

The Undercount of Young Children in Official Statistics:  
Discussion

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**1. Focus of Discussion**

Forty years ago, Ansley Coale gave a lecture on the coverage of the US Census. Coale was the originator of what we now call “Demographic Analysis.” In that lecture, Coale made special note of the undercount of young children. He wondered whether parents were forgetting their youngest child or whether children were missed because their families were being missed due to events associated with having a young child, such as needing to re-locate. Although we have learned much in the past 40 years, these are still, roughly, the questions for today.

In this discussion, I review the evidence of a special problem with the coverage of young children. I inventory possible explanations. I add my speculation as to what the likely causes are. However, the most important questions are what are the implications for the planning of the next round of census and what are the implications of the current plans and ideas for the coverage of children in the future. Throughout this discussion, I will draw what we have learned from the four excellent papers presented here, and the years and decades of research that supports the findings of these papers.

Let me begin by reminding the reader of some definitions. In an era where the census counts often exceed our measure of truth, O’Hare would have us measure Census MINUS Truth, which was actually common many decades ago. However, Truth MINUS Census has been the standard for the past four decades and I will continue the practice here.

We can define net coverage as:

$$\begin{array}{c} \text{Net Coverage} \\ \text{EQUALS} \\ \text{Omissions} \\ \text{MINUS} \\ \text{Erroneous Inclusions} \\ \text{MINUS} \\ \text{Statistical Additions/Imputations} \end{array}$$

Although I will use the term “omissions,” I believe that the concept that Dolson discusses, “Not Observed,” may point us to a better nomenclature. It focuses us on the issue of whether the census process has “observed” enough information to uniquely identify a specific person. It may help get us out of the argument of what to call the situation when a census taker can only determine that there are probably 3 people who are usually resident in the housing unit. Were the 1, 2, 3, 4, 5... who living there really counted or really missed? It is easier to answer the question of how many individuals were identified and observed.

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<sup>1</sup> The views expressed are those of the author and not necessarily those of the Census Bureau.

The substantive point here is that, when comparing over time or between groups, we must account for changes in each of these three components.

Similarly, we must recall that

Net Undercount  
EQUALS  
Net Coverage Error  
PLUS  
Net Content Error

The difference between the census number and an estimate of truth includes both coverage and content errors. In our context, this would obviously include any age mis-reporting. It also includes errors and inconsistency in classification by race and origin between the census and the vital statistics system.

Most of the data used in this discussion for the US comes from Demographic Analysis (DA). All 0-4 cohorts for all censuses under analysis were covered by birth registration, with major birth registration completeness tests available for 1950 and for the mid 1960s. There are few immigrants, documented or otherwise, in this age group. The DA numbers for infants & toddlers are about as solid as any social science measurements.

For reasons not well understood, the Census Coverage Measurement (CCM) and similar matching studies in the US (A.C.E., PES, PEP) do not show high undercount for young children. While these studies provide important information geographically and for other groups such as renters, they are not as strong for national estimates of young children.

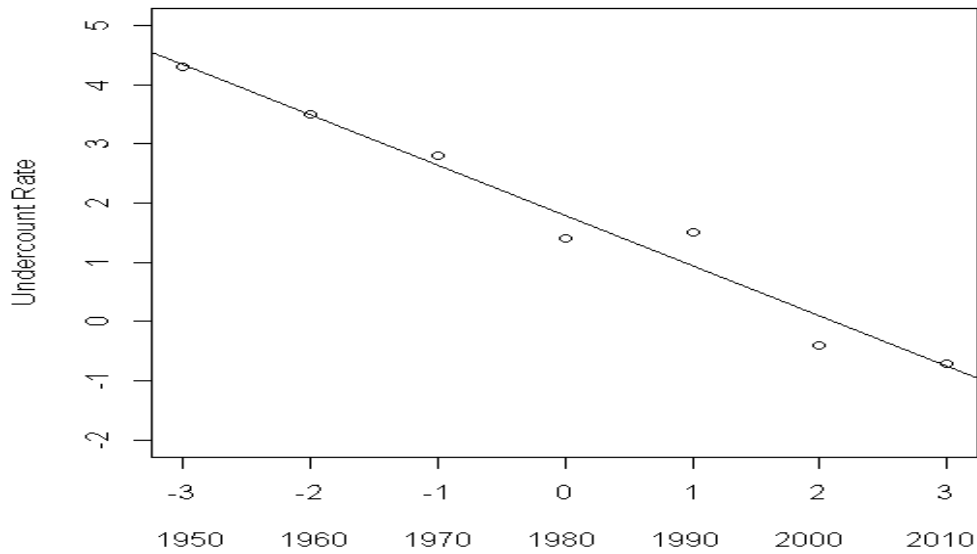
Result from Canada come from a Reverse Record Check. For young children, this is largely a match from the birth records to the census results. It thus has the strength of DA, while providing the richness of individual results of a match study.

