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**Historical Examination of
Net Coverage Error for Children
in the U.S. Decennial Census: 1950 to 2010**

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Historical Examination of Net Coverage Error for Children in the U.S. Decennial

Census: 1950 to 2010

Dr. William P. O'Hare

Abstract

Recent studies have highlighted the high net undercount of children, particularly young children, in the 2010 U.S. Decennial Census. However this issue has received little systematic attention from demographers historically. Given the extensive use of decennial census data, the high net undercount of young children is both a data and a social equity problem. This study examines patterns and trends in the net undercount of children in the U.S. Decennial Census from 1950 to 2010. The focus is on trends in the net undercount of children relative to adults. The initial emphasis on all children (age 0 to 17) shifts to a focus on young children (age 0 to 4) where net undercount rates are the higher than any other age group. Differences between net undercount rates of Black and Non-Black populations are also examined over the 1950 to 2010 period. Results show that the differential net undercount of young children relative to adults as well as older children is now larger than the differential net undercount of Blacks and Non-Blacks.

Introduction

The Census Bureau's Demographic Analysis (DA) shows a net overcount of only 0.1 percent in the 2010 U.S. Decennial Census for the total population. However, this masks a substantial difference between adults and children. DA shows a net overcount of 0.7 percent of adults (age 18 and older) and net undercount of 1.7 percent for children (age 0 to 17). Moreover, the net undercount rate of 1.7 percent for children of all ages masks important differences among children of different ages. The net undercount rate for children age 0 to 4 was 4.6 percent in the 2010 U.S. Decennial Census, but there was a net overcount of 1.5 percent for children age 14 to 17.

The relatively high net undercount rate for children of all ages and the very high net undercount rate for young children in the 2010 U.S. Decennial Census raise questions about the net undercount of children in the U.S. Decennial Censuses historically. How do the net undercount rates for children in the 2010 U.S. Decennial Census compare to U.S. Decennial Census results in the past? Have children always had a higher net undercount rate than adults? Have younger children always had a higher net undercount rate than older children?

This paper provides a detailed and systematic examination of the net undercount of children (the population age 0 to 17) in general and young children (population age 0 to 4) in particular in every U.S. Decennial Census since 1950. Differences between Black and Non-Black populations are also examined.

The results shown here are likely to foster better understanding of Census coverage issues for children in the U.S. and the results may also help deepen our understanding of the high net undercount rate for children in other countries as well. The high net undercount of young children has been documented in societies as varied as China, South Africa, Laos, the former Soviet Union, and Canada (Goodkind, 2011; Anderson and Silver, 1985; Anderson, 2004, Statistics Canada, 2004 and 2010).

While the high net undercount of young children in the U.S. Decennial Census has been noted in past studies, the issue has not been examined systematically over time. When data for children have been made available in the past, they are often a small part of a larger volume related to assessing the quality of the U.S. Decennial Census count (U.S. Decennial Census Bureau, 1974; Fay et al., 1988; Robinson, et al, 1993; Robinson and Adlakha, 2002). In many analyses, data for young children are not shown separately from all children which masks important distinctions by age. In addition, the professional literature has offered few ideas about why young children experience such high net undercount rates in the U.S. Decennial Census.

In this paper, I refer to the population age 0 to 17 as “children” and the population age 0 to 4 as “young children.” The population age 18 and over are referred to as “adults.”

After providing background on the Demographic Analysis (DA) estimation methodology, the results of U.S. Decennial Censuses from 1950 to 2010 are examined to detect patterns and trends over time. The net undercount rates of children are compared to those of adults and net undercount rates for children in different age

groups are compared. Trends in net undercount rates of Black and Non-Black children are also examined. Finally, some of the key implications of the study's findings are discussed.

Demographic Analysis History and Methodology

Assessing the net undercounts in the U.S. Decennial Census is typically based on one of two methods: 1) Demographic Analysis (DA), or 2) Dual System Estimates (DSE). This study focuses on the results of DA for reasons that will be explained later in the article. Since there are already several detailed descriptions of the DA methodology available, I will only review the method briefly here (Robinson, 2010; Himes and Clogg, 1992, U.S. Census Bureau, 2010a).

The DA method has been used to assess the accuracy of U.S. Decennial Census figures for more than a half century and its origins are often traced back to an article by Price (1947). The unexpectedly high number of young men who turned up at the first compulsory selective service registration on October 6, 1940 alerted scholars to the possibility of under-enumeration in the 1940 U.S. Decennial Census. The selective service data also provided an independent population estimate for assessing the size of such under-enumeration in the U.S. Decennial Census.

The relatively high net undercount among young children was uncovered early in the history of DA. Census Bureau analysts noted the relatively high undercount of young children in the 1940 U.S. Decennial Census (U.S. Decennial Census Bureau, 1944). In one of the first systematic efforts to use DA to examine U.S. Decennial Census results, Coale (1955) found children age 0 to 4 had a relatively high net

undercount rate in the censuses of 1940 and 1950. Siegel and Zelnik (1966) also found a significant net undercount of children age 0 to 4 in the 1950 and 1960 Censuses. Coale and Zelnick (1963) found high net undercount rates for young children in the U.S. Decennial Census as far back as 1880. Coale and Rives (1973) found very high undercount rates for young Black children in every U.S. Decennial Census from 1880 to 1970. Recent analyses of historical census results also found high net undercount of young children. Hacker (2013) shows that children age 0 to 4 had higher than average net undercount rates in each U.S. Decennial Census from 1850 to 1930. Genealogical research also shows a similar pattern of underreporting young children as far back as the 1850s (Adams and Kasakoff, 1991). Despite early detection of the high net undercount rate for children, I have been unable to find any examination of the trends over time.

The DA methodology used in the 2010 U.S. Decennial Census is described in some detail by U.S. Census Bureau (2010a). The DA method employed for the 2010 U.S. Decennial Census used one technique to estimate the population under age 75 and another method to estimate the population age 75 and older (West, 2012). Since this study focuses on children, only the method used for people age 0 to 74 is discussed here (people under age 1 are classified as age 0).

The DA methodology used in the 2010 Census is described here in some detail with the understanding that DA estimates from past censuses were derived using similar approach. While a few details of the DA estimation methodology have changed from decade to decade, the basic framework has not. The DA methodology involves comparing the Census counts to independent population estimates based largely on

vital events. For a history of DA use at the U.S. Census Bureau over time, see Robinson (2010).

The 2010 DA estimates for the population age 0 to 74 are based on the compilation of historical estimates of the components of population change: Births (B), Deaths (D), and Net International Migration (NIM). The data and methodology for each of these components are described in a separate background document prepared for the development and release of the Census Bureau's 2010 DA estimates (Robinson, 2010; Devine et al., 2010; Bhaskar et al., 2010).

As described by the U.S. Census Bureau (2010a) the DA population estimates for age 0 to 74 are derived from the basic demographic accounting equation (1) applied to each birth cohort:

$$(1) P_{0-74} = B - D + NIM$$

P_{0-74} = population for each single year of age from 0 to 74

B = number of births for each single year of age

D = number of deaths for each age cohort since birth

NIM = Net International Migration for each age cohort

For example, the estimate for the population age 17 on the April 1, 2010, Decennial Census date, is based on births from April 1992 through March 1993, reduced by the deaths to that cohort in each year between 1992 and 2010, and incremented by Net International Migration (NIM) of the cohort each year over the 17-year period.

Births are typically the largest component of DA estimates for children. For example, births account for 97 percent of DA population estimate for age 0 to 17 in 2010, and for 99.6 percent of the DA population estimate for the population age 0 to 4 (U.S. Census Bureau, 2010b). The DA estimate of the population age 0 to 4 released in May 2012 is comprised of 21,076,000 births, 148,000 deaths, and net international migration of 244,000.

The birth and death data used in the Census Bureau's DA estimates come from the U.S. National Center on Health Statistics (NCHS) and these records are widely viewed as being accurate and complete (Devine et al., 2010). The Census Bureau assumes death data have been complete since 1959 and birth data have been complete since 1985 (Devine et al., 2010). Adjustments were made to earlier DA estimates to account for under-registration of births and deaths.

There are four major limitations to DA. First, it is only routinely available for the nation as a whole. The fact that many people move after birth is a barrier to employing this method at the subnational level. While attempts have been made to produce subnational DA estimates, they have not been widely used (Robinson, Ahmed, and Fernandez, 1993; Adlakha et al, 2003).

