Demographic Analysis 2010: Estimates of Coverage of the Foreign-Born Population in the American Community Survey

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Abstract

The U.S. Census Bureau produced estimates of net international migration from 2000 to 2010 for the 2010 Demographic Analysis (DA). Foreign-born immigration is a large component of net international migration and is estimated using data from the American Community Survey (ACS). The coverage of recent foreign-born immigrants in the ACS is unknown, and undercoverage may result in an underestimate of foreign-born immigration. Currently, we assume that undercoverage of foreign-born immigrants in the ACS is accounted for through the application of weights and population controls, but the ACS is only controlled by age, sex, race, and Hispanic origin, and not nativity. In this working paper we present results from our research examining the coverage of the foreign-born population in the ACS. Using data from the 1) Census 2000, 2) Accuracy and Coverage Evaluation (A.C.E.) program, and 3) Census 2000 Supplementary Survey (C2SS), we developed coverage factors. In this paper, coverage factors refer to adjustment factors to account for the coverage of the foreign-born population in the ACS. We then applied the coverage factors to annual ACS data from 2001-2009 to produce alternative estimates of foreign-born immigration. The strengths and limitations of this methodology are discussed as well as our overall estimates of coverage of the foreign-born in the ACS.

Introduction

The Demographic Analysis (DA) program at the U.S. Census Bureau used information from vital statistics records and data on international migration to produce estimates of the population on April 1, 2010 by age, sex, and race.[1] Foreign-born immigration from 2000 to 2010 is a large component of net international migration, and is estimated using data from the American Community Survey (ACS). The coverage of recent foreign-born immigrants in the ACS is unknown, and undercoverage may result in an underestimate of foreign-born immigration. Currently, we assume that coverage in the ACS is accounted for through the application of weights and population controls, but the ACS is only controlled by age, sex, race, Hispanic origin, and geography and not by nativity.[2] Since the ACS data cannot be controlled by nativity, there could still be coverage error if there are differences in coverage between the native and foreign-born populations within weighting cells.

The foreign born, especially recent immigrants, are believed to be a hard-to-count group which increases the likelihood of coverage error for this population. In fact, research has shown that English language ability, literacy skills, understanding of the census, residential attachment, and legal status are all factors that contribute to coverage error in censuses and surveys (Fein and West 1988; Iversen, Furstenberg and Belzer 1999; Martin 2007; Massey and Capoferro 2004). Because of data limitations, there have been no studies that empirically measure the coverage of the foreign-born population in the ACS.

This paper presents results from research examining the sensitivity of estimates of foreign-born immigration to alternative assumptions of coverage of the foreign born in the ACS. Using data from the 1) Census 2000, 2) Accuracy and Coverage Evaluation (A.C.E.) program, and 3) Census 2000 Supplementary Survey (C2SS), we developed

[1] For DA, race is limited to two categories, Black and non-Black. For DA 2010, a separate series of estimates was produced by age, sex, and Hispanic origin for the population aged 19 and under on April 1, 2010.

[2] The ACS is controlled to housing-unit and population estimates produced by the Population Estimates Program. These estimates use the most recent census as a base and then account for population change to that base throughout the decade. Because nativity was not included on the short form, or 100-percent items, it cannot be estimated as part of the intercensal population estimates.

indirect estimates of coverage of the foreign born in the ACS (U.S. Census Bureau 2009).[3] These estimates of coverage, or coverage factors, were then applied to data from the 2001 to 2009 single-year ACS files to produce estimates of foreign-born immigration which were used in the 2010 DA high series (Devine et al. 2010). Our main findings show that the coverage factors for non-Hispanics imply close to full representation in the ACS, but for Hispanics, the coverage factors suggest an underrepresentation, particularly for males.

Background

The goal of this project was to produce an upper range of plausible estimates of foreign-born immigration using ACS data for the 2010 DA. Demographic Analysis is a technique that uses administrative and survey data to produce national estimates of the population by age, sex, and race, which are independent of the decennial census being evaluated (Himes and Clogg 1992; Robinson et al. 1993; Robinson, West, and Adlakha 2002; Siegel 1974). The particular analytic method for the DA estimates depends on the sub-group being estimated (Robinson 2011). The first sub-group is the population under age 65 and was estimated using the components of population change: births, deaths, and migration. For the 2010 DA, this population was estimated using historical vital statistics records of births and deaths from 1945 to 2010 from the National Center for Health Statistics (NCHS), and data from the ACS and other sources to estimate international migration (Devine et al. 2010). The second sub-group (population 65 years or older) was estimated using administrative data on aggregate enrollment in the Medicare program.[4] The race classification for DA is limited to the Black and non-Black populations because of limited race detail in the historical vital statistics records. The strength of DA is the relationships between the basic demographic variables and the data used to measure them (Robinson 2011).

[3] The Census 2000 Supplementary Survey (C2SS) was the demonstration phase of the ACS.
[4] A revised middle series of the 2010 Demographic Analysis estimates was issued in May, 2012 in which the cohort-component method was used for the population aged 65 to 74 instead of Medicare-based estimates. This method change was made because research showed that estimates for 65, 66, and 67 year olds not enrolled in Medicare are relatively high (for more information see: http://www.census.gov/popest/research/DA_Methodology.pdf).

The 2010 DA estimates were developed independent of the 2010 Census. It is this quality—independence—that makes the DA estimates a useful tool for evaluating census results. Since 1950, DA estimates have been used to measure coverage error in decennial censuses. Results have shown a substantial reduction in the net undercount rate over time (Robinson, West, and Adlakha 2002). DA estimates have also consistently found under-coverage for some age, sex, and race groups in the census, particularly for Black males (Robinson 2011).

Coverage in the decennial census is measured by comparing the census counts to independent estimates of the population developed through demographic analysis or a post-enumeration survey. Although there has long been considerable interest in the coverage of the foreign-born population in the decennial census (Marcelli and Ong 2002), the data needed to measure it have not been available. Following the 1990 and 2000 Census, coverage was measured by comparing estimates from the post-enumeration survey to census counts from the short form or 100-percent items. Since nativity was not one of the 100-percent items, it could not be included in the post-enumeration survey. Demographic analysis does not include indicators of nativity because historical and current administrative data on deaths by place of birth are limited. Coverage in demographic surveys, such as the ACS, is measured by comparing the results of the survey with independent estimates developed by the Population Estimates Program. The estimates are based on the census questions that were asked to everyone (100-percent items or short form) and, since nativity was only included on the sample questionnaire (long form), the estimates cannot be produced by nativity.

While there are no direct estimates of coverage for the foreign-born population in censuses or surveys, there are several reasons to expect that this group might be undercounted. In their study of low-income inner-city residents in Philadelphia following the 1990 Census, Iversen, Furstenberg, and Belzer (1999) found that interpretations about the meaning and purpose of the census, English language ability, literacy skills, and connection to government were related to measurement errors in the census. Research on the relationship between residential attachment and survey coverage shows that people with tenuous ties to residence, including recent immigrants, are more likely to be omitted

from surveys and censuses (Martin 2007). Other scholars have questioned the coverage of undocumented immigrants—a part of the foreign-born immigration estimate—in surveys and censuses given the nature of their legal status and perceived risks to participating in a government survey (Massey and Capoferro 2004). Our research is a first attempt to empirically measure the coverage of the foreign-born population in the ACS.