## 2. Review of Symptoms

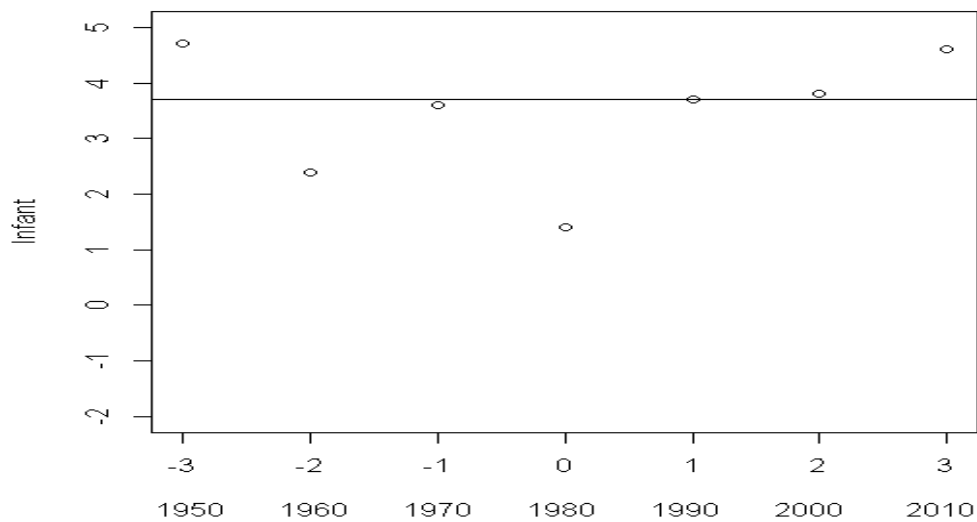
What is the problem that concerns us? I start with the United States. I will look at the overall trend (young vs. old), but both O'Hare and Dolson present interesting results by more detailed age which deserve attention as well.

O'Hare presents two striking graphs, which I present here in somewhat altered form. I have added a fit line by hand. Other fits are possible; after all, we have here seven (7) data points and two degrees of freedom. However, most would agree that a trend exists

I think that what catches our attention is not the absolute level of the measured undercount for children, but rather the different trend lines. If the trend for adults was equally flat, we would be asking why, in spite of our work and investment, there was no improvement in undercount generally. So, for the US at least, the salient question is why the two trends diverge.



**Figure 1:** Estimated net undercount by year for population 18 and over with reference line.



**Figure 2:** Estimated net undercount by year 0 to 4, with reference line.

What is amazing is how these trends persist through censuses that were quite different from each other. An explanation based on the unique properties of a single census would not be adequate. A quick review show very different these censuses were.

1950: Census: This was the last US “traditional census,” completely conducted by enumerators going door-to-door. There was no household questionnaire, but instead a large listing sheet. Many enumerators were housewives, otherwise unemployed. Payment was per case. It was also the last “pre-computer” census. The enumeration period was relatively short.

1960: Census: This was the first census with “self enumeration.” Household questionnaires were mailed. Enumerators visited each household and transcribed the “self-enumerated” questionnaire onto a machine readable form. It was the first census processed by computer and the first with whole-person imputation.

1970: Census: The first census with most of the country “Mail out/ Mail back” (MO/MB). The census was also partially adjusted for net missed people and missed housing units via the sample “occupancy status check” and the sample “Post Enumeration Post Office Check” (Cantwell et al, 2004).