Second, DA estimates are only available historically for Black and Non-Black groups. This restriction is due the lack of race specificity and consistency for data collected on the birth and death certificates historically. The only group that has been identified consistently over time is Blacks (African-Americans). DA estimates for the

net undercount of Hispanic children were made available for young children in 2000 and all children in 2010, but there are no such estimates prior to 2000.

The third limitation of the DA estimates is that they only supply net undercount/overcount figures. A zero net undercount could be the result of no one being missed (omissions) or double counted (erroneous enumerations) or it could be the result of an equal number of omissions and erroneous enumerations.

The fourth limitation of the DA methodology is the lack of any measures of uncertainty regarding the point estimates. However, in the DA release of December 2010, the Census Bureau offered results for five different DA scenarios to illustrate the uncertainty surrounding the DA estimates. For children age 0 to 17, the DA estimates ranged from a low of 75,042,000 to a high of 76,222,000, which amounts to a 1.6 percent difference between the lowest and highest estimates. The results for the population age 0 to 4 ranged from a low of 21,181,000 to high of 21,265,000 for the five scenarios. In percentage terms, the difference between the lowest estimate and the highest estimate is 0.39 percent. This provides at least one guide to expected variation in the DA estimates and suggests that the DA estimates for children are likely to contain relatively little error.

Despite these limitations, DA has been used for many decades; the underlying data and methodology are strong, and it has provided useful information for those trying to understand the strengths and weaknesses of the U.S. Decennial Census. According to Robinson (2000, page 1), “the national DA estimates have become the accepted benchmark for tracking historical trends in net Census undercounts and for assessing coverage differences by age, sex, and race (Black, all other).”

The other major source of data on undercounts and overcounts is the Census Bureau's Dual Systems Estimates (DSE) methodology. The DSE uses a Post-Enumeration Survey to develop an estimate of the true population which is then compared to the Census counts. The DSE approach for 2010 is called Census Coverage Measurement but DSE has been given other names in previous censuses. The 2010 U.S. Decennial Census is the first one where DSE has produced data for the population below age 5, so there is no way to examine historically comparable data for young children using DSE, which is a major limitation in the current study. Although it should be noted that there were Dual System Estimates of coverage issued prior to 1990. Moreover, there are no consistent data from the DSE approach prior to 1990 (O'Hare, et al 2012). For example, the 1980 Census evaluation (called the Post-Enumeration Program- PEP) issued a report with 12 different estimate series (U.S. Census Bureau 1981).

In the context of comparing the results of DSE (in the 2000 U.S. Decennial Census, the DSE was called the Accuracy and Coverage Evaluation – A.C.E.) and DA in the 2000 Census, and noting the generally consistent results, the Census Bureau (2003, page v) concludes,

“The primary exception to the consistency of results occurs for children aged 0-9. While the A.C.E. Revision II estimates a small net overcount for children 0-9 (the estimate was not statistically significantly different from zero), Demographic Analysis estimated a net undercount of 2.56 percent. The Demographic Analysis estimate for this age group is more accurate than those for other age groups because the estimate for young children depends primarily on recent birth registration data which are believed to be highly accurate.”

In comparing the DA results to DSE results in the 2000 Decennial Census, Zeller (2006. P. 320) also concluded:

“Since the Demographic Analysis estimate for young children depended on highly accurate recent birth registration data, the Demographic Analysis estimate is believed to be more accurate.”

Hogan et al (2013, page 98) also find:

“Given the methodology that underlies DA, its estimates of younger populations tend to be quite accurate.”

A National Research Council report (2004, page 254) made the same observation about the inconsistency of DA and DSE estimates for young children and the authors note, “No explanation for this discrepancy has been advanced.”

O’Hare, et al (2012) document the inconsistency between DSE and DA estimates for young children and suggest that uncorrected correlation bias may result in an underestimation of the undercount for young children in the DSE methodology. Table 1 shows the differences between DA and DSE estimates for young children in 2000 and 2010. In 2010, DA estimates a net undercount of 4.6 percent for the population age 0 to 4, but the net undercount estimate from DSE for this population is only 0.7 percent.

Table 1. Net Percent Undercount Estimates from DA and DSE for age 0-9 and 10-17 in 2000 and 2010

	2000 Age 0-9	2010 Age 0-9	2010 Age 0-4
DA	-2.6	-3.4	-4.6
DSE	0.5	-0.2	-0.7

Source: O’Hare et al 2012

In the analysis shown here, I rely exclusively on DA estimates. I believe that the strengths of DA methodology make it a particularly good technique for estimating the number of young children. In addition, the inconsistency between DSE and DA estimates for young children raises questions about the DSE estimates for young children. Since there are no comparable figures for the undercount of young children from the DSE approach prior to 2010 and no comparable data for all children prior to 1990, it is unsuited for the current analysis.

Data Sources

DA estimates for the 1950 through 2000 Censuses are from a Census Bureau internal file which provides DA estimates of the population by age, sex, and race (Black and Non-Black) for each U.S. Decennial Census year. These DA estimates are based on an on-going compilation of historic birth and death certificate data and net international migration estimates. Some adjustments to birth and death data for earlier years are made by the Census Bureau based on estimated under-registration.

The corresponding counts from the U.S. Decennial Censuses are also available on this internal file. Since DA estimates are only available for the youngest ages from the 1940 U.S. Decennial Census, the time series examined here starts in 1950. Since the internal Census Bureau historical series has been updated regularly, the figures presented here may differ in minor ways from data published previously by the Census Bureau.

For the 2010 U.S. Decennial Census data in this paper, I used the revised DA estimates issued in May 2012. In May 2012 the Census Bureau issued revised

Demographic Analysis estimates for the total population, the Black alone population, the Black alone or in combination population, the Not Black alone population and the Not Black alone or in combination population (U.S. Census Bureau, 2012). The estimates for the Black Alone or in Combination populations were only provided for the population below age 30. The May 2012 estimates were based on the more recent birth and death data and improvements from ongoing research compared to the DA estimates originally released in December 2010.

In the remainder of this study, I follow the model used by Velkoff (2011) and show the differences between the U.S. Decennial Census counts and DA estimates as the U.S. Decennial Census count minus the DA estimate. This calculation is often labeled “net census coverage error” in other research. In this construction, a negative number implies a net undercount and a positive number implies a net overcount. This may be a point of confusion because in some past studies a similar measure has been used which subtracts the U.S. Decennial Census counts from the DA (or DSE) estimates. In that construction, a negative figure implies an overcount. I chose to use the Velkoff style of presentation because I feel having an undercount reflected by a negative number is more intuitive.

In converting the differences between U.S. Decennial Census counts and DA estimates to percentages, the difference is divided by the DA estimate. Estimates are shown rounded to the nearest thousand for readability.

Historic Patterns in the Net Undercount of Adults and Children

Examination of net census coverage rates from 1950 to 2010 indicates a significant and steady reduction in the net undercount in the total population. Figure 1 shows that the net undercount rate for the total population has fallen nearly ever decade since 1950, reaching a small net overcount in 2010. However, when the overall trend is decomposed by age, a somewhat different story emerges.