Data and Methods

The data for this analysis come from several sources including 1) Census 2000 short- and long-form files, 2) Dual System Estimates (DSE) of the U.S. population in 2000, 3) C2SS, and 4) 2001 to 2009 single-year ACS files. The Census 2000 short-form file contains data on all residents of the United States as of April 1, 2000. These data contain information on age, sex, race, and Hispanic origin of the U.S. population. The Census 2000 long-form data file is a sample of about one-in-six U.S. households and contains detailed information about the demographic and socioeconomic characteristics of the U.S. population, including nativity.

The Dual System Estimates from the Accuracy and Coverage Evaluation (A.C.E.) Revision II program are estimates of the United States population in 2000, which were used to identify population over- and under-counts in Census 2000 (Hogan 2003). These estimates were based on data collected through the Post-Enumeration Survey (PES) and are aggregated to the national level by sex, race and Hispanic origin, and broad age groups (U.S. Census Bureau 2002a). The A.C.E. program used a combined race and Hispanic origin domain to categorize post-strata, which included seven mutually exclusive categories: non-Hispanic White, non-Hispanic Black, Hispanic, Native Hawaiian or Pacific Islander, non-Hispanic Asian, non-Hispanic American Indian or Alaska Native on a reservation, and non-Hispanic American Indian or Alaska Native not on a reservation. For this analysis, we recoded the race and Hispanic origin categories: non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic Asian, and non-Hispanic other. Age was reported in five broad groups: 0-9, 10-17, 18-29, 30-49, and 50

years and older. We collapsed the two youngest age groups into 0-17 and kept the remaining categories as reported.

Data from the C2SS were also used to estimate the U.S. population by age, sex, race, Hispanic origin, and nativity in 2000. The C2SS was a large scale demonstration of the American Community Survey (ACS) and included 1,239 counties and 866,000 housing units (U.S. Census Bureau 2009). Data are available for both the 2000 ACS (a subset of the C2SS that only included information for the 36 test sites) and the C2SS; however, the C2SS data are used in this analysis since it was designed to be nationally representative and is more similar to later years of the ACS in sample size. In addition, data from the single-year ACS files from 2001 to 2009 on nativity, prior place of residence, and year of entry to the United States were used.

The C2SS and ACS data files contain survey weights, which we used in the calculation and evaluation of the coverage factors. There are different stages in the weighting process of the ACS to account for possible errors related to the probability of sample selection, non-interview bias, and mode bias as well as to control the data to housing-unit and population controls (U.S. Census Bureau 2009). In this analysis, we used the weight prior to population controls (pre-controlled weight) and the weight that includes population controls (final ACS weight). The pre-controlled weight includes all of the error adjustments discussed above and is also controlled to housing-unit totals developed by the Population Estimates Program. The final ACS weight includes all of the error adjustments, the housing-unit controls, and population controls which are also developed by the Population Estimates Program.

Methods

In this paper we create four series of coverage factors to estimate the representation of the foreign-born population in the ACS (Figure 1).[5] The initial foreign-born coverage factor series (FBC-1) is calculated using data from Census 2000 and the C2SS and is the base for the other coverage factor series. The second series of coverage factors (FBC-2) is the

[5] The C2SS was a survey of the household population and did not include the group quarters population. Therefore, the coverage factors in this paper are calculated using data on the household population and are only applied to estimates of the household population.

same as FBC-1 but includes an adjustment for sampling error in the C2SS. For the third series of coverage factors (FBC-3), the FBC-1 series is adjusted for census coverage using the DSE from the A.C.E. Revision II program. The final series of coverage factors (FBC-4) combines the adjustments for sampling error and census coverage from FBC-2 and FBC-3 (Text Box 1).

Foreign-Born Coverage Factors 1 (FBC-1)

The FBC-1 are calculated by dividing the foreign-born population totals in Census 2000 sample data by the estimates of the foreign-born population in the C2SS. Specifically, we calculate the FBC-1 by sex, Hispanic origin, and five broad age groups (0-17, 18-24, 25-44, 45-64, and 65+) using the Census 2000 totals and pre-controlled estimates from the C2SS. The pre-controlled estimates from the C2SS were created using the pre-controlled survey weights, which include adjustments for the probability of selection into the sample, non-interview bias, and mode bias and are controlled to housing-unit totals. We use the pre-controlled estimates rather than the population-controlled estimates (final ACS weight) because the estimates using the final ACS weight are already adjusted for coverage. The process of calculating the FBC-1 for foreign-born Hispanic males aged 18-24 is illustrated in Figure 1. The Census 2000 estimate for this population is 1,219,000 while the C2SS pre-controlled estimate for the same population is 1,108,000. Dividing the Census 2000 estimate by the C2SS pre-controlled population estimate produces a coverage factor of 1.10. This means that the pre-controlled estimate for this group would need to be increased by 10 percent to equal the Census 2000 estimate.

Foreign-Born Coverage Factors 2 (FBC-2)

For 2010 DA, we developed a range of estimates of the U.S. population on April 1, 2010, which included four different estimates of foreign-born immigration from 2000 to 2010 (Devine et al. 2010). To calculate the highest plausible estimate of foreign-born immigration, we recalculated the FBC-1 coverage factors using estimates from the C2SS that were adjusted for sampling error. Specifically, we calculated the margin of sampling error for the C2SS estimates of the foreign-born population by age, sex, and Hispanic origin. We then subtracted the margin of error from the estimate to create a lower-bound

estimate (lower bound of the 90 percent confidence interval), which we then used to calculate the FBC-2 coverage factors using the same methodology outlined above for FBC-1. Although the same process could be repeated using the upper bound of the 90 percent confidence interval to calculate upper-bound estimates, these would overlap with estimates that were created using other methodologies.

Foreign-Born Coverage Factors 3 (FBC-3)

The third series of coverage factors (FBC-3) include an adjustment for coverage in Census 2000. We use data from the DSE of the A.C.E. Revision II project to modify the census estimates of the foreign-born population prior to making any comparisons to the C2SS (Figure 2). The first step in creating these coverage factors is to produce the modified A.C.E. population estimate. This modified estimate is calculated by multiplying the DSE estimate for a particular age, sex, and race group by an adjustment factor to account for correlation bias between the census and the PES.

Correlation bias occurs because the general assumption of independence between the census and PES is violated by causal dependence and heterogeneity (U.S. Census Bureau 2002b). Causal dependence occurs because inclusion in the census makes a person more likely or less likely to be included in the PES. Heterogeneity occurs when the probability of being included in the census and PES varies across persons within sex, age, race, and Hispanic origin groups or post-strata. In other words, population groups who are more likely to be missed in the census are also more likely to be missed in the PES. Of the two sources of correlation bias—causal dependence and heterogeneity—there is greater risk of underestimation from heterogeneity.