1980: Census: This was the census with the highest percentage of the population enumerated on a mail-back questionnaire. MO/MB covered most of the country and a high percentage of the households returned the questionnaire by mail. This census also had a “non-household sources” (federal, state and local administrative records) program to reduce the undercount. Although there was no paid advertising, there was robust publicity, including a free Super Bowl ad and a series of “Peanuts” cartoons.

1990: Census: The MO/MB area was reduced and the percentage returning by mail fell. Enumerators were paid by the hour, but pay rates were low. There was the beginning of what became the Master Address File. This census included several unique programs including the Parolee/Probationer Programs and the Detroit Were-You-Counted. It was also the first census to explicitly recognize the role of duplicate enumerations in offsetting misses (Jones, 1986). The enumeration period extended over many months.

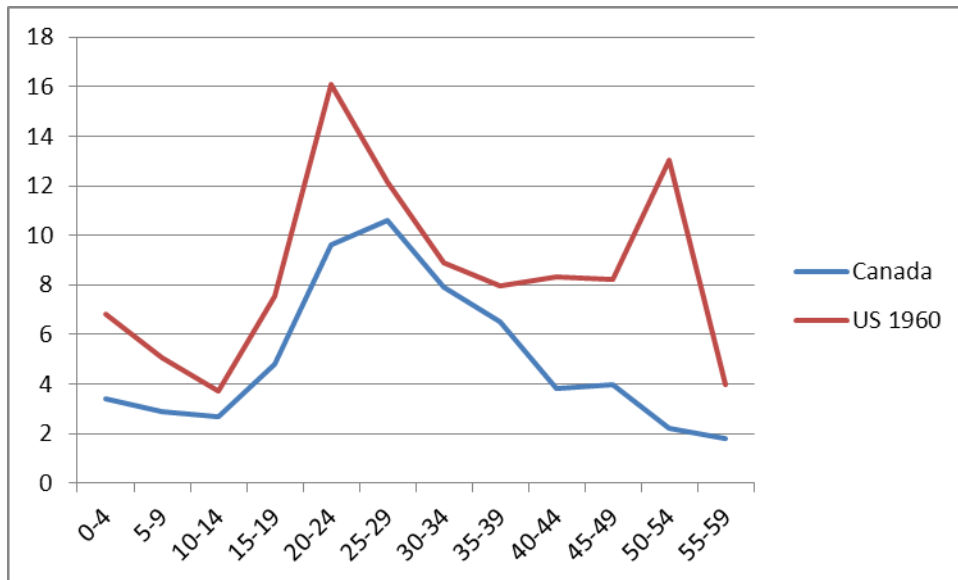
2000: Census: There was the first paid advertising campaign. A unique feature was the Housing Unit Duplication program, where a large number of duplicate households were initially removed, and then many of them put back to offset the missed household presumably living in the same housing units.

2010: Census: Address list was greatly improved and put on a GPS basis. Last minute change to a paper based NRFU lead to a poorly tested enumerator questionnaire.

Canadian census taking also evolved during this period, moving to pre-listing addresses and mail-out/mail-back and, most recently, encouraging internet response. I don’t have the data, but I suspect that the results for Canada would not show divergent trends for the two age groups. Dolson presents trends since 1986 for 0-4, 5-9 and 10-14. This seems to show that the undercount of young children relative to older children has gotten smaller over this time. Looking at more ages and more years will prove quite interesting.

I am not sure what to make of it, but Dolson’s data on gross undercount rates from 2011 reminded me greatly of the pattern we used to see for net undercounts for total population in earlier censuses. Below, I plot Dolson’s gross undercount numbers for the total population against the net undercount rate for black males from the 1960 US Census.

Although the two measures are not strictly comparable (net vs. gross, black males vs. total) the comparison is striking. More detailed comparisons of the two censuses and their histories would be quite interesting.