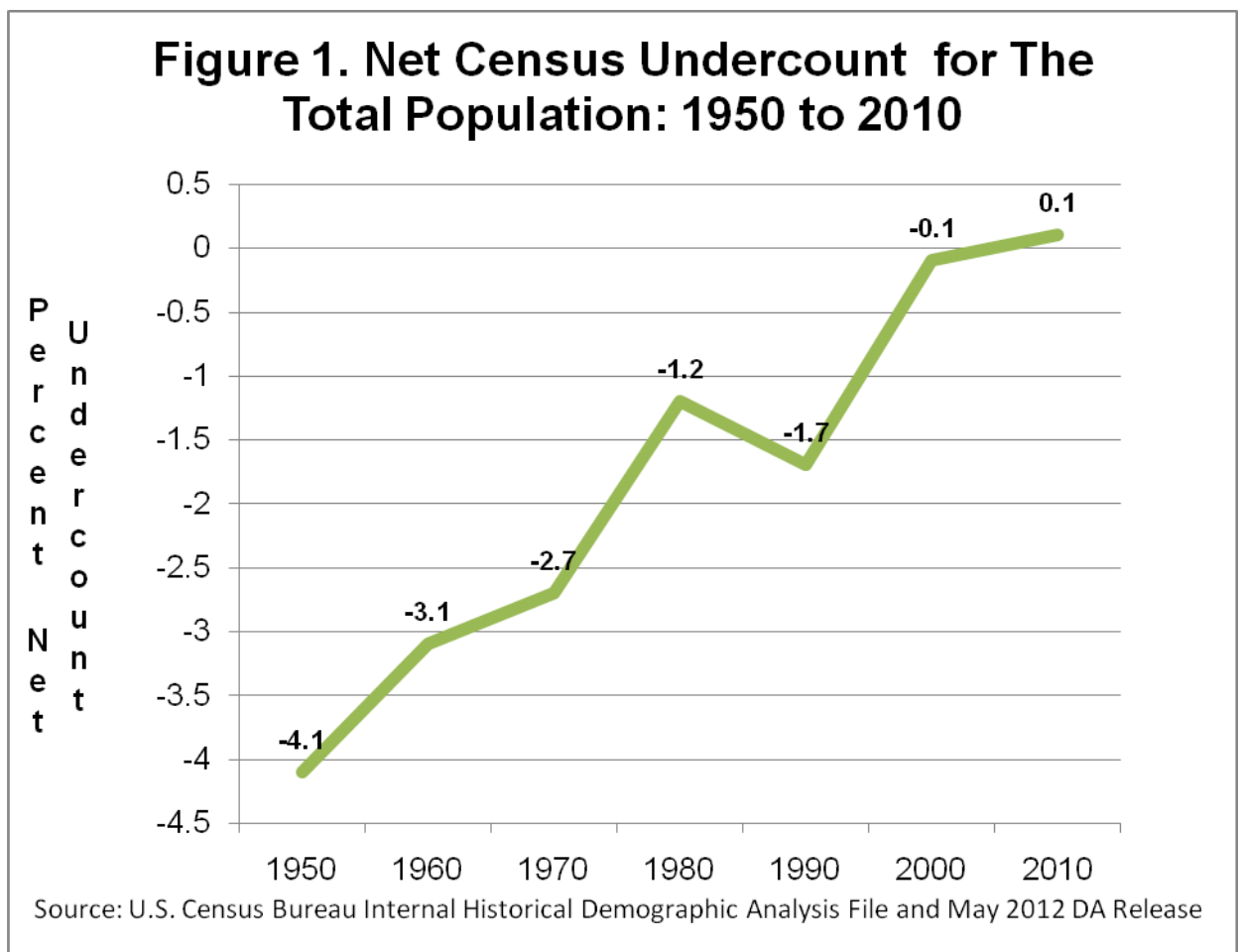
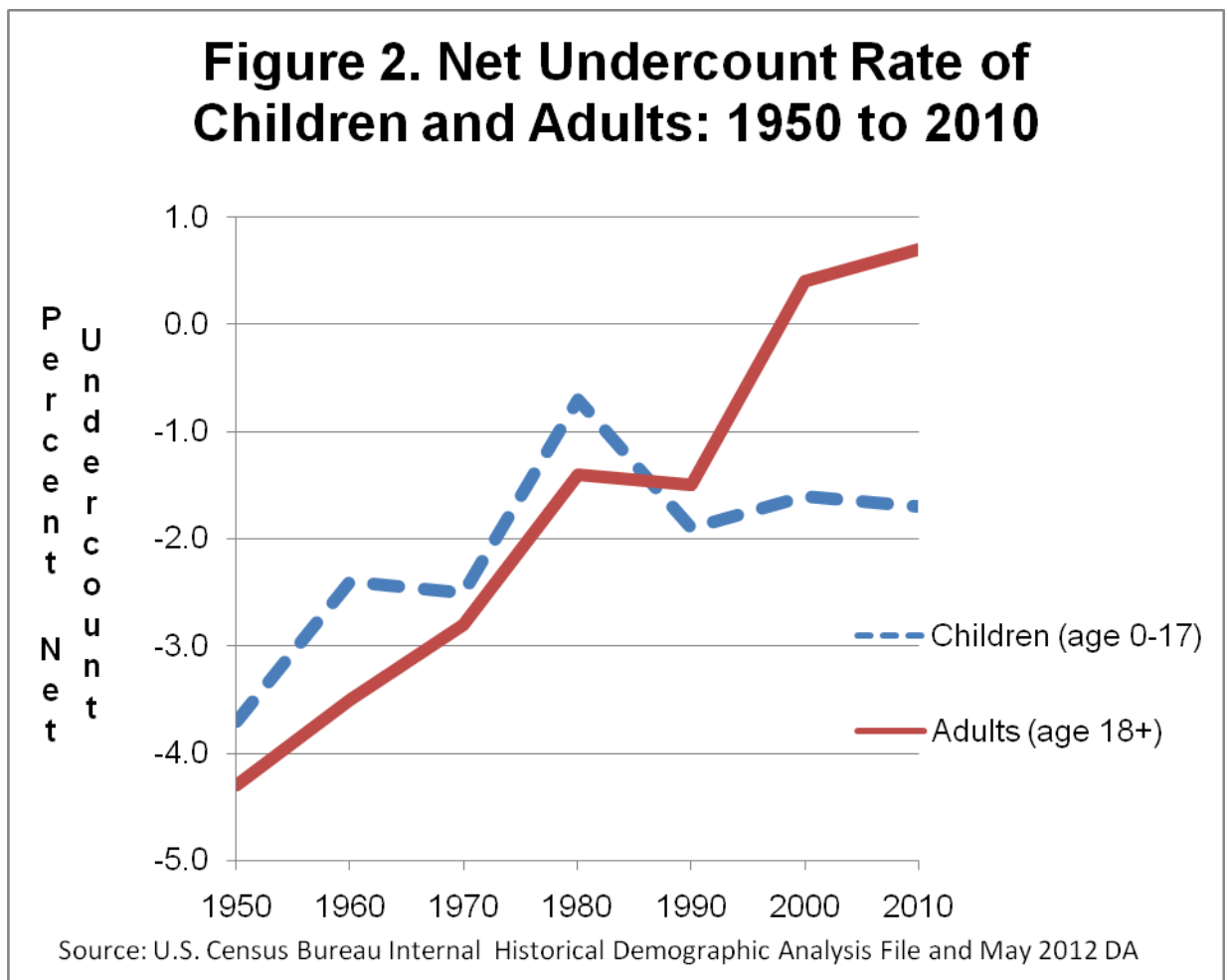


Figure 2 shows net undercount rates for the adult population (age 18+) and the child population (age 0 to 17) for each U.S. Decennial Census from 1950 to 2010. Figure 2 shows that there have been two very distinct periods between 1950 and 2010 in terms

of the net undercount trends of adults and children. Between 1950 and 1980, the net undercount rates for both groups declined steadily and the differences between the net undercount rate of children and adults were not large. Specifically, the net undercount of the adult population went from 3.8 percent in 1950 to 1.4 percent in 1980. For children the net undercount rate fell from 3.5 percent to 0.7 percent over the same period.