To correct for correlation bias in the DSE estimates, we used adjustment factors developed for A.C.E. Revision II to correct for correlation bias between the census and A.C.E. results for adult males (U.S. Census Bureau 2002b).[6] The correlation bias ratios were estimated using the Two Group Model which first postulates two groups of people within each male stratum—hard to count and easy to count—with a constant bias

[6] Research following the 1990 Census found that correlation bias between the census and PES is minimal for children and adult females (Bell 1991).

parameter across post-strata and then calculates the adjustment factor using DSE estimates of females within each age-race group and the sex ratio estimates from the 2000 DA as control totals.[7] The A.C.E. Revision II program developed correlation adjustment ratios for males 18-29, 30-49, and 50 years and older by the DA race categories Black and non-Black.

For this analysis, we experimented with different ways of applying the correlation bias adjustment factors to create modified A.C.E. estimates by age, sex, and race. The first approach was to use the non-Black correlation bias ratio for all non-Black males over the age of 18, including those classified as Hispanic. Next, we applied the Black correlation bias ratio for all Black and Hispanic males over the age of 18. The final approach, which was the method that we ultimately used for the DA estimates, was to apply the Black correlation bias adjustment to all foreign-born males aged 18 and older, regardless of their race.

The second step in calculating the FBC-3 coverage factors was to divide the modified A.C.E. estimates by the 100 percent item census counts to get an A.C.E. adjustment factor by age, sex, race, and Hispanic origin (Figure 2). In the third step, the A.C.E. adjustment factor was multiplied by the census sample-data estimate by age, sex, race, Hispanic origin, and nativity to get a modified Census 2000 estimate of the foreign-born population by age, sex, race, and Hispanic origin. The final step in calculating the FBC-3 coverage factors was to divide the modified Census 2000 population by the C2SS pre-controlled estimates by age, sex, and Hispanic origin. This last step is identical to how we calculated the FBC-1 coverage factors, only with modified Census 2000 population estimates.

Foreign-Born Coverage Factors 4 (FBC-4)

For the final series of coverage factors (FBC-4), we combine the sampling error adjustment from FBC-2 and the census coverage adjustment from FBC-3. Specifically, we divide the Census 2000 estimates that have been modified for coverage using the DSE

[7] For more information about correlation bias between Census 2000 and A.C.E. Revision II, see PP-53 in the DSSD A.C E. Revision II Memorandum Series: http://www.census.gov/dmd/www/ace2.html.

from the A.C.E. Revision II project by the C2SS estimates that have been adjusted for the margin of error (lower-bound of the 90 percent confidence interval).

Assumptions

The methodology used to create the different series of coverage factors contains several implicit assumptions about the quality of Census 2000 data, the C2SS estimates, and the comparability of C2SS data to other years of ACS data. In the first series of coverage factors (FBC-1), we assume that the population was fully enumerated in Census 2000 and that there were no systematic measurement or coverage errors in estimates of the foreign-born population by age, sex, and Hispanic origin. In addition, we also assume that the Census 2000 sample data—based on a large sample of the total population—provide accurate estimates of the population by nativity. We also assume that despite differences in sample size, estimates from the C2SS are comparable to those from the Census 2000 long-form data (U.S. Census Bureau 2004). We apply the rates calculated using data from the C2SS to ACS data from 2001 to 2009, so there is also an assumption that the rate of coverage for the foreign-born population in the C2SS is similar to the rate of coverage for the foreign-born population in later years of the ACS. This is a strong assumption, especially given changes in the ACS sample size—roughly 587,000 housing units in 2000 compared to 1,918,000 housing units in 2009—that could be potentially overestimating the undercoverage of the foreign-born immigrant population for later years of ACS data (U.S. Census Bureau 2015). In addition, there might be variation in nonsampling errors between the earlier and later years of data collection. Finally, there is the assumption that recent foreign-born immigrants have the same coverage as the total foreign-born population.

For the FBC-3 coverage factors, we assume that there were measurement and coverage errors in the Census 2000 and that the population totals need to be modified to reflect these errors. A second assumption used in this methodology is that the A.C.E. adjustment factors, which can only be calculated for the total population and not by nativity, are applicable to the foreign-born population. If the foreign-born coverage in the DSE cells differs from the coverage of the total population, there will be error in our coverage factor calculation. The assumptions from the first series concerning the comparability of Census

2000 data to the C2SS and applying coverage factors derived from the C2SS to other years of the ACS are also made for this series of coverage factors.

There are also assumptions related to the correlation bias adjustment factors used to create the modified A.C.E. estimates. The correlation bias adjustment factors were available for adult males by the DA race categories of Black and non-Black. Only the Black correlation bias ratios imply an undercount in the census. The first option that we tested was to apply the Black correlation bias adjustment factors to only the Black DSE estimates. However, this resulted in a reduced modified Census 2000 foreign-born population which created coverage factors that implied over-coverage of the foreign-born population in the census.[8]

The second option was to apply the Black correlation bias adjustment ratios to the Black and Hispanic DSE estimates. For this option, we assume that the coverage rates of Hispanic males are more similar to those of Black males than they are to other non-Black males (a category that is largely made up of non-Hispanic Whites). The third option was to apply the Black correlation bias adjustment factors to *all* foreign-born males and not just Black and Hispanic males. Here we are assuming that the foreign-born male population has coverage rates that are more similar to Black males than they are to non-Black males. The results presented below used the third option (Black correlation bias adjustment ratios for all adult foreign-born males). In addition to the theoretical concerns presented above, we also chose this option because it produced the highest coverage factors and one of the goals of the project was to create the highest plausible estimates of foreign-born immigration for the 2010 DA. Estimates of the FBC-3 coverage factors calculated using the first option (Black correlation bias adjustment ratios for Black males only) and the second option (Black correlation bias adjustment ratios for Black and Hispanic males) are presented in Appendix A (Tables A-3 and A-4).

For the FBC-3 coverage factors methodology, we assume that there is negligible correlation bias for adult females and, therefore, a correlation bias adjustment for

[8] Based on expert judgment, we felt that it was unlikely that the foreign-born population was over-covered in the ACS.

females is unnecessary. An evaluation of the 1990 Post Enumeration Survey (PES) and 1990 DA sex ratios found evidence of significant correlation bias in the DSEs for adult males but not adult females or children (Bell 1991). That males (especially Black males) have different rates of coverage in the census than females has been well documented (Robinson, West, and Adlakha 2002). However, there have been no studies focusing on correlation bias for females and, by not adjusting for correlation bias among females, we could be underestimating FBC-3 coverage factors for females.

Finally, to produce the FBC-2 and FBC-4 series, we use the lower-bound estimate of the 90 percent confidence interval to calculate the coverage factors. This methodology assumes that sampling error in the C2SS estimates needs to be accounted for. However, the Census 2000 estimates used to calculate the coverage factors come from the sample-data which also have sampling error.

Estimating Foreign-Born Immigration

After creating the coverage factors, we applied them to annual estimates of foreign-born immigration using C2SS 2000 data and ACS data from 2001-2009 and compared these to estimates developed by using standard ACS survey weights. For this analysis, we used the final ACS survey weight and the weight prior to population controls (pre-controlled weight). The final ACS population weights are controlled to independent population estimates developed by the U.S. Census Bureau. We would normally assume that any coverage error in the ACS is accounted for in the final ACS weight; however, the final ACS weighted estimates are controlled by age, sex, race, and Hispanic origin, and not nativity. The pre-controlled weight is the weight produced in the weighting process just prior to controlling to the population totals and includes adjustments for the probability of selection into the sample, non-interview bias, mode bias, and housing unit controls (U.S. Census Bureau 2009). The coverage factors are applied by multiplying the coverage factors by the pre-controlled population weights from the ACS and then using the resulting weights to re-estimate foreign-born immigration.

