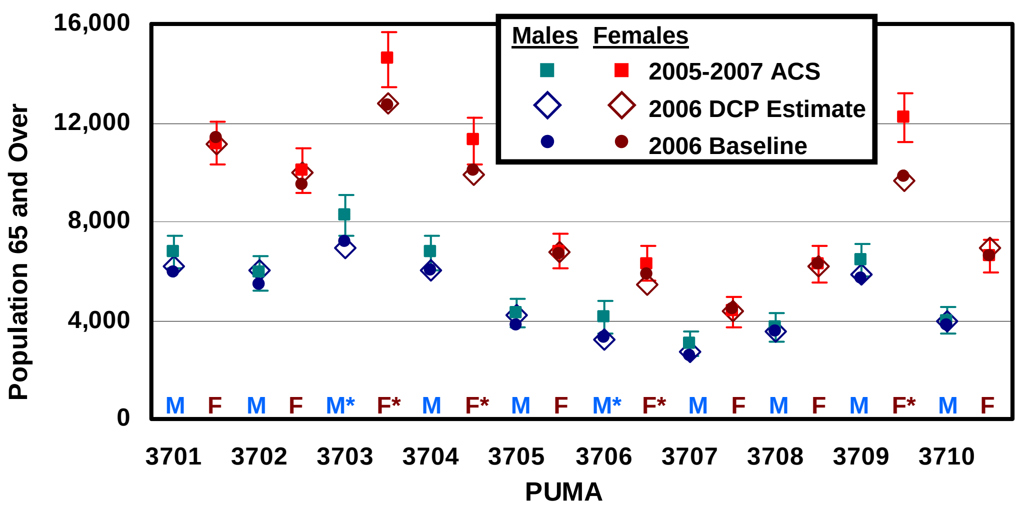
	PUMA Average			
	Census 2000 5% PUMS		ACS 2005-2007 PUMS	
Mutually Exclusive Race	Estimate	CV	Estimate	CV
Total, in-migrants, 5 and over	13,481	7.3	3,122	33.5
White, nonhispanic	2,130	28.0	579	107.2
Black, nonhispanic	3,538	18.3	799	77.0
Hispanic	6,185	13.7	1,475	58.9
Total, in-migrants 25-44 years	5,943	11.5	1,228	53.4
White, nonhispanic	914	41.6	212	184.8
Black, nonhispanic	1,736	26.1	338	123.8
Hispanic	2,539	21.3	585	93.9
Educational Attainment				
Total, in-migrants, 25 and over	8,131	9.6	1,790	44.4
High school graduate or higher	4,978	12.4	1,244	53.5
College graduate	1,687	24.8	395	101.8
Total, in-migrants 25-44 years	5,943	11.5	1,228	53.4
High school graduate or higher	3,898	14.0	953	60.3
College graduate	1,329	27.6	298	115.4

Figure 1. Population 0 to 4 by Sex for Bronx PUMAs: Comparing 2005-2007 ACS Estimates to DCP Estimates



Sex Ratio	3701	3702	3703	3704	3705	3706	3707	3708	3709	3710
2000 Census	103.6	104.5	102.1	103.0	102.6	103.4	106.4	103.6	104.8	99.9
Jul 01-Jul 06 Births	104.7	103.6	107.0	104.4	104.1	104.1	103.3	103.2	102.3	104.5
2006 DCP	104.1	105.5	104.0	103.2	102.3	104.7	108.8	104.0	105.2	100.4
2005-2007ACS	87.4	129.2	131.8	102.2	112.9	106.5	102.5	92.9	93.3	96.0

Figure 2. Population 65 and Over by Sex for Bronx PUMAs: Comparing 2005-2007 ACS Estimates to DCP Estimates



***Difference between the ACS and DCP estimates is significant at the .10 level.**