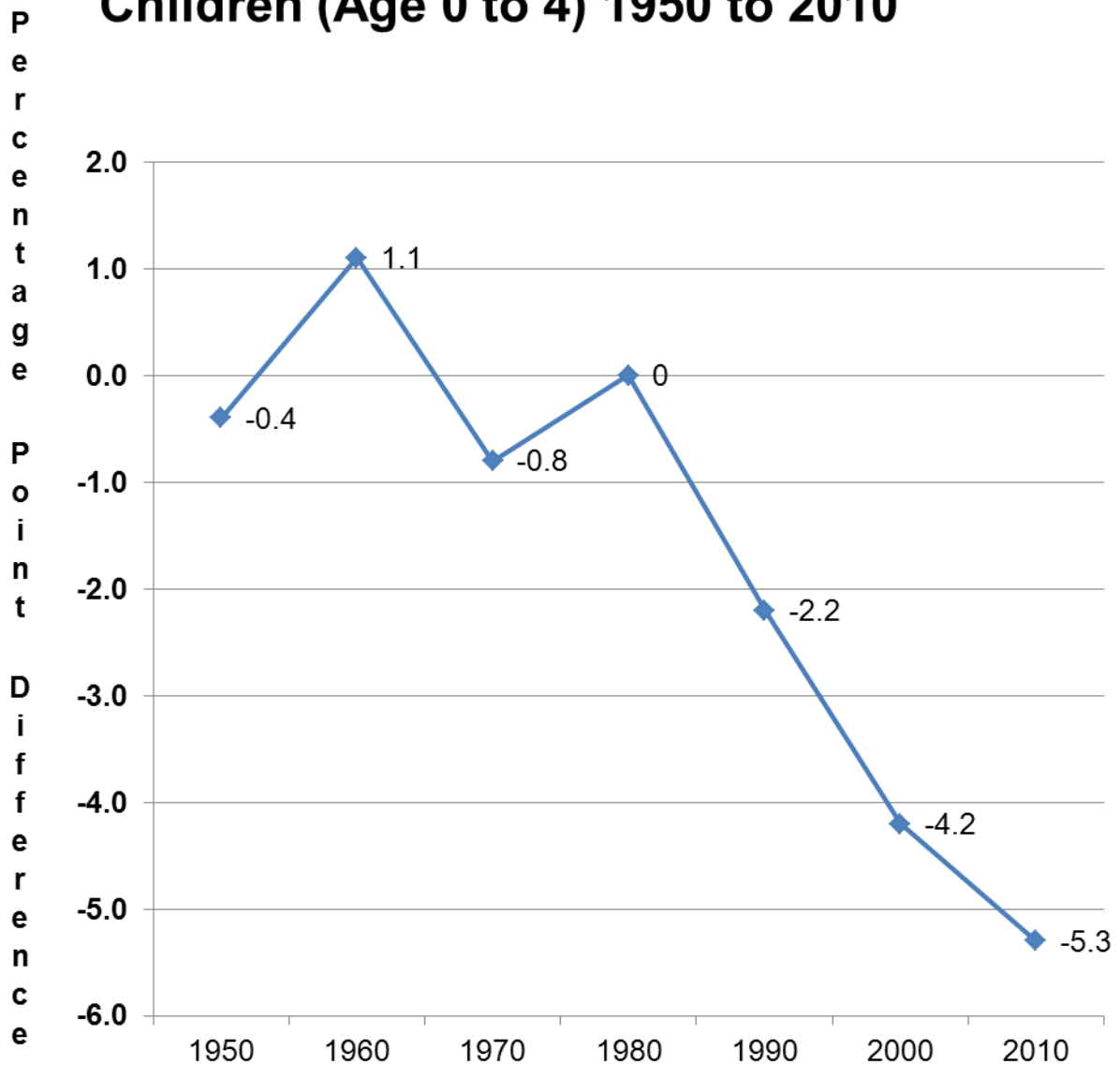
Between 1980 and 1990, the net undercount rates of both children and adults increased but the divergence between undercount rates of children and adults begin to emerge during this period because the net undercount rate for adults went from 1.0

percent in 1980 to 1.6 percent in 1990, and the net undercount rate for children went from 0.7 percent in 1980 to 1.8 percent in 1990.

The gap between the net undercount rates of children and adults went from 0.2 percentage points in 1990 (1.6 percent for adults and 1.8 percent for children) to 2.4 percentage points in 2010 (0.7 percent overcount for adults compared to a 1.7 undercount of children).

Figure 3 shows the gap between the census coverage rates of adults and children from 1950 to 2010 in a more direct way. Between 1950 and 1980 the gap was relatively small and stable, varying between 0 and 1 percentage point in absolute terms. Figure 3 shows the divergence after 1980 is striking and appears to be increasing at an exponential rate.

Figure 3. Gap in Net Undercount Rates of Adults (Age 18+) and Young Children (Age 0 to 4) 1950 to 2010



Source: U.S. Census Bureau Internal Historical Demographic Analysis File and May 2012 Demographic Analysis Release

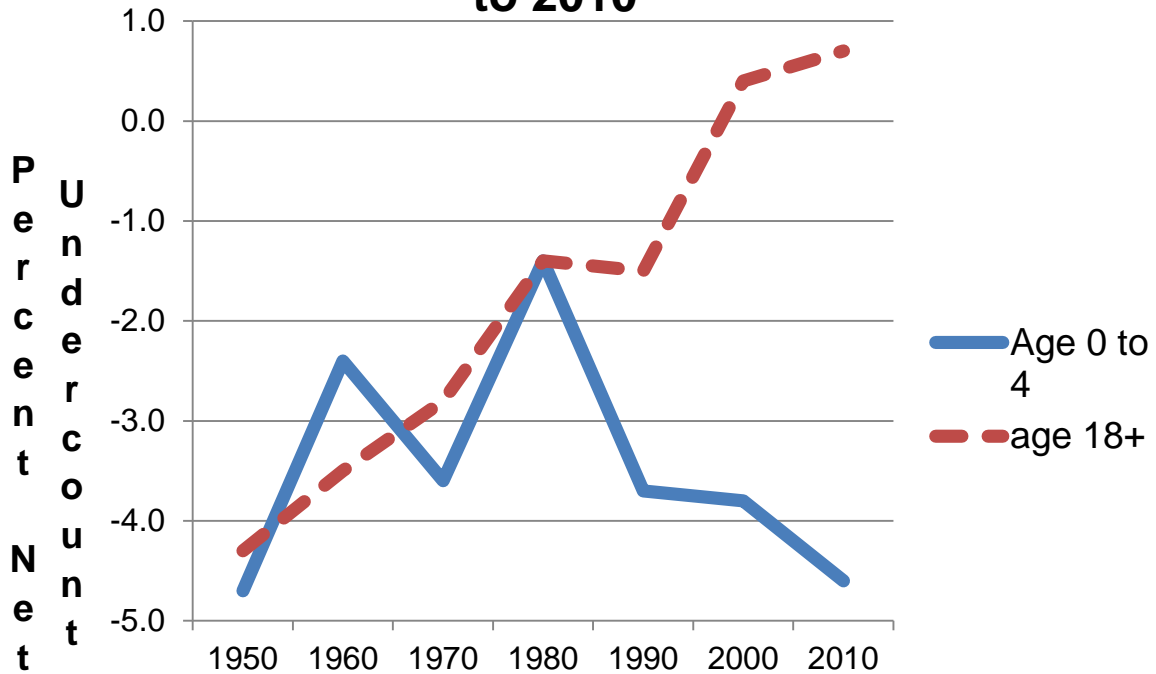
The high net undercount rate for the population age 0 to 4 in the 2010 U.S. Decennial Census suggests this age group should be examined separately. Figure 4

shows the net undercount rates of young children (age 0 to 4) and adults (age 18+) from 1950 to 2010. The gap between the undercount rate for young children and adults has grown from 0.9 percentage points in 1950 to 5.3 percentage points in 2010 with most of the change coming since 1980. In 1980, the net undercount rates for adults was 1.0 and for young children it was 1.4 percent, but by 2010, the net undercount rate for young children was 4.6 percent while the adult population experienced a net overcount of 0.7 percent.

Perhaps the most striking aspect of Figure 4 is the change in the net undercount rates of young children following the 1980 Census. Between 1980 and 2010, the net undercount rate for young children went from 1.4 percent to 4.6 percent. Over the same period the net undercount rate of adults continued the improvement that had been witnessed during the 1950 to 1980 period. What happened after 1980 that altered the trajectory of net undercount rates for young children? The profession has not offered any answers to this question.

Another perspective on the data in Figure 4 is to see the 1980 data as an outlier. If one ignores the results from the 1980 Census, there has been relatively little movement in the net undercount of young children between 1950 and 2010. If one discounts the 1980 results, the net undercount of young children was between -2.4 percent and -4.6 percent in every Census from 1950 to 2010 with out much of a temporal pattern before or after 1980. From this perspective the question is not what happened after 1980, but rather why has there been consistently high net undercount rates for young children since 1950? Again, the profession has not offered any answers to this question.