For the 2010 DA, foreign-born immigration was estimated using data on residence one year ago (ROYA) and year of entry (YOE) from the ACS. The ROYA method used data

from an ACS question which asks respondents to identify where they—and each individual member of their household—were living one year prior to the survey. Foreign-born immigration was estimated as the foreign-born population whose residence one year ago was abroad (outside the United States and Puerto Rico). The YOE method used data from the ACS which asks respondents what year they came to live in the United States. For this method, foreign-born immigration was estimated as the foreign-born population who came to live in the United States the year prior to the survey year.

Results

The FBC-1 and FBC-2 coverage factors and margins of error by age, sex, and Hispanic origin for the foreign-born population are presented in Table 1. Five broad age groups were used to ensure large sample sizes while also maintaining intuitive breaks in the age distribution (e.g., less than 18 years of age).[9] Age, sex, and Hispanic origin groups with a coverage factor less than 1.0 were estimated to have been overrepresented in the C2SS while groups with a coverage factor greater than 1.0 were underrepresented.

Overall, the FBC-1 coverage factors for non-Hispanics tend to be fairly close to 1.0, meaning many of these sex-age groups were fully represented in the C2SS data. The FBC-1 coverage factors for non-Hispanic males 25-44 years old and non-Hispanic females 18-24 years old were 1.06 and 1.10, respectively, implying underrepresentation for these groups. The FBC-1 coverage factors for Hispanics males ages 0-17, 18-24, and 25-44 and Hispanic females ages 0-17 were above 1.0, implying undercoverage. Hispanic males under the age of 18 had one of the highest rates of undercoverage, with a coverage factor of 1.17. Hispanic females under the age of 18 and ages 18-24 both had coverage factors of 1.11, indicating that these groups were underrepresented by as much as 11 percent in the C2SS data.

The FBC-2 coverage factors are higher than the FBC-1 coverage factors for all groups because the method used to create this series used the lower bound of the 90 percent

[9] Table A-1 (appendix) shows the estimated populations for the foreign-born stock, ROYA, and YOE populations by the age, sex, and Hispanic origin categories used to develop the FBC-1 and FBC-2 series.

confidence interval of the C2SS estimates. This had the intended effect of inflating the coverage factors (Table 1). With the exception of non-Hispanic males aged 65 and over, the FBC-2 coverage factors for all age-sex-Hispanic origin groups are statistically greater than 1.0. In this series, Hispanic males under 18 years of age have among the highest undercoverage rates (1.23) and non-Hispanic males 65 years or older have among the lowest (1.02), which is similar to the FBC-1 coverage factors.

The FBC-3 and FBC-4 coverage factors by age, sex, and Hispanic origin for the foreign-born population are shown in Table 2. The age profile for these coverage factors is based on the age groupings available for the DSEs[10]. The FBC-3 coverage factors for non-Hispanics imply that these sex-age groups are fully represented in the C2SS data, the only exception being males aged 30-49 which have a coverage factor of 1.11.

The FBC-3 coverage factors for Hispanics males ages 0-17, 18-29, and 30-49 and Hispanic females ages 0-17 are above 1.0. Hispanic males aged 0-17 and 30-49 have the highest FBC-3 coverage factor (1.15) indicating that these groups could be under-covered in the C2SS data by as much as 15 percent. The FBC-3 coverage factor for Hispanic males aged 18-29, which makes up the largest proportion of recent immigrants (Table A-2 in Appendix A), is 1.12. Among Hispanic females, the largest FBC-3 coverage factors were for those under 18 years old (1.09). The FBC-3 coverage factors for Hispanic females aged 18-29 and 30-49 were both close to 1.0 implying that these groups have nearly full representation in the C2SS data.

The FBC-4 coverage factors for non-Hispanics are close to 1.0 with the exception of males aged 30-49 whose coverage factor is 1.13. For Hispanics, the FBC-4 coverage factors range from 1.21 for males less than 18 year old to 1.01 for females 50 years or older. In summary, the FBC-3 and FBC-4 coverage factors are generally lower than the FBC-1 and FBC-2 coverage factors but also indicate potential undercoverage of foreign-born Hispanics in the C2SS data.

[10] Table A-2 (appendix) shows the estimated populations for the foreign-born stock, ROYA, and YOE populations by the age, sex, and Hispanic origin categories used to develop the FBC-3 and FBC-4 series.

ROYA estimates

In this section we compare annual estimates of foreign-born immigration by coverage factor and survey weight using the Residence One Year Ago (ROYA) method. Specifically, the foreign-born population whose residence one year ago was abroad are considered immigrants. Estimates of foreign-born immigration using the ROYA method are reported in Table 3. Margins of error for the estimates are also reported in this table.[11] Because the 2010 ACS data were not available during the production of the DA estimates, we hold the estimates from 2009 constant for 2010. The cumulative estimates from 2000 to 2010 for the pre-controlled and final ACS weights are 12.2 million and 12.7 million, respectively. The final ACS weights are controlled to population estimates produced by the Census Bureau in an effort to account for coverage error in the ACS. However, the ACS is controlled by age, sex, race, and Hispanic origin and not by nativity.

The cumulative estimates for the FBC-1 and FBC-2 series are 12.8 million and 13.3 million, respectively. While the total FBC-1 estimate of foreign-born immigration is higher than the final ACS weighted estimate, the two are not statistically different from each other. The FBC-2 estimates of foreign-born immigration from 2000 to 2010 are statistically significant from the total estimate using the final ACS weight. The cumulative FBC-3 estimate of foreign-born immigration is 12.5 million, which is significantly lower than the estimate using the final ACS weight. The FBC-4 estimate from 2000 to 2010 is 13.0 million, which is not statistically different from the final ACS weighted estimate of 12.7 million.

YOE estimates

We also compared annual estimates of foreign-born immigration using coverage factors and survey weights for the Year of Entry (YOE) method. For the YOE method, immigration is defined as the foreign-born population whose year of entry to the United States was in the year prior to the survey year. Estimates of foreign-born immigration

[11] See Appendix B for more information on the method used to calculate margins of error for the coverage factor and survey weighted estimates of foreign-born immigration.

using the YOE method by survey weight and coverage factor are presented in Table 4. The table also reports margins of error for each estimate.

The cumulative estimate of foreign-born immigration from 2000 to 2010 using the pre-controlled weight is approximately 14.0 million. The final ACS weighted estimate for the 2000 to 2010 period is 14.6 million. The FBC-1 and FBC-2 estimates are 14.8 million and 15.4 million, respectively. The cumulative estimate using the FBC-1 coverage factors is not statistically different from final ACS weighted estimate. However, the FBC-2 coverage factors do produce a statistically higher estimate than the final ACS weighted estimates. The FBC-3 cumulative estimate is 14.4 million, but this estimate is not statistically different from the final ACS weighted estimate. The FBC-4 estimate is 15.0 million and is statistically higher than the final ACS weighted estimate of 14.6 million.

