OVERSIGHT OF THE 2000 CENSUS: REVISITING THE 1990 CENSUS

HEARING

BEFORE THE

SUBCOMMITTEE ON THE CENSUS

OF THE

COMMITTEE ON
GOVERNMENT REFORM
AND OVERSIGHT
HOUSE OF REPRESENTATIVES

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OVERSIGHT OF THE 2000 CENSUS: REVISITING THE 1990 CENSUS

TUESDAY, MAY 5, 1998

HOUSE OF REPRESENTATIVES,
SUBCOMMITTEE ON THE CENSUS,
COMMITTEE ON GOVERNMENT REFORM AND OVERSIGHT,
Washington, DC.

The subcommittee met, pursuant to notice, at 3 p.m., in room 2247, Rayburn House Office Building, Hon. Dan Miller (chairman of the subcommittee) presiding.

Present: Representatives Miller, Davis of Virginia, Shadegg, Snowbarger, and Maloney.

Staff present: Thomas Hofeller, staff director; Thomas Brierton, deputy staff director; Jennifer Safavian, chief counsel; Lara Chamberlain and Kelly Duquin, professional staff members; David Flaherty, senior data analyst; Michelle Ash, minority counsel; and David McMillen, minority professional staff member.

Mr. MILLER. Good afternoon. We'll get this hearing underway. First, I ask unanimous consent that all Members' and witnesses' written statements be included in the record. Without objection, so ordered.

This afternoon, we'll have opening statements by Congresswoman Maloney and myself, and then we'll proceed immediately to the first panel.

This is our second hearing of the Census Subcommittee. The concern we have—is that we are moving toward a failed census. The General Accounting Office has given us warnings consistently each time they've given a report, the most recent one being in March, that the risk of a failed census has increased. The Inspector General has given us a warning that the plan that has been proposed for the year 2000 census—I call the largest statistical experiment in history—is a very risky endeavor.

The census is something that is extremely critical and, as we get closer to the census, I think it will become even more evident to Americans because it is fundamental to our elected Democratic forum of government. Most elected officials in this country are dependent upon a census: school boards members, county commission, city council, State legislatures, and Congress, of course. If we have a census that fails, we are threatening our Democratically-elected system of government. But we also have to have a census that the American people trust. If we have a census that is not trusted, we are threatening, the way we operate in this country. The skepticism in this country would greatly increase.

Today, the focus is going to be on the 1990 census and looking at what worked, what didn't work, and what we should learn from that experience. The 1990 census consisted, as we know, first as an enumeration where we tried to count the entire population of this country. It counted 98.4 percent of the people, the second best census in history—not a bad number, actually. Some people may even think it's the best census we've had.

After they did the enumeration, a sample was conducted of approximately 150,000 households that was going to be used for adjustment. What we know happened in 1990 was that sampling was a failure. Secretary Mosbacher considered the option of using sampling for adjustment, and he rejected it. The recommendation from the Census Bureau was based on adjustment; they wanted to take a congressional seat away from Wisconsin and a seat away from Minnesota. After Mosbacher rejected that recommendation, in 1992 they realized there was a computer mistake, and it never should have been a recommendation. It would have been done after the fact if Secretary Mosbacher had made the decision to eliminate a seat from both Pennsylvania and Wisconsin.

The Census Bureau has acknowledged that the information from the 1990 census was less accurate for population areas of under 100,000 people, so anything with less than 100,000 people was statistically less accurate. Now that means all census tracts—municipalities, counties, and all of less than 100,000 people—had less accurate information than if you'd adjust it. The census tracts—census blocks—are the cornerstones of how you build up congressional districts, city council districts, and school board districts. The idea of trying to use something less accurate as the foundation was, to me, a little unbelievable that they'd even attempted to do it.

The Census Bureau felt the sampling that took place after the 1990 census was so inaccurate that it would not be used in any intercensal analysis—that is when you adjust the census between 1990 and the year 2000, and they did not use the sampling that was done back in 1990.

One of the concerns that many people had, is that the Census Bureau was actually deleting people from counts. They would go through a census block or a census tract—and delete people; people that were not necessarily double counted or should not have been counted, they just would delete them to say, on average, they shouldn't exist.

Well, what's been proposed for the year 2000 census, is, first of all, they're not even going to do a full enumeration to start with. They're only going to count 90 percent of the population. We have no fallback position. This means they're going to totally rely on sampling in year 2000. They are not going to attempt to do a full enumeration because they decided adjustment and sampling is the only way to go, and yet sampling was the failure in 1990. The plan now is to count 90 percent, and then they'll do a sample after that of 750,000 households. That's about five times larger than 1990, and they're going to allow half the time to do it. Now, we're going to count twice as many households in half the time and in year 2000, they're going to use a less experienced work force. Instead of using census employees, they're going to use part-time workers. It's an unrealistic goal to achieve, and that is part of the reason we're

moving toward failure. I am concerned that the administration is pushing more political science than it is statistical science or empirical science.