Figure 4. DA Net Undercount Estimamntes for Age 0 to 4 and Age 18 and older; 1950 to 2010

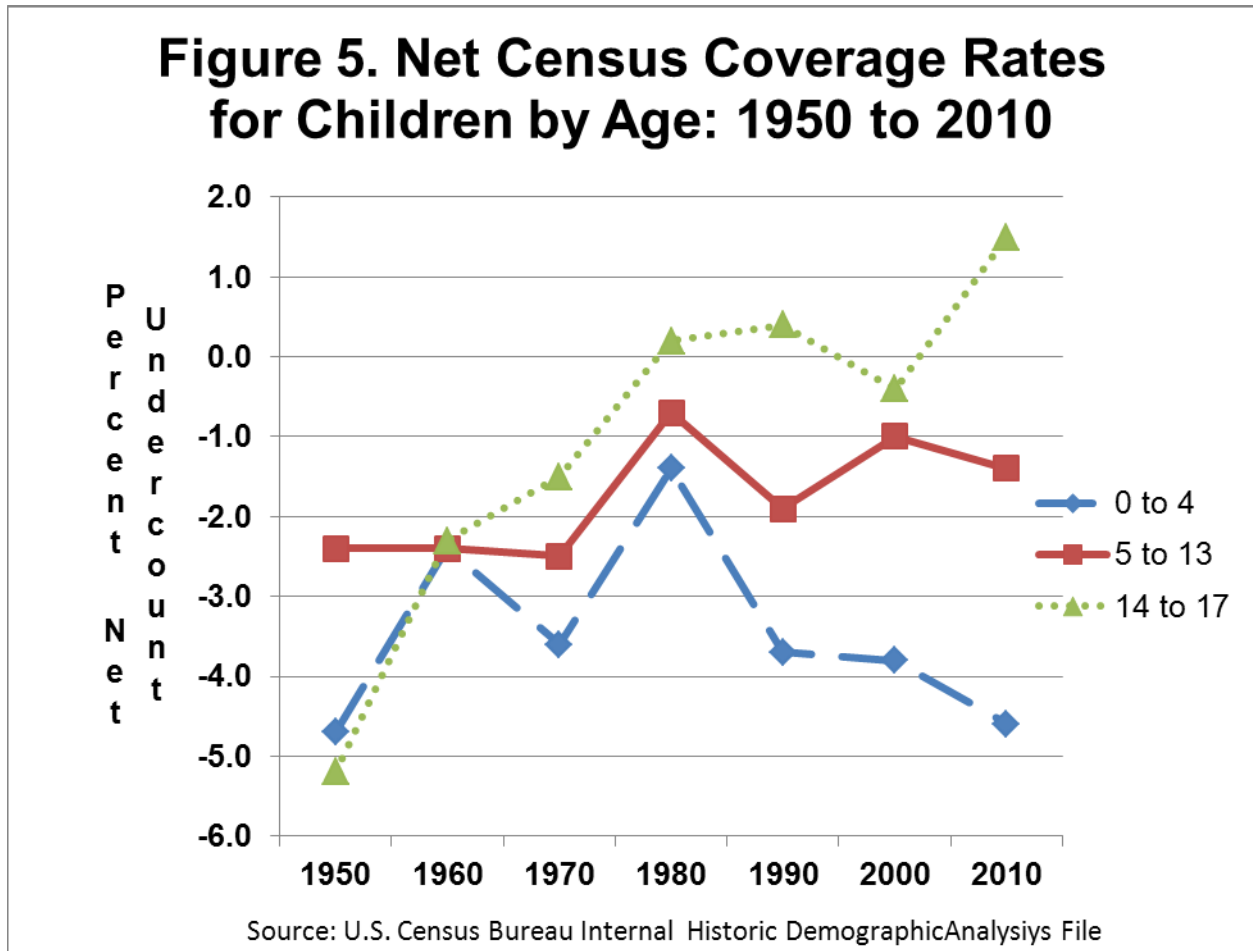


Source: U.S. Census Bureau Internal Historic Demographic Analysis File

Children by Age

The overall trend in the net undercount rates of children from 1950 to 2010 masks very different trajectories for children in different age groups. Figure 5 shows the trends in net census undercount rates since 1950 for three age groups of children; age 0 to 4, age 5 to 13, and age 14 to 17. These age groupings were used because these groups have very different net census coverage rates in the 2010 U.S. Decennial Census.

Figure 5 shows that there has been growing divergence in census coverage rates for children of different ages and that the differences among age groups are more striking after 1980 than before.



In the earliest year of the period examined here, both young children and older children (those age 14 to 17), had above average net undercount rates. In 1950, both groups had undercount rates in the neighborhood of 5 percent, while the 5 to 13 age group had an undercount rate about half that.

Similar to the adult population, the net undercount rates for the population age 14 to 17 has shown steady decline since 1950, reaching a net overcount of 1.5 percent in 2010. From 1950 to 1980, the young child population also experienced an improving undercount rate, going from 4.7 percent undercount in 1950 to 1.4 percent in 1980. While the net undercount rate of the population age 14 to 17 continued to improve after 1980, the net undercount rate of the population age 0 to 4 fell from 1.4 percent in 1980 to 4.6 percent in 2010.

Relative to young children and the population age 14 to 17; children in middle childhood (age 5 to 13) experienced pretty steady net undercount rates between 1950 and 2010. The rates for this age group varied from a low net undercount of 0.7 percent in 1980, to a high of 2.5 percent in 1970. Even though the net undercount rate for those ages 5 to 13 has been relatively small; it is worthy noting that there has been a net undercount for the population age 5 to 13 in every census since 1950.

The net undercount rate for young children in 2010 (4.6 percent) is almost the same as the rate experienced by this group in the 1950 Census (4.7 percent). Over the same time period the net undercount rate for the population age 14 to 17 fell from 5.2 percent to a net overcount of 1.5 percent; a 6.7 percentage point swing.

Historic Patterns by Single Year of Age

The 2010 results show a clear age gradient in terms of net undercounts and net overcounts for children. In 2010, the correlation between net undercount rates and age for children was - 0.96. For children, as age increases net undercount rates decrease.

Has there been a similar gradient by age in terms of the net undercounts and overcounts of children in the past Censuses?

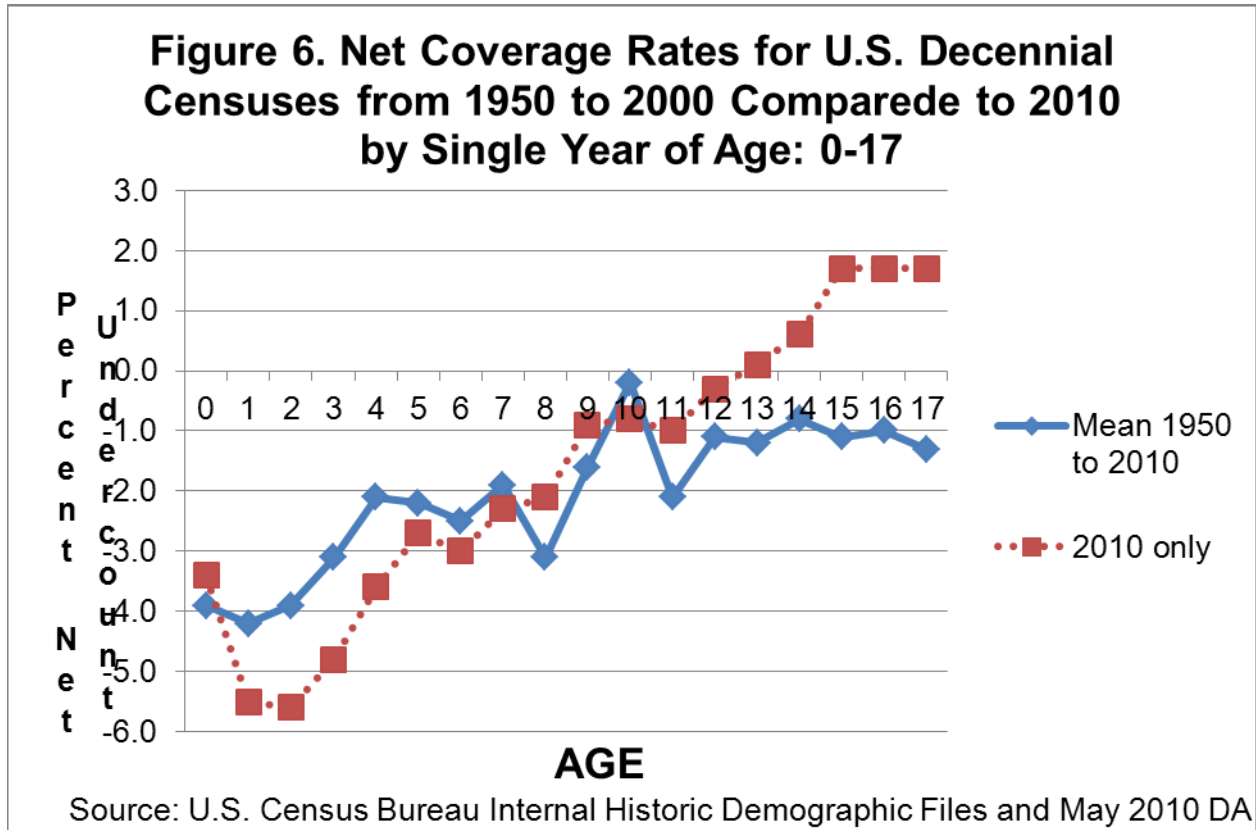


Figure 6 shows the net undercount rate of children by single year of age for the 2010 U.S. Decennial Census and the average net undercount rate over every U.S. Decennial Census 1950 to 2000 by single year of age from 0 to 17.