**Figure 3:** Gross undercount rates from Canada 2011 plotted with net undercount rates for US Black Males in 1960.

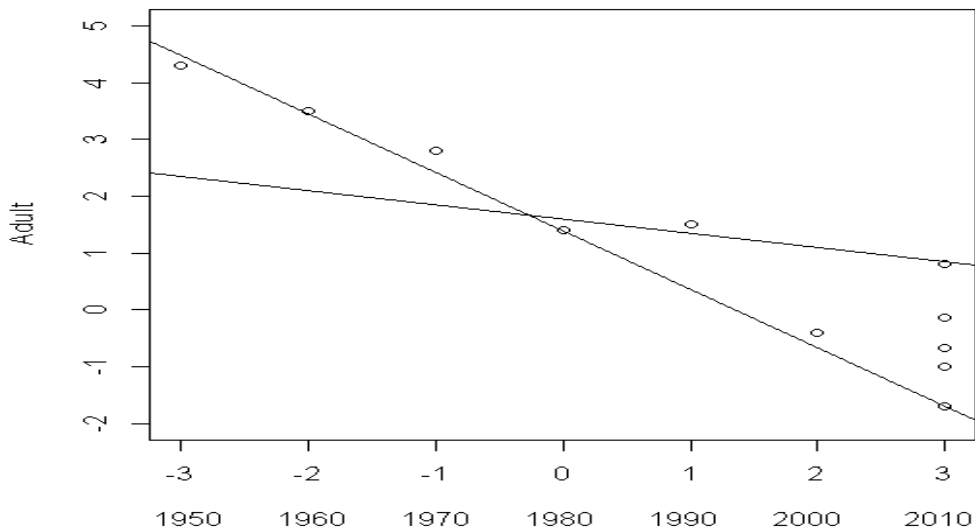
### 3. Inventory of Possible Explanations

In this section, I try to inventory all possible explanations for the observed trends. If we then can eliminate those that are false, the remaining one must be true. The goal is to develop hypotheses that are consistent with all the observed data. These hypotheses can be further tested with more data.

#### 3.1 Trends in Adult Coverage as Measured by Demographic Analysis

##### We are seeing the trends we want to see

Before the census results were known, the Census Bureau produced five different sets of Demographic Analysis estimates based on different assumptions. The Census Bureau was careful not to highlight any one set as “preferred” or “most likely.” Each estimate, if taken as a reference implies an undercount rate, just as does the estimate cited by O’Hare. Depending upon which of the 5 estimate sets are chosen and which of the earlier census to include or ignore, any number of fits are “reasonable.” I have plotted two: in one, the undercount in 1990 is an outlier, in the other Census 2000 is an outlier. One shows a steep decline in net undercount, the other is relatively flat. The reader is invited to pencil in others.



**Figure 4:** Estimated net undercount by year for population 18+, with alternative estimates and trends added.

### Errors and Improvements in Demographic Analysis

In 1950, birth registration data were available for none of the adult-age cohorts. Estimates had to be developed using demographic models. With each census, more and more adults are from registered cohorts. Further, administrative record data allow better estimates for recent years. On the other hand, there were statistically few undocumented immigrants living in the US, a percentage that increased until the 1986 immigration reform act, fell, and then began increasing again.

### Feed-Back between DA estimates and Census Results

After each census, it is common for the DA estimates to be revised. Indeed the 2010 number that O'Hare cites is based on a 2012 revision. Major revisions took place after the 1980 and 2000 Census results were known. These revisions are anchored in the data, of course, but also in beliefs of what levels and patterns of undercount are "reasonable." Considerable judgement is still needed for those over 18.

The feed-back can work in the other direction. In 1990, a senior administration official announced to the press that the census would meet the population estimates figure (it didn't). The households "unduplication" program in 2000 was informed by preliminary DA estimates.

## Changes in Census Taking

In developing hypothesis, it is necessary to take into account the differences in census taking outlined above. It may be that the people taking the 2010 Census were simply smarter than Hansen, Hurwitz, Tepping, Rothwell and Waksberg. Certainly, per household funding was much higher. However, both explanations must be mediated through a proximate causality. Of course, our explanation must address why these changes affect the enumeration of adults and children differently.