We had some problems in 1990, and that's what we're here to learn about. We need to come up with how to go about addressing those problems of undercount and do a better job. The Census Bureau, I think, is moving in the right direction by correcting some of those problems. For example, we know that 50 percent of the error in 1990 is related to the address list, and the Census Bureau has recently asked for a supplemental appropriation of $100 million to help address that issue. They are using, in this case, better marketing techniques and I think that's very helpful.

In 1991, when Secretary Mosbacher was addressing the issue of whether to use adjustment or not, he had eight guidelines. I think there are copies of those available, and I think it's worthy of looking at those guidelines in evaluating whether adjustment should be used.

[The guidelines referred to follow:]

Mosbacher Eight Guidelines For Adjustment

1. The Census shall be considered the most accurate count of the population of the United States, at the national, State and local level, unless an adjusted count is shown to be more accurate. The criteria for accuracy shall follow accepted statistical practice and shall require the highest level of professional judgment from the Bureau of the Census. No statistical or inferential procedure may be used as a substitute for the Census. Such procedures may only be used as supplements to the Census.

2. The 1990 Census may be adjusted if the adjusted counts are consistent and complete across all jurisdictional levels: national, State, local, and census block. The resulting counts must be of sufficient quality and level of detail to be usable for Congressional reapportionment and legislative redistricting, and for all other purposes and at all levels for which census counts are published.

3. The 1990 Census may be adjusted if the estimates generated from the pre-specified procedures that will lead to an adjustment decision are shown to be more accurate than the census enumeration. In particular, these estimates must be shown to be robust to variations in reasonable alternatives to the production procedures, and to variations in the statistical models used to generate the adjusted figures.

4. The decision whether or not to adjust the 1990 Census should take into account the effects such a decision might have on future census efforts.

5. Any adjustment of the 1990 Census may not violate the United States Constitution or Federal statutes. If an adjustment would violate Article I, Section 2, Clause 3 of the U.S. Constitution, as amended by Amendment 14, section 2, or 13 U.S.C. section 195, or any other constitutional provision, statute or later enacted legislation, it cannot be carried out.

6. There will be a determination whether to adjust the 1990 Census when sufficient data are available, and when analysis of the data is complete enough to make such a determination. If sufficient data and analysis of the data are not available in time to publish adjusted counts by July 15, 1991, a determination will be made not to adjust the 1990 Census.

7. The decision whether or not to adjust the 1990 Census shall take into account the potential disruption of the process of the orderly transfer of political representation likely to be caused by either course of action.

8. The ability to articulate clearly the basis and implications of the decision whether or not to adjust shall be a factor in the decision. The general rationale for the decision will be clearly stated. The technical documentation lying behind the decision shall be in keeping with professional standards of the statistical community.

Mr. MILLER. Let me just comment about a couple of these. This first one the census shall be considered the most accurate count of the population of the United States at the National, State, and local level unless an adjusted count is shown to be more accurate—unless. The burden of proof is on the change. If they're going to change to those radical new ideas, the burden of proof is on them to prove that it worked, and in 1990, it was a failure. I think it's irresponsible, especially considering that we're dropping the idea of counting everybody in a full enumeration. We have to go to an adjusted account without having a fallback position.

Then, the second point is that the 1990 census was adjusted. The adjusted counts are not consistent and complete across all jurisdictional levels: National, State, local, and census block. Well, the Census Bureau, itself, acknowledges that counts under 100,000 are less accurate.

Another point was that the decision on whether or not to adjust the 1990 census, should've taken into account the effects of such a decision on future census efforts. The concern that I have there is the mail response rate. That's one of the keys that we need to have a successful census. And we know right now in Sacramento and Columbia, SC, where the dress rehearsals are taking place, the mail response rate is below 50 percent. The response to that usually is, "Well, that's a dress rehearsal, and people know it doesn't really count, and that's the reason the response is less." If people understand that all we're going to do is sample, why complete a questionnaire? We're going to lower the response rate by mail, once people know we're going to adjust the census. So we're really threatening future census efforts if we start using sampling right off the bat.

And one final comment, the ability to articulate clearly the basis and implications of the decision whether or not to adjust shall be a factor in the decision. The general rationale for the decision will be clearly stated. The idea is; how do you explain to a community that have people deleted from the counts? That the Census Bureau goes in there and honestly counts the population? The Census Bureau here in Washington says, "We're going to reduce your population, not because of duplication in people being counted, but just because, statistically, there's an average, and we think you should be deleted." That happened when they tried to do adjustment in 1990. That's going to be very difficult to explain. What we do know about 1990, and will hear more about and discuss today, is that sampling was a failure. Trying to use sampling and totally rely on sampling without a fallback position in year 2000 is, in my opinion, irresponsible. Sampling is not ready for the prime-time. We need to do a full enumeration and continue to work on this effort.

And with those statements, and before we begin, I would like to call upon the ranking member, Mrs. Maloney.