The age gradient for all U.S. Decennial Censuses from 1950 to 2000 is not as steep as that seen in the 2010 U.S. Decennial Census, but the general form of the relationship seen in the 2010 U.S. Decennial Census is consistent with past censuses in terms of a higher than average net undercount rate for young children and underscore

the extent to which the high undercount of young children has been a long-standing problem.

The main point here is that young children have had higher census net undercount rates than older children consistently since 1950. The slope of the age gradient has changed over time, but fundamental relationship between age and net undercount rates have been relatively consistent since 1950.

Age heaping on age 10 is evident in Figure 6 and the Figure also reflects the results of the 1990 Census where ages ending with the numeral “8” were heavily under-represented. If the age heaping could be corrected, it is likely that the relationship between age and net undercount rates in the past would be smoother.

Undercount of Black Children Over Time

Historically, Black is the only race group that was coded consistently in birth and death certificate data, so it is the only group for which DA estimates could be produced.

The key to using the DA methods for Blacks and Non-Blacks is making the race categories consistent between the vital events data and the Decennial Census. There have always been issues in trying to make data from these two data systems consistent, but the challenge of making accurate DA estimates for Blacks and Non-Blacks has increased in recent years. In discussing the use of vital statistics for DA estimates by race the Census Bureau (Devine et al 2010, p.4) concludes, “While some of these issues may be relatively minor in terms of the impact on the final DA estimate of coverage, developing the estimates for DA race categories comes with a more complex, and substantial set of challenges.” See Robinson (2010) for a good general

discussion of issues associated with racial classifications in the U.S. Decennial Census and the vital events registers.

Developing a historic series of net undercount rates for the Black population is a bit problematic because the official categories or definitions have changed over time. Prior to the 1980 Census, the U.S. Decennial Census figures used to compare with the DA estimates for Blacks were the U.S. Decennial Census figures for Blacks. In 1980, the Census Bureau compared the DA estimates to a modified file which assigned people in the “some other race” category to a Black or Non-Black category (Fay, Passel, and Robinson, 1988). In 1990, the Census Bureau used the race of father from the birth certificate to assign race to newborns and then compared DA estimates for Blacks to the MARS (Modified Age, Race, and Sex) file from the Census. For 2000, the Census Bureau used race of father from the birth certificate to assign race to newborns and then DA estimates were compared to an average of Black alone and Black alone or in combination based on the Census Bureau’s modified race file (U.S. Bureau of the Census, 2003).

There are multiple problems in trying to make data collected in the U.S. Decennial Census racial categories comparable to the race data collected on birth and death certificates. For example, the “Some Other Race” category is a response category for the race question in the U.S. Decennial Census but not in birth or death certificates. Because the birth certificate data does not have a “some other race” category, the Census Bureau constructs a set of modified race categories from the U.S. Decennial Census responses in which respondents in the some other race category are distributed to Black and Non-Black categories. Thus for making comparisons between

DA estimates and the U.S. Decennial Census counts for Blacks and Non-Blacks, one must use the 2010 U.S. Decennial Census modified race tabulations available on the Census Bureau's website. Correctly re-assigning people from the "some other race" category to Black Non-Black categories is a challenge.

A second issue is the fact that U.S. Decennial Census respondents in 2000 and 2010 could mark more than one race. Prior to the 2000 Census, respondents were only allowed to mark one race in the U.S. Decennial Census, which meant the race data from the U.S. Decennial Census and from vital events were consistent in this regard. In 1997, the U.S. Office of Management and Budget (1997) updated Statistical Policy Directive 15 requiring federal data collection efforts to allow respondents to mark more than one race.

This issue is further complicated by the fact that it wasn't until 2003 that the federal government issued new standard birth certificate and death certificate forms allowing parents to mark more than one race. However, birth and death certificate data are collected by states and states only changed to the new form slowly over time. Every year after 2003, a new group of states adopted the new birth certificate and death certificate forms. Therefore, each year after 2003 to 2010 the Census Bureau received files on births from NCHS with two kinds of racial categories: one file with multiple race data and one file which is bridged back to single races available before 2000 Census.

The mixed race data from the birth (and death) certificates had to be put into Black and Non-Black categories, based on both single-race and multiple-race reported by mother and fathers. NCHS provided the Census Bureau with both the multiple races

that are reported and the multiple race response “bridged” to the pre-1997 OMB single race categories. Details about the bridging method are provided by NCHS on their website (http://www.cdc.gov/nchs/nvss/bridged_race.htm).

In addition, for the DA release of May 2012, DA estimates were provided for “Black alone” as well as “Black alone or in combination” so birth certificate data had to be put into these two different racial categories. The black alone or black alone or in combination were only employed for the population born since 1980, that is, those under age 30 in 2010. The Census Bureau only has the raw data from birth certificates for those born after 1980.

Another issue is that birth certificate forms only record the race of the mother and father while the race of a child is asked directly in the Decennial Census. Thus, the race of the newborn must be inferred from the race of the parent(s). This is further complicated by a significant level of missing data. While data on the race of mother is relatively complete, many birth certificates are missing data on the race of the father. In 2009, 19 percent of birth certificate forms did not contain the race of the father (Martin, et al, 2011).

When both parents report the same race, that is the race assigned to the child. When the two parents report different races on the birth certificate, the Census Bureau assigns newborns to one of thirty-one race categories based on the reported race of their mother and father and on parent-child race relationships seen in the 2000 and 2010 U.S. Decennial Census data (Ortman, Hollman and Guarneri, 2012).

Given the issues described above, one should view DA estimates for Blacks (alone or alone or in combination) cautiously. Small differences or small changes over time could be due to methodological issues rather than real differences or changes.