Conclusion

For the 2010 Demographic Analysis, the U.S. Census Bureau developed estimates of the U.S. population on April 1, 2010, which ranged from the low series estimate of 305.7 million to the high series estimate of 312.7 million (Devine et al. 2010). The foreign-born immigration component for the high series was estimated using the YOE methodology and the lower-bound Census coverage factors. This was determined to be the highest plausible estimate of foreign-born immigration. This paper has provided an overview of the methodology used to develop the four series of coverage factors researched for 2010 DA. Each individual series has particular strengths and limitations based on the data and assumptions used to produce the series, and no one series should be considered as a definitive estimate of the coverage of the foreign-born population in the ACS.

This research has also been a first attempt to empirically estimate the coverage of the foreign-born population in the ACS. The findings show that the coverage factors for the non-Hispanic foreign-born population are generally lower than the coverage factors for Hispanics. Furthermore, the coverage factors are particularly high for male Hispanics suggesting that, among the foreign-born population, this group has the highest rate of

undercoverage in the ACS. Using these coverage factors to calculate estimates of foreign-born immigration provided additional benchmarks for 2010 DA.

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Table 1.
Foreign-Born Coverage Factors with no Adjustment (FBC-1) and Foreign-Born Coverage Factors with Sampling Error Adjustment (FBC-2)

Age	FBC-1								FBC-2			
	Non-Hispanic				Hispanic				Non-Hispanic		Hispanic	
	Male		Female		Male		Female		Male	Female	Male	Female
	Coverage factor	Margin of error	Coverage factor	Margin of error	Coverage factor	Margin of error	Coverage factor	Margin of error	Coverage factor	Coverage factor	Coverage factor	Coverage factor
0-17	1.01	0.06	1.02	0.06	1.17	0.06	1.11	0.06	1.07	1.08	1.23	1.17
18-24	1.04	0.06	1.10	0.05	1.10	0.06	1.11	0.05	1.10	1.15	1.17	1.17
25-44	1.06	0.02	1.03	0.02	1.07	0.03	1.04	0.03	1.08	1.06	1.10	1.07
45-64	1.01	0.02	1.01	0.02	1.05	0.04	1.01	0.03	1.03	1.03	1.08	1.05
65+	0.99	0.03	1.04	0.03	1.07	0.07	1.05	0.05	1.02	1.06	1.14	1.11

Source: U.S. Census Bureau, Population Division, Census 2000 Sample Edited Data File and Census 2000 Supplementary Survey, special tabulation.

Table 2.

Foreign-Born Coverage Factors with Census Coverage Adjustment (FBC-3) and Foreign-Born Coverage Factors with Census Coverage and Sampling Error Adjustments (FBC-4)

Age	FBC-3								FBC-4			
	Non-Hispanic				Hispanic				Non-Hispanic		Hispanic	
	Male		Female		Male		Female		Male	Female	Male	Female
	Coverage factor	Margin of error	Coverage factor	Margin of error	Coverage factor	Margin of error	Coverage factor	Margin of error	Coverage factor	Coverage factor	Coverage factor	Coverage factor
0-17	0.96	0.05	0.97	0.05	1.15	0.06	1.09	0.05	1.02	1.02	1.21	1.15
18-29	0.99	0.03	0.94	0.03	1.12	0.05	1.02	0.03	1.03	0.98	1.17	1.05
30-49	1.11	0.02	0.99	0.02	1.15	0.04	1.02	0.03	1.13	1.01	1.18	1.04
50+	0.99	0.02	0.94	0.01	1.03	0.04	0.98	0.03	1.01	0.95	1.08	1.01

Note: Black correlation bias ratios were used for all adult foreign-born males.

Source: U.S. Census Bureau, Population Division, Census 2000, Census 2000 Accuracy and Coverage Evaluation Program, and the Census 2000 Supplementary Survey, special tabulation.

Table 3.

Residence One Year Ago (ROYA) Estimates of Foreign-Born Immigration by Survey Weight and Coverage Factor: 2000 to 2010

(In thousands)

Year	Pre-controlled ACS weight		Final ACS weight		FBC-1		FBC-2		FBC-3[1]		FBC-4[1]	
	Estimate[2]	Margin of error[3]	Estimate[2]	Margin of error[3]	Estimate[2]	Margin of error[3]	Estimate[2]	Margin of error[3]	Estimate[2]	Margin of error[3]	Estimate[2]	Margin of error[3]
2000	1,395	70	1,420	66	1,476	75	1,532	78	1,442	74	1,494	77
2001	1,382	58	1,421	57	1,461	62	1,517	64	1,425	61	1,477	63
2002	1,164	56	1,228	58	1,230	59	1,276	62	1,199	59	1,243	61
2003	982	48	1,025	48	1,038	51	1,077	53	1,012	50	1,049	52
2004	1,081	52	1,124	47	1,146	55	1,190	57	1,121	55	1,163	57
2005	1,169	29	1,188	32	1,237	31	1,284	32	1,209	31	1,253	32
2006	1,103	26	1,190	28	1,165	28	1,209	29	1,135	27	1,177	28
2007	1,052	33	1,114	34	1,108	35	1,149	37	1,076	34	1,115	36
2008	1,017	27	1,069	29	1,068	29	1,107	30	1,035	28	1,072	29
2009	911	28	984	31	956	29	990	30	925	28	957	29
2010[4]	911	28	984	31	956	29	990	30	925	28	957	29
Total	12,168	145	12,746	145	12,840	155	13,322	161	12,504	152	12,956	158

[1]The FBC-3 and FBC-4 coverage factors use the Black correlation bias ratios for all adult foreign-born males.

[2]Estimates include both the under 65 and 65 and over populations.

[3]Data are based on a sample and are subject to sampling variability. A margin of error is a measure of an estimate's variability. The larger the margin of error is in relation to the size of the estimate, the less reliable the estimate. When added to and subtracted from the estimate, the margin of error forms the 90 percent confidence interval.

[4]For 2010, we hold the 2009 estimates constant.