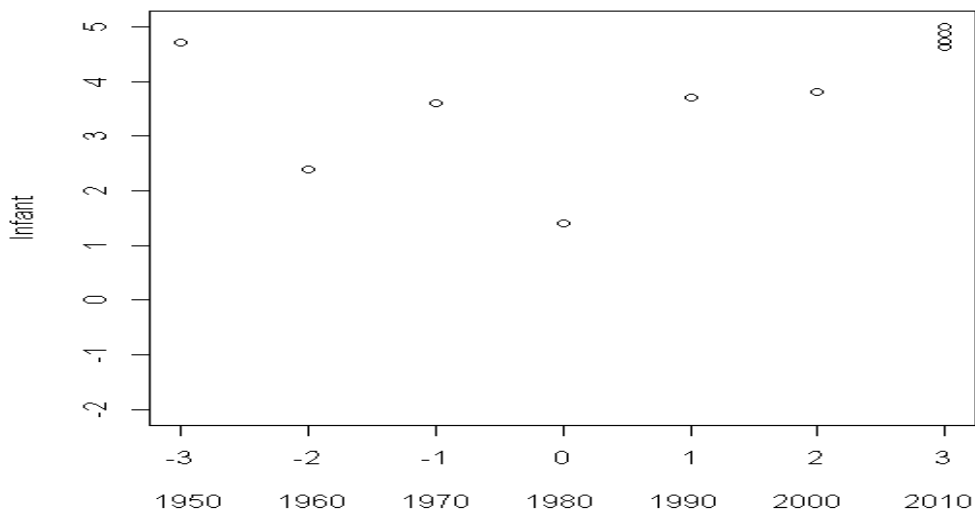
- (1) Fewer housing units omitted from address list. This seems possible, given the greatly increased focus on this aspect.
- (2) Better pay & training for enumerators: This is possible. However, certain aspects need to be kept in mind. First, the housewives of the 1950 & 1960 censuses may have been under paid, however, they were relatively highly skilled and well motivated. This NRFU training would only affect interviews done by enumerators, not those mailed back.
- (3) Better questionnaire design.
- (4) More duplicates offsetting omissions. If one lists causes of duplication of adults one can see that the opportunity for duplication was relatively small in earlier censuses:
  - Mis-delivery of questionnaire & apartment mix-ups: this does not happen much in a traditional census (“Lady, you just talked to me 5 minutes ago at the other door!”)
  - College students: Both fewer in 1950 and much less likely, as WWII veterans, to be listed by their parents.
  - Second homes: People were happy to own one house in the 1950s & 1960s.
  - Movers: Enumeration period was much shorter in earlier censuses, lessening the chances of someone moving to be counted in both places.
- (5) Paid advertising: Advertising was less necessary in a non-mail-back census. In any case, with the three major networks in 1980 and other media buzz, free advertising worked reasonably well, as evidenced by the mail-back rate.

### 3.2 Trends in Infant & Toddler Coverage as Measured by Demographic Analysis

How can we explain this lack of trend with explanations consistent with the trend observed for adults?

#### **We are seeing the trends we want to see**

Since the 2010 DA estimates are so closely tied to the vital registration statistics, plotting the five points has little impact on the trends we see. Plotting the five other points changes our perception of lack of a trend very little.



**Figure 5:** Estimated net undercount by year 0 to 4, with alternative estimates added

### Errors and Improvements in Demographic Analysis:

In the early years, a correction for birth registration completeness was necessary, but this issue has become nearly irrelevant. Now, the only possible source of significant error on the births would be that there is a large amount of “birth tourism,” so that DA is greatly underestimating the emigration of young citizens, but this seems unlikely to occur on a sufficient scale.

### Feed Back between DA estimates and Census Results

Given the constraining nature of the vital statistics system, there is little room for biases to creep the measurement for this group. Once vital registration completeness was estimated at near complete, there was little room for professional judgement.

### Changes in Census Taking

Let’s look first at the hypothesis outlined above:

- (1) Better address listing: This should have improved coverage of infants & toddlers along with coverage of adults. It is possible, however, that the improvement was, for example, mainly for small, one-person dwelling units, so it would improve coverage for adults but not children. Alternatively, the improvement was for whole buildings, while small subunits, perhaps including disproportionately small families with toddlers, were still being missed.
- (2) Better pay: This should have improved coverage of all groups.
- (3) Better questionnaire design. It is hard to explain why better design would work only for adults. This should have had more of an impact on infants and toddlers



(4) More duplicates offsetting omissions. It could be that the observed “gap” is because there are relatively few duplicate to offset omissions of infants and toddlers. With the exception of joint-custody children, none of the duplicated groups would be differentially infants & toddlers: college students, retired people with second homes, prisoners counted at home and in jail.