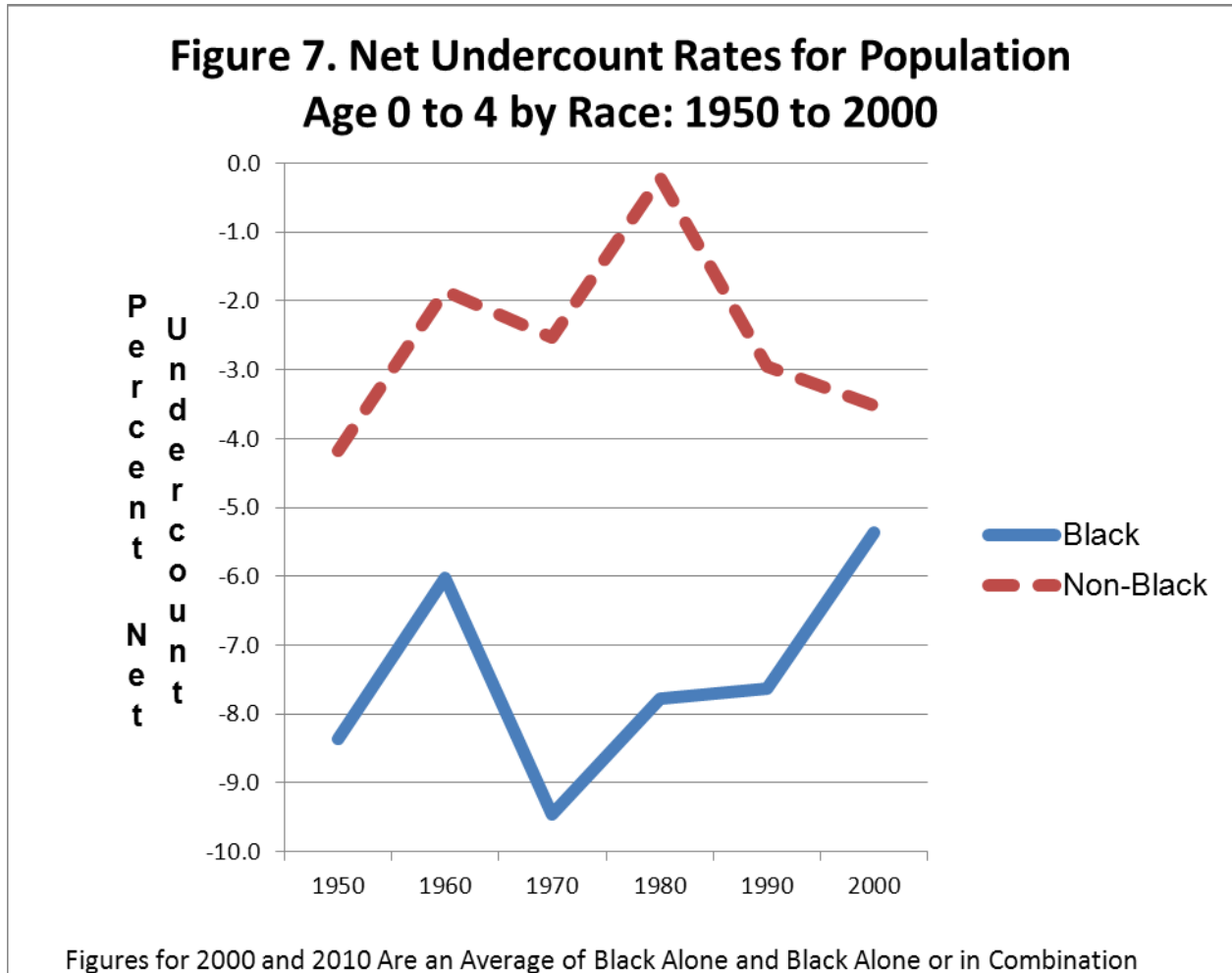
Assignment of race on death certificates is also a potential problem, but deaths contribute very little to the DA estimates for children (Aries et al. 2008).

Since the most recent trends are complicated by new data on Black Alone and Black Alone or in Combination available only in 2010, I discuss the changes between 2000 and 2010 in Black and Non-Black net undercount rates separately from the 1950 to 2000 trends. It should also be noted that in the 2000 Census, respondents were allowed to select more than one race similar to the 2010 situation but the Census Bureau only released one set of DA estimates for blacks in 2000 which makes this data easily comparable to earlier censuses.

Trends by Race from 1950 to 2000

Figure 7 shows the net undercount rate of Black children and Non-Black children for each U.S. Decennial Census from 1950 to 2000. In every U.S. Decennial Census from 1950 to 2000, the net undercount rate for Black children was higher than that for young Non-Black children. However, the gap has narrowed mostly because of changes from 1990 to 2000 because the net undercount rate for the Black population has decreased. The net undercount rate for Black children in 1950 was 6.0 percent but it had fallen to 1.3 percent in 2000. The net undercount rate for Non-Black children fell from 1950 to 1980, but has remained relatively stable since 1980 at relatively low rates. It should be noted that Hispanics who have relatively high net undercount rates, have

become a much larger component of the non-Black child population since 1980 (O'Hare, 2013) and this complicates interpretation of recent trends.



Trends by Race from 2000 to 2010

The bottom panel in Table 4 shows the net undercount rate for all children and young children in four race categories: 1) Black Alone, 2) Black Alone or in Combination, 3) Not Black Alone, and 4) Not Black Alone or in Combination. None of these figures are comparable to the data from 2000, when there was only one figure for blacks.

Trends between 2000 and 2010 in the net undercount rate differ significantly depending on whether one uses data for the Black Alone child population or the Black Alone or in Combination child population.

The net undercount figures from the 2010 U.S. Decennial Census show that for children age 0 to 17, the difference between the net undercount rate for Black alone (0.6) and Black alone or in combination (1.5) was less than one percentage point. However, for young children (age 0 to 4) the difference between these two groups was much larger. The net undercount rate for Black alone children age 0 to 4 was 4.4 percent, but for Black alone or in combination the net undercount rate was 6.3 percent.

The only difference between the Black Alone and the Black Alone or in Combination populations is the group that is black in combination. While this is a relatively small group, the 2010 DA estimate show 3,195,000 Black Alone age 0 to 4 and 3,905,000 Black Alone or in Combination age 0 to 4. By subtraction this means there were only 710,000 in the Black in Combination category. So the black in combination group accounts for 18 percent of the Black Alone or in Combination group.

The two figures confound efforts to understand recent trends in the net undercount rates of Black and Non-Black populations. The net undercount rate reported by the Census Bureau for Blacks age 0 to 4 in the 2000 Census was 5.4 percent. The net undercount rate for Black alone in 2010 (4.4 percent) suggests that the net undercount rate for this population fell between 2000 and 2010, but the net undercount rate for Black alone or in combination (6.3 percent) suggest that the net undercount rate for this group increased between 2000 and 2010. It should be noted that the Black Alone or in Combination population better reflects the spirit of U.S. Office

of Management and Budget (2001) regulation regarding use of data based on more than one race category.

Recall that the reported net undercount rate for blacks in 2000 was the DA estimate compared to an average of the Black Alone and Black Alone or in Combination Census figures.

Hispanics 2000 to 2010

The historical data on Hispanics is very limited but examination of data from 2000 and 2010 show the net undercount rate for young Hispanics has been consistent. The net undercount rate for young Hispanic children in 2000 was 7.7 percent compared to 7.5 percent in 2010.

Discussion

U.S. Decennial Census undercounts are typically examined through a comparative lens. If all groups and all places were undercounted equally, the U.S. Decennial Census undercount would be much less of a problem, at least in a political or public relations context.

Historically the comparative paradigm used most often has been the comparison of Black and Non-Black populations (see Fein, 1989 as well as Anderson, Citro and Salvo, 2012, page 175-178). I argue that age differences are now just as important as racial differences.

Moreover, the usefulness of Black/Non-Black comparisons is fading, as Hispanics become a much larger share of the Non-Black population. In 1980, Hispanics made up 9 percent of the population age 0 to 17, but in 2010 they were 23 percent. Projections indicate Hispanics will be 27 percent of the child population by 2020. Hispanics are a much larger share of the Non-Black population today and data indicate they have undercount rates that rival or exceed those of Blacks. Consequently, the gap between Black and Non-Black undercount rates is confounded by changing demographics of the Non-Black population. There is a similar problem comparing Hispanics to the Non-Hispanic population because the Non-Hispanic population includes Blacks. The composition of the Non-Black population has changed more rapidly for children than for other age groups.

The comparative perspective used in this study focuses largely on differences by age and I would argue that this is an important perspective as we move forward. While this perspective has been employed in past in limited cases, it has not received the same focus of attention that racial differentials have received. Over time, the gap between the measured undercount rates of adults and young children has become larger than the gap between Black and Non-Black populations. The gap between DA estimates for young children and adults (5.3 percentage points in 2010) is now much larger than the gap between Blacks and Non-Blacks of all ages (3.0 percentage points in 2010) (Velkoff, 2011).

Even among children the gap in the net undercount rates between the youngest group of children, those age 0 to 4, (-4.6 percent) and the oldest group of children, those age 14 to 17, (+1.5 percent) is 6.1 percentage points, while the difference

between the net undercount rate of young Black children (4.4 percent for Black Alone or 6.3 percent Black Alone or in Combination) and the rate for Not Black (Not Black Alone -4.6 percent) and Not Black Alone or in Combination (-1.9 percent) is much smaller.

It is also clear that people under age 18 should not be treated as a homogeneous age group with regard to U.S. Decennial Census undercounts and overcounts as has been done in previous reports. The data show that young children have a relatively high net undercount rate while the population age 14 to 17 has a net overcount and the gap between these two age groups has been growing over time. Analyses that fail to make a distinction among age groups of children are likely to find interpretation of findings difficult. The explanation for why young children experience a high net undercount is likely to be quite different than the explanation for why teens (age 14-17) have a net overcount. Moreover, combining the age 0 to 4 population and the age 14 to 17 population into one group masks the differences between the Census and the DA estimates in both groups. Examination of historic trends since 1950 indicates that younger children have always been undercounted at a higher rate than older children in the U.S. Decennial Census.