Source: U.S. Census Bureau, Population Division, 2000 through 2009 single-year American Community Survey, special tabulation. For more information on the ACS, see http://www.census.gov/acs/www

Table 4.
Year of Entry (YOE) Estimates of Foreign-Born Immigration by Coverage Factor and Survey Weight: 2000 to 2010
(In thousands)

Year	Pre-controlled ACS weight		Final ACS weight		FBC-1		FBC-2		FBC-3[1]		FBC-4[1]	
	Estimate[2]	Margin of error[3]	Estimate[2]	Margin of error[3]	Estimate[2]	Margin of error[3]	Estimate[2]	Margin of error[3]	Estimate[2]	Margin of error[3]	Estimate[2]	Margin of error[3]
2000	1,535	79	1,574	73	1,630	84	1,695	88	1,594	83	1,655	87
2001	1,592	72	1,647	69	1,691	77	1,758	80	1,653	76	1,716	80
2002	1,388	65	1,445	67	1,473	69	1,530	72	1,434	68	1,488	71
2003	1,210	50	1,260	54	1,287	54	1,338	56	1,256	52	1,305	55
2004	1,154	59	1,218	58	1,227	63	1,276	66	1,202	62	1,248	65
2005	1,311	34	1,333	33	1,393	36	1,448	38	1,362	36	1,415	37
2006	1,299	27	1,384	28	1,379	29	1,434	31	1,348	29	1,399	30
2007	1,253	33	1,309	34	1,326	35	1,378	37	1,292	35	1,341	36
2008	1,142	30	1,197	30	1,205	32	1,251	33	1,170	31	1,213	32
2009	1,036	25	1,100	27	1,092	27	1,133	28	1,059	26	1,098	27
2010[4]	1,036	25	1,100	27	1,092	27	1,133	28	1,059	26	1,098	27
Total	13,954	163	14,569	161	14,795	174	15,374	182	14,430	172	14,975	179

[1]The FBC-3 and FBC-4 coverage factors use the Black correlation bias ratios for all adult foreign-born males.
[2]Estimates include both the under 65 and 65 and over populations.
[3]Data are based on a sample and are subject to sampling variability. A margin of error is a measure of an estimate's variability. The larger the margin of error is in relation to the size of the estimate, the less reliable the estimate. When added to and subtracted from the estimate, the margin of error forms the 90 percent confidence interval.
[4]For 2010, we hold the 2009 estimates constant.
Source: U.S. Census Bureau, Population Division, 2000 through 2009 single-year American Community Survey, special tabulation. For more information on the ACS, see http://www.census.gov/acs/www.

Text Box: Terminology for Coverage Factors Series

Coverage factors series		Census adjustment	ACS adjustment
FBC1 –	Foreign-born coverage factors with no adjustment	Census sample-data estimates are not adjusted.	ACS estimates are not adjusted.
FBC2 –	Foreign-born coverage factors with sampling error adjustment	Census sample-data estimates are not adjusted.	ACS estimates are adjusted by the upper-bound of the 90 percent confidence interval.
FBC3 –	Foreign-born coverage factors with census coverage adjustment	Census sample-data estimates are adjusted for coverage using the Dual System Estimates (DSE) from the Accuracy and Coverage Evaluation (A.C.E.) Revision II program.	ACS estimates are not adjusted.
FBC4 –	Foreign-born coverage factors with census coverage and sampling error adjustments	Census sample-data estimates are adjusted for coverage using the Dual System Estimates (DSE) from the Accuracy and Coverage Evaluation (A.C.E.) Revision II program.	ACS estimates are adjusted by the upper-bound of the 90 percent confidence interval.

Figure 1. Calculation of Foreign-Born Coverage Factors with no Adjustment, FBC-1

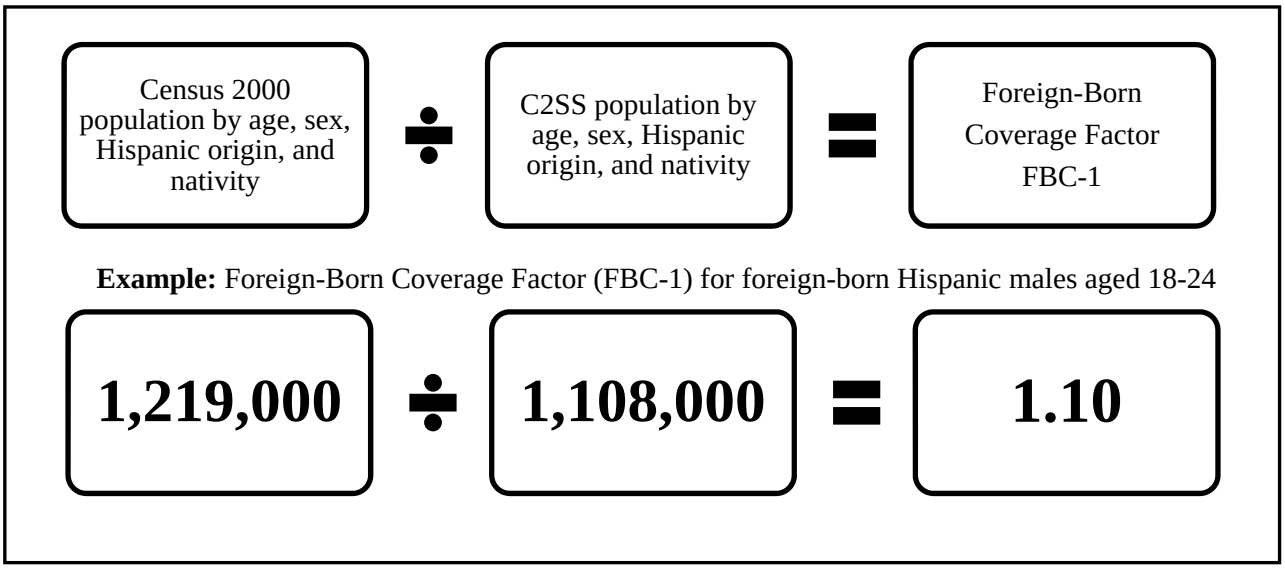
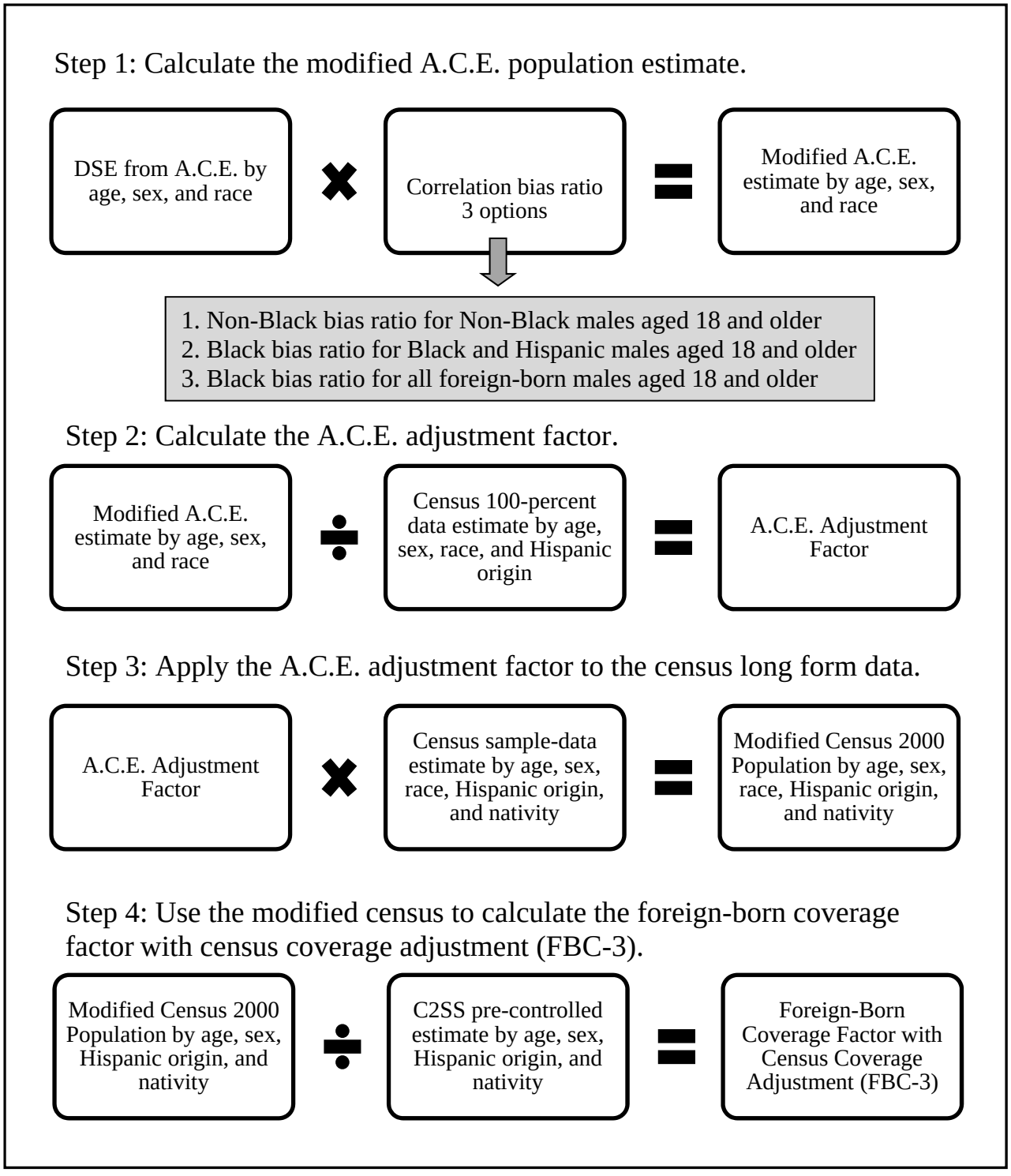