(5) Paid advertising: No obvious reason that this would not also include households with children.

### **Hypothesis unique to Infants & Toddlers:**

(1) In the 1950s & 1960s, having children in the home was the norm. Indeed, this was the epitome of the single-family nuclear household. Housewife enumerators would have been especially attuned to the presence of children. Households became increasingly complex, on average, as the baby-boom children left the household. There were greatly increased proportion of out-of-wedlock births. This increased the number of single-mothers, sub-families or children cared for by someone other than their parents. For example, perhaps there are more households where the young mother is not firmly attached to the household where the child usually resides, cared for by the grandmother. Neither young mother nor the grandmother feels responsible for reporting the child.

(2) Changing questionnaire roster length: this is possible. Mention is often made about the number of spaces on the questionnaire and how this might cause children to be left off. However, the 1950 listing book had essentially unlimited number of rows. So perhaps in this aspect the design did not improve.

(3) Errors and biases in imputation and editing: we are imputing too few children? Perhaps we are imputing age incorrectly.

(4) Increase in proportion proxy, close-out, count-only questionnaires accepted. This is possible and needs to be investigated. Proxies may not know about a very young child living there or a sub-family staying there.

(5) Changing demographic patterns (e.g. increased foreign born) have made infants & toddlers disproportionately hard to count. For example:

- Children are now more likely to reside in a household containing undocumented/unauthorized residents, where the whole household is more likely to be missed or imputed.

- Children are more likely to be residing in housing units without the landlords knowledge or permission.

(6) Some families increasingly make a conscious decision not to report young children on the Census questionnaire. Because they distrust the government, they don't want the government to know about the existence of their young children. Perhaps when children enter school, they feel it is too late to hid them from the government.

(7) Increasingly, time constraints on householders with young children in the household make them less likely to fill out the census questionnaire completely. Since young children are typically listed last, they are the ones left off. Alternatively, they don't answer at all, and become proxy or close-out households.

(8) Problems with continuation forms. Young children could be disproportionately listed last, so would be greatly affected by the inability to match continuation forms to correct households.

#### 4. My Conjectures

I have yet to find a mother who agreed with the hypothesis that “parents often forget their youngest child.” So, it seems likely to me that the best line of research would assume that the child and parent are missed together, or that the child was not living with the parent.

This could come about from three situations.

First, the child and parent are living in a housing unit as a “sub-family.” For example the mother and child are staying “just temporarily” with the grandparents. The grandparents have a firm conception of their current “permanent” household, and the sub-family is not part. The issue is not then the size of the household, but its complexity. Because of this, I believe that the emphasis on large families and the length of the questionnaire roster are misplaced. Obviously, if the interview is not done on Census Day, but days before or weeks after, the chances of remembering and including these sub-families drops sharply.

Secondly, the child is not living with the mother, but being taken care of by another relative, such as the grandmother or aunt. Perhaps the aunt takes care of the child during the day, and the child sometimes sleeps there, sometimes with the grandmother and sometimes with the mother. Such a situation does not fit easily into a concept of “usual residence.”

This goes to Weinberg’s discussion of the various “probe questions,” e.g. “Were they any additional people staying here on April 1, 2010 that you did not include in Question 1: Children, such as newborn babies, or foster children?” This is a very complex cognitive task, doubly so if the questionnaire is being completed days before or weeks after on April 1!

The third alternative is that the child and mother are missed because the “housing unit” in which they live are missed. Here Dolson provides a richness of exciting results, which seem to support this hypothesis at least in Canada, and make it a strong possibility for the United States. However, the CCM estimated that only 0.6 percent of the housing units were missed in 2010. While the CCM seems to over estimate the coverage of young children, likely due to correlation bias, it seems somewhat unlikely that this problem applies to the housing units where children live. That is not to say that there are not hidden units around back, in garage, in basement, etc.. Still, the kind of analysis that Dolson reports is exciting indeed.

## 5. Implications for Future Plans

All of this brings us to Vitrano's talk. Will the changes planned for 2020 help or hurt the enumeration of children? He list four areas of early research:

- Administrative Records
- Optimizing Self Response
- Streamlining and Automating Field Management and Operations
- Targeted Address Canvassing

Streamlining field operations may be quite important for costs, but it is hard to see how it would directly affect the enumeration of children. Similarly, Vitrano asks "Will changes to the way we build our address list help or hurt the coverage of children?" I would guess that, again while it may save money, it is unlikely to have a direct impact on the coverage of children.