The increasing complexity of measuring race in the U.S. is reflected in the data on changes in the net undercount rates Blacks and Non-Blacks since 2000. The difficulty of providing meaningful and stable categories for respondents undercounts the important work currently underway at the U.S. Census Bureau (2013).

While the high net undercount rate for young children is clear, the reasons for such a high rate are not. It is possible that the way the U.S. Decennial Census data are

collected and/or processed results in a high net undercount of young children. For example, the continuation form used by the Census Bureau to capture information on persons in large households may have a differential impact on young children. The 2010 U.S. Decennial Census mail out questionnaire only contains room for complete information for six people in the household. If there are more than six people in the household, the Census Bureau must follow-up to get complete information. The 2010 American Community Survey shows that 10.1 percent of young children live in such large households, compared to 3.5 percent of adults. Therefore, any problem following-up with these types of households would affect young children disproportionately.

It is possible that the way the Census Bureau imputes age to cases where age is not provided or the data provided is implausible, may result in an underestimation of young children. Perhaps, too many people had their age imputed as age 14 to 17, and too few had their age imputed as age 0 to 4.

It is also plausible that the living arrangements and/or locations of young children may be the driving force behind their high net undercount rates. Research shows that the number of children living in high poverty neighborhoods increased by more than 1.5 million after 2000 (The Annie E. Casey Foundation, 2012).

While speculation about these kinds of explanation abound, there is very little in the way of empirical research testing these ideas. As we move towards the 2010 Decennial Census, it is important to try and gain a better understanding of why young children have such a high net undercount rate in the Census. Without an understanding of why young children are missed in the Census, it will be difficult to devise operations

that are likely to improve our count of this group in 2020.

Conclusions

A passage from the 1940 U.S. Decennial Census (U.S. Decennial Census Bureau, 1944, page 32), reads, “Underenumeration of children under 5 year old, particularly of infants under one year old, has been uniformly observed in the United States U.S. Decennial Census and in the Censuses of England and Wales and of various countries of continental Europe.” This observation from almost 70 years ago is still largely true today. Moreover, the net undercount rate for those age 0 to 4 in the 2010 U.S. Decennial Census is almost identical to the net undercount rate experienced by this age group in the 1950 Census, indicating little progress had been made in addressing this issue.

Given the fact that young children had a higher net undercount rate than any other age group in 2010 and the net undercount rate for this group has tripled since 1980, it seems that this age group should be a focus of attention in planning for the 2020 U.S. Decennial Census.

While the dominant historical comparative paradigm regarding differential census undercounts has been Black compared to Non-Black, I argue that the gap between different age groups now rivals the Black/Non-Black gap in importance. It is also worth noting, that net undercount trends by age have not been compromised by changing definitions.

Analyses provided here also underscore the difficulty of assessing census coverage for racial groups. In 2010, for the first time, estimates were provided for “Black Alone” and “Black Alone or in Combination.” However, the complexity of trying to make racial categories in the birth and death certificate data match those of the U.S. Decennial Census questionnaire highlights the many challenges faced in producing undercount and overcount rates by race. Moreover, the production of these two more nuanced race categories complicates comparisons with earlier data by race. These results underscore the importance of the Census Bureau’s research on measuring race in the Census.

The high net undercount of young children has been evident for many decades and it has increased dramatically in recent decades. In the 2010 U.S. Decennial Census, the net undercount rate for young children was much higher than for any other age group. This suggests that households with young children should be a prominent focus for those aiming to get a more complete and accurate U.S. Decennial Census count in 2020.

Tables

Table 1. Net Percent Undercount Estimates from DA and DSE for age 0-9 and 10-17 in 2000 and 2010

	2000 Age 0-9	2010 Age 0-9	2010 Age 0-4
DA	-2.6	-3.4	-4.6
DSE	0.5	-0.2	-0.7

Source: O'Hare et al 2012

Table 2. Net Undercount for age groups 1940 to 2010

	1940	1950	1960	1970	1980	1990	2000	2010
All Races All ages *	-5.2	-3.7	-2.5	-2.4	-0.9	-1.6	-0.1	0.1
All Races Age 0-4	-8.2	-4.7	-2.4	-3.6	-1.4	-3.7	-3.8	-4.6
All Races Age 5-13	-5.1	-2.3	-2.4	-2.5	-0.7	-1.6	-0.2	-1.4
All races age 0- 17	-5.7	-3.5	-2.3	-2.5	-0.7	-1.8	-0.7	-1.7
All races Age 18+	-5	-3.8	-2.6	-2.3	-1	-1.6	0.1	0.7
Gap Between Adults and Young Children (Adults - Young Children)	3.2	0.9	-0.2	1.3	0.5	2.1	3.9	5.3
Gap Between Adults and All Children (Adults - All Children)	0.7	-0.3	-0.3	0.2	-0.3	0.2	0.7	2.4

Source: Calculated from Census Bureau Internal Historic File

*These estimates for all ages may differ slightly from previously published estimates but they are internally consistent with the estimates for children shown here.

Table 3. Net Undercount Rates by Single Year of Age: 1950 to 2010

Age	1940	1950	1960	1970	1980	1990	2000	1950-2000 Mean	2010
All Ages	-5.2	-3.7	-2.5	-2.4	-0.9	-1.6	-0.1	-1.9	
0	-15	-11.2	-2.3	-3	0.8	-3	-5	-3.9	-3.4
1	-13	-7.2	-1.9	-3.5	-2.7	-4.2	-4.4	-4	-5.5
2	-4.7	-2.6	-2.9	-4.7	-2.9	-4.3	-4.5	-3.6	-5.6
3	-4	-0.9	-3	-4	-1.6	-4.3	-3.3	-2.9	-4.8
4	-3.5	-0.6	-2	-2.8	-0.8	-2.9	-1.8	-1.8	-3.6
5	-3.4	-2.4	-1.5	-3.1	-1.1	-2.8	-1.5	-2.1	-2.7
6	-4	-3.3	-2.4	-2.8	-1.3	-2.9	-2	-2.4	-3
7	-5.9	-3	-1.4	-2.7	0.2	-2.7	-1.2	-1.8	-2.3
8	-4	-1.1	-3.4	-4.1	-3.2	-6.3	-1.5	-3.3	-2.1
9	-7.9	-3.2	-3.1	-3.2	-0.6	0.4	-0.6	-1.7	-0.9
10	-3.5	-1	-2.5	0.8	1	0.8	1	0	-0.8
11	-8.9	-5.4	-2.1	-2.8	-0.3	-0.4	0.9	-1.7	-1
12	-3	-0.4	-1.7	-2.3	-0.8	-0.6	1.5	-0.7	-0.3
13	-4.9	-0.8	-3.4	-2.4	-0.3	0.1	1.5	-0.9	0.1
14	-5	-4.3	0.3	-0.8	0	0.3	2.1	-0.4	0.6
15	-3.7	-4.1	-2.3	-1.1	0.6	0.5	2.8	-0.6	1.8
16	-2.3	-3	-3.5	-2.1	0.3	0.4	2.5	-0.9	1.6
17	-5.6	-5.6	-2.7	-1.9	-0.2	1.8	1.8	-1.1	1.7

Source: U.S. Census Bureau Internal Historic Demographic Analysis file and DA release May 2012

Table 4. Summary Undercount Rates of Black and Non-Black Children age 0-4 and 0-17 1940 to 2000

	Black Age 0 -4	Black age 0 - 17	Non-Black Age 0-4	Non-Black age 0-17
1940	-12.6	-6.7	-7.5	-5.6
1950	-8.4	-6	-4.2	-3.2
1960	-6	-4.7	-1.8	-2
1970	-9.5	-5.9	-2.5	-2
1980	-7.8	-3.6	-0.2	-0.1
1990	-7.6	-5.3	-3	-1.1
2000	-5.4	-1.3	-3.5	-0.5
	Black Alone 0-4	Black Alone age 0 -17	Not Black Alone 0-4	Not Black Alone age 0 - 17
2010	-4.4	-0.6	-4.6	-4.2
	Black Alone or in Combination Age 0-4	Black Alone or in Combination Age 0 -17	Not Black Alone or in Combination Age 0-4	Not Black Alone or in Combination Age 0 -17
2010	-6.3	-1.5	-1.9	-1.7
Source: U.S. Census Bureau Internal Historic Demographic Analysis file and DA File Released May 2012				

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