Figure 2. Calculation of Foreign-Born Coverage Factors with Census Coverage Adjustment, FBC-3



Appendix A

Table A-1.
Estimates of the Foreign-Born Stock, Residence One Year Ago Abroad (ROYA), and Year of Entry (YOE) in the Prior Year Populations by Census Age, Sex, and Hispanic Origin: 2000

Age	Non-Hispanic				Hispanic			
	Male		Female		Male		Female	
	Estimate	Margin of error[1]	Estimate	Margin of error[1]	Estimate	Margin of error[1]	Estimate	Margin of error[1]
Foreign-born stock population								
0-17	740,539	38,331	733,729	30,224	801,848	34,811	738,823	30,959
18-24	659,562	26,886	643,027	23,267	1,168,824	40,891	809,381	32,874
25-44	3,326,868	51,897	3,491,550	50,025	3,560,873	64,434	3,026,266	43,113
45-64	2,220,252	36,536	2,553,529	39,235	1,248,207	28,266	1,322,299	24,761
65+	977,562	28,373	1,442,583	28,927	318,565	12,525	489,373	14,876
ROYA population								
0-17	80,951	11,605	92,109	12,144	60,951	12,133	58,936	9,915
18-24	67,529	9,692	69,977	8,548	116,603	15,096	57,962	9,092
25-44	201,392	16,236	171,295	13,649	137,648	17,285	88,794	12,103
45-64	52,412	7,170	58,276	7,788	21,416	4,471	24,943	5,581
65+	17,552	4,058	23,636	4,256	6,198	3,296	10,990	3,478
YOE population								
0-17	122,235	13,554	100,354	14,226	88,675	14,399	79,436	10,710
18-24	52,123	8,090	65,110	8,219	157,054	20,169	89,919	14,177
25-44	190,711	16,105	193,810	14,770	165,972	19,641	101,644	13,463
45-64	44,329	6,616	39,127	6,280	24,742	5,994	21,822	4,218
65+	9,901	3,287	15,667	4,728	4,528	2,219	7,074	2,724

Note: The estimates were calculated using the final ACS weight.
[1]Data are based on a sample and are subject to sampling variability. A margin of error is a measure of an estimate's variability. The larger the margin of error is in relation to the size of the estimate, the less reliable the estimate. When added to and subtracted from the estimate, the margin of error forms the 90 percent confidence interval.
Source: U.S. Census Bureau, Census 2000 Supplementary Survey, special tabulation.

Table A-2.

Estimates of the Foreign-Born Stock, Residence One Year Ago Abroad (ROYA), and Year of Entry (YOE) in the Prior Year Populations by A.C.E. Age, Sex, and Hispanic Origin: 2000

Age	Non-Hispanic				Hispanic			
	Male		Female		Male		Female	
	Estimate	Margin of error[1]	Estimate	Margin of error[1]	Estimate	Margin of error[1]	Estimate	Margin of error[1]
Foreign-born stock population								
0-17	740,539	38,331	733,729	30,224	801,848	34,811	738,823	30,959
18-29	1,404,615	37,063	1,431,404	33,018	2,184,550	58,357	1,634,166	38,815
30-49	3,321,222	49,111	3,482,278	50,902	3,027,888	48,906	2,688,801	37,186
50+	2,458,407	42,975	3,217,007	44,207	1,084,031	24,459	1,324,352	25,913
ROYA population								
0-17	80,951	11,605	92,109	12,144	60,951	12,133	58,936	9,915
18-29	133,080	15,137	141,281	12,910	170,762	19,021	103,163	13,490
30-49	156,279	16,072	119,783	11,317	92,044	13,225	51,688	8,747
50+	49,526	6,662	62,120	7,401	19,059	4,952	27,838	5,854
YOE population								
0-17	122,235	13,554	100,354	14,226	88,675	14,399	79,436	10,710
18-29	124,712	12,126	138,942	12,514	228,263	25,287	132,769	17,498
30-49	137,422	13,583	138,282	13,021	105,273	14,868	66,536	9,652
50+	34,930	5,448	36,490	6,282	18,760	5,330	21,154	4,827

Note: The estimates were calculated using the final ACS weight.

[1]Data are based on a sample and are subject to sampling variability. A margin of error is a measure of an estimate's variability. The larger the margin of error is in relation to the size of the estimate, the less reliable the estimate. When added to and subtracted from the estimate, the margin of error forms the 90 percent confidence interval.

Source: U.S. Census Bureau, Census 2000 Supplementary Survey, special tabulation.

Coverage Factors with Alternative Correlation Bias Adjustments

Table A-3.

Foreign-Born Coverage Factors with Census Coverage Adjustment (FBC-3) and Foreign-Born Coverage Factors with Census Coverage and Sampling Error Adjustments (FBC-4) by Age, Sex, and Hispanic Origin: Non-Black Correlation Bias Adjustment for all Non-Black Males

Age	FBC-3								FBC-4			
	Non-Hispanic				Hispanic				Non-Hispanic		Hispanic	
	Male		Female		Male		Female		Male	Female	Male	Female
	Coverage factor	Margin of error	Coverage factor	Margin of error	Coverage factor	Margin of error	Coverage factor	Margin of error	Coverage factor	Coverage factor	Coverage factor	Coverage factor
0-17	0.96	0.05	0.97	0.05	1.15	0.06	1.09	0.05	1.02	1.02	1.21	1.15
18-29	0.93	0.03	0.94	0.03	1.04	0.05	1.02	0.03	0.97	0.98	1.09	1.05
30-49	1.04	0.02	0.99	0.02	1.06	0.03	1.02	0.03	1.06	1.01	1.09	1.04
50+	0.96	0.02	0.94	0.01	0.99	0.04	0.98	0.03	0.98	0.95	1.03	1.01

Note: Non-Black correlation bias ratios were used to adjust all adult foreign-born non-Black males.