Increased self response may help or it may hurt. To help, the responses (questionnaires) which should include toddlers but do not, would have now include them. Why? Perhaps they are completed closer to Census Day. Perhaps with internet response targeted probes could help. This will be difficult. A long list of coverage-check questions will bore the respondents and have them "tune out" and click quickly through. But which household should be asked only about young children and which only about college students?

Vitrano lists some ways internet responses could help:

- Removal of space limitations for listing household members
- Opportunities for expanded help/assistance
- Non-English language opportunities

These are important possibilities and might help. As discussed above, the length of the roster may play a role in creating the problem. Expanded opportunities for assistance may help, but only for those who are motivated. I find it hard to believe that large numbers of respondents would have included the child if it had been easier to get assistance.

Increased language assistance could play a big role. However, it will not be a matter of translating the English words into Spanish, Chinese, Creole French, etc. It will be necessary to translate the census concepts of household and "usual residence" into the cultures of the people using these languages. This will be an exciting but challenging possibility.

Similarly, administrative records could either help or hurt. If those administrative records are targeted on children, they may help. WIC files and SNAP files or even state birth records could have a big impact. However, obtaining and using these state files would be a major challenge. IRS files could help, if the missed children are from parents or guardians who file tax returns. Alternatively, if children are not well represented in the administrative records the problem could get worse.

## 6. Concluding Remarks

The 64 thousand dollar question, or perhaps the 640 million dollar question, is how to improve census quality while reducing cost and conducting a census consistent with the Supreme Court's and Congress' concept of an "actual enumeration." Vitrano is very clear: "We need to reduce the overall cost of the census, but if we can reduce the overall costs, we intend to invest some of the savings into hard-to-count populations and areas."

Cost has not been a main driver in conducting the Census since the 1970 Census. I recall Director Barabba saying in 1980 words to the effect "Our job is to count all the people, not count as many as we can for a given cost."

Many of us painfully remember the proposals for the 1990 Census to use statistical methods to reduce costs while maintaining quality. With limited exceptions, the Supreme Court has blocked the use of most of the obvious statistical methods. Administrative records have been used in the census since at least 1980, but the extensive use necessary to save significant money remains under discussion. Much work is being done, but much work remains.

Currently, the United States is at a disadvantage in understanding the issue of coverage of children. Demographic Analysis provides accurate number but only aggregate net undercounts at the national level with quite limited detail on sub-group. Post-enumeration surveys such as the CCM do not seem to well measure the coverage young children. The Canadian RRC combines the best of both. In the 1980s the Census Bureau experimented with RRC in the Forward Trace Study (Hogan, 1983 Mulry and Dajani 1989). This study showed that the RRC was unlikely to work for a number of reasons, including the 10-year gap between censuses and the large number of undocumented immigrants.

However, there is no reason why a RRC could not be used in the United States for young children. Indeed, for this group, a RRC reduces to a match of births to the current census. Since names and date of birth are now captured in the Census, the first stage of matching would be relatively simple and the needed tracing and field follow-up reduced. Further, since the issue is understanding and evaluating, not census adjustment, the sample size need not be large. This is a technique will worth revisiting for understanding the coverage of young children.

## References

- Cantwell, Patrick, Howard Hogan and Kathleen Styles, 2004, "The Use of Statistical Methods in the U.S. Census" *The American Statistician*, August 2004, Vol. 58, No.3, pp 1-10.
- Hogan, Howard, 1983, "The Forward Trace Study: Its Purpose and Design," Proceedings of the Section on Survey Research Methods, American Statistical Association, 168-172.
- Jones, Charles D., 1985, "MEMORANDUM FOR Kirk M. Wolter: 'Thoughts on 'Doubling Counting in the 1980 Census and Implications for 1990,'" February 19, 1985, Bureau of the Census, Washington, DC 20233.
- Mulry, Mary and Dajani, A. (1989), "The Forward Trace Study," Proceedings of the Survey Research Methods Section, American Statistical Association, 675-680.