Source: U.S. Census Bureau, Population Division, Census 2000, Census 2000 Accuracy and Coverage Evaluation Program, and the Census 2000 Supplementary Survey, special tabulation.

Table A-4.

Foreign-Born Coverage Factors with Census Coverage Adjustment (FBC-3) and Foreign-Born Coverage Factors with Census Coverage and Sampling Error Adjustments (FBC-4) by Age, Sex, and Hispanic Origin: Black Correlation Bias Adjustment for Black and Hispanic Males

Age	FBC-3								FBC-4			
	Non-Hispanic				Hispanic				Non-Hispanic		Hispanic	
	Male		Female		Male		Female		Male	Female	Male	Female
	Coverage factor	Margin of error	Coverage factor	Margin of error	Coverage factor	Margin of error	Coverage factor	Margin of error	Coverage factor	Coverage factor	Coverage factor	Coverage factor
0-17	0.96	0.05	0.97	0.05	1.15	0.06	1.09	0.05	1.02	1.02	1.21	1.15
18-29	0.93	0.03	0.94	0.03	1.12	0.05	1.02	0.03	0.97	0.98	1.17	1.05
30-49	1.04	0.02	0.99	0.02	1.15	0.04	1.02	0.03	1.06	1.01	1.18	1.04
50+	0.96	0.02	0.94	0.01	1.03	0.04	0.98	0.03	0.98	0.95	1.08	1.01

Note: Black correlation bias ratios were used to adjust all adult foreign-born Black and Hispanic males.

Source: U.S. Census Bureau, Population Division, Census 2000, Census 2000 Accuracy and Coverage Evaluation Program, and the Census 2000 Supplementary Survey, special tabulation.

Appendix B

Variance Estimation

We estimated the variance, standard error, and margin of error for the coverage factors that do not already have an adjustment for sampling error (FBC-1 and FBC-3). We also estimated the variance, standard error, margin of error for all estimates of foreign-born immigration using the survey weights from the ACS and the coverage factors.

Variance of Coverage Factor Estimates

To estimate the margin of error for the coverage factors, we first estimated the standard error of both the census long-form and ACS estimates. To calculate the standard errors for the ACS estimates, we used the Successive Differences Replication (SDR) method with a set of 80 replicate weights (U.S. Census Bureau 2009). These replicate weights were controlled to housing-unit estimates but not to population estimates.

The standard errors for the census long-form estimates were calculated using Equation 1:

$$s.e.(\hat{y}) = 1.7\sqrt{5\,\hat{y}\,\left(1-\frac{\hat{y}}{N}\right)} \qquad (1)$$

where $\hat{y}$ is the estimate from the census long-form, 1.7 is the appropriate design factor, 5 is the inverse of the probability of selection into the sample (1/6) minus 1, and N is the total population for the publication area. The publication area or universe for our analysis is the national household (resident population excluding the group quarters population) population, which was 273,643,273.

The standard error of the FBC-1 coverage factors is estimated using Equation2 where $\hat{y}$ is the estimate from the census long-form and $\hat{x}$ is the estimate from the ACS:

$$\text{s.e. } FBC_1 = \frac{\sqrt{s.e.(\hat{x})^2\left(\frac{\hat{y}}{\hat{x}}\right)^2 + s.e.(\hat{y})^2\left(\frac{\hat{y}}{\hat{x}}\right)^2}}{\hat{x}} \qquad (2)$$

The FBC-3 is calculated as the product of the A.C.E. adjustment factor and the ratio of the census long-form estimate to the ACS estimate (Equation 3). Therefore, the standard error of the FBC-3 is the standard error of the ratio between the census long-form estimate and the ACS estimate multiplied by $\hat{F}$ which is the A.C.E. adjustment factor (Equation 4).

$$FBC_3 = \hat{F}\ \frac{\hat{y}}{\hat{x}} \tag{3}$$

$$s.e.\ FBC_3\ =\ \hat{F}\ s.e.\left(\frac{\hat{y}}{\hat{x}}\right) \tag{4}$$

The margins of error for the coverage factors are estimated by multiplying the standard error of the coverage factor by 1.645.

Variance of Foreign-Born Immigration Estimates

The ROYA and YOE estimates of foreign-born immigration are derived using data from the ACS. The ACS data contain both sampling and non-sampling errors. Sampling error is the uncertainty associated with an estimate that is based on data from a sample and not the entire population and can be estimated using statistical methods. The Successive Differences Replication (SDR) method is used to estimate variance in the ACS estimates (U.S. Census Bureau 2009). The first step in the process to estimate variance is to calculate replicate factors. Next the survey weights are recalculated using the replicate factors to create a series of replicate weights. For the ACS there are 80 replicate weights. Finally, the replicate weights are used to estimate the variance of an estimate. The variance of an ACS estimate ($\hat{\theta}$) is estimated using the following formula:

$$v\left(\hat{\theta}_0\right) = \frac{4}{80}\sum_{r=1}^{80}(\hat{\theta}_r\ -\ \hat{\theta}_0)^2 \tag{5}$$

where ($\hat{\theta}_0$) denotes the estimate computed using the sample weight and $\hat{\theta}_1, \hat{\theta}_2, \ldots, \hat{\theta}_{80}$ denote the estimates computed using the replicate weights (U.S. Census Bureau 2009). The variance of $\hat{\theta}_0$, $v\left(\hat{\theta}_0\right)$, is estimated as the sum of squared differences between each replicate estimate $\hat{\theta}_r$ (r = 1, …, 80) and the estimate $\hat{\theta}_0$ from the full sample.

The formula presented in Equation 1 was used to estimate variance for the estimates of foreign-born immigration using the pre-controlled and final ACS survey weights. To estimate variance for the estimates of foreign-born immigration with coverage factors (FBC-1, FBC-2, FBC-3, and FBC-4), we multiply the pre-controlled survey weights and pre-controlled replicate weights by the coverage factors (*f*). The pre-controlled survey weights include adjustments for the probability of selection into the sample, non-response, and mode bias. These weights also include housing-unit controls but are not controlled to population estimates. The formula used to estimate variance for the series with coverage factors is presented in Equation 6.

$$v\left(f\hat{\theta}_0\right) = \frac{4}{80}\sum_{r=1}^{80}(f\hat{\theta}_r - f\hat{\theta}_0)^2 \quad (6)$$

In this equation, $v(f\hat{\theta}_0)$ is the variance of the adjusted estimate and $f\hat{\theta}_1, f\hat{\theta}_2, \ldots, f\hat{\theta}_{80}$ are the adjusted estimates computed using the replicate weights. In general, the variance estimates for the series with coverage factors are greater than the variance estimates for the series calculated using the survey weights because the replicate weights have been increased.