Mrs. MALONEY. I'd like to thank very much the chairman for yielding, and I'd also like to very much welcome two of my colleagues, Congressmen Sawyer and Petri. I look very much forward to your testimony.

Much of what we know about the 1990 census is a direct result of the work done by Congressman Sawyer's subcommittee. Indeed, his subcommittee also laid much of the groundwork for the 2000 census. He was among the few Congress Members who understood

that oversight of the census is a decade-long responsibility, not something that can be done in the last 2 or 3 years before the census.

I would also like to welcome Wade Henderson, the executive director of the Leadership Conference on Civil Rights. I am sorry that he is the last witness that we will have today, and I do hope that we will get to his testimony before the 5 o'clock scheduled votes.

For some, the 1990 census was a success. If you are white and living in the suburbs, the census did a good job of counting you and your neighbors. For many, however, the 1990 census was a failure. For urban and rural blacks, the census was a failure. For whites living in rural rental housing, the census was a failure. For poor Hispanics in urban, suburban, or rural areas, the census was a failure. The census was a failure for these people because a large percentage of them were left out.

Today, we will hear testimony from three scholars about why the attempts to fix the 1990 census did not work. I hope they will also address how we make sure the same mistakes are not made again in the 2000 census. The 1990 census failed both the public and Congress, and we simply cannot let that happen again.

I know there has been a great deal of partisan discussion and debate regarding the 2000 census, but now I would like to really, in a bipartisan way, reach out and really complement the question posed by my Republican colleague, Representative Harold Rogers, when he testified before Sawyer and Petri at a hearing. Representative Rogers asked, in reference to the 1990 census, and I quote, Were the methods for counting our population, while learning more about it, outmoded? In light of existing sampling techniques, they were, end quote. I agree with Representative Rogers. I agree with Representative Porter Goss, who took to the House floor on September 25, 1992, and he said—this Republican elected official with whom I agree. And I quote, from Porter Goss, quote, If the data are adjusted, four million people not included in the official 1990 census will be acknowledged, and the statistics will be truly reflective of the actual population of the United States, end quote.

The fact that the attempts to fix the 1990 census can be construed to have failed is all the more reason we must work harder to see that there is a system in place to correct these inequities in 2000. Some seem to be saying that since the plan to adjust the census in 1990 was not perfect, we should simply do nothing in 2000. I am glad these people weren't in charge of our space program. After Apollo 13, they would have folded their tents and run for the hills.

I urge all of our witnesses to be mindful of the consequences if the 2000 census is a failure.

For Congress, it will be an embarrassment, although I am sure that there are many here who would prefer that we did not redistrict the Congress in 2001. For the public, an inaccurate census is a travesty. Representation will be misallocated, and Federal funds will be distributed in excess to the wealthy and with scarcity to the poor. It is our responsibility to get the most accurate census.

The National Academy of Sciences has come out in favor of sampling, as has the Census Bureau, as being more accurate and costing less.

I am very pleased that two of my colleagues who have worked very hard on this issue, both in this Congress and in prior Congresses, are here. I look forward to Representative Sawyer's and Representative Petri's testimony.

Porter Goss——

Mr. MILLER. Let the record show it was Congressman Porter Goss——

Mrs. MALONEY. Porter Goss.

Mr. MILLER [continuing]. And not Peter Goss, yes. Thank you.

We'll have our colleagues Congressman Sawyer and Congressman Petri, if you'd come forward, and we appreciate your being here today as we—it was actually the suggestion of Congresswoman Maloney—that we have you here because of your experience and knowledge from 1990, and I'm glad we have the time which wasn't available, at the first hearing when we wanted to focus on the dress rehearsals.

Congressman Sawyer, both of you, your official statements will be put in the record, if you'd like to begin.

STATEMENTS OF HON. THOMAS C. SAWYER, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF OHIO; AND HON. THOMAS E. PETRI, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF WISCONSIN

Mr. SAWYER. Well, thank you very much, Mr. Chairman. Thank you for this hearing. Thank you, Congresswoman Maloney, for your part in helping make this possible. I'm going to try to truncate my testimony because it's simply too long to read. But, let me begin by saying I'm not going to engage in a jeremiad about sampling, although, if you have questions, I'd be pleased to discuss them. I think that much of what you have said, Mr. Chairman, is true. I think some is a misreading, but that, nonetheless, is a matter of difference of opinion.

What I'd like to do this afternoon is to go through the kinds of difficulties that were encountered in 1990 because, I think, they're instructive for the period that we're in right now. I think it's important to understand that problems can be detected during the dress rehearsal, but often those problems underestimate what will actually happen during the actual count. A dress rehearsal is much like the war games that every military force on Earth undertakes, but the chaos of war is a very different matter.

Trying to count the Nation, in a matter of weeks, requires an enormous amount of flexibility and capacity to adjust to change as it occurs. In that sense, the 1990 census encountered operational problems almost from the very start. In March, when they mailed out some 90 million forms across the United States, newspapers began to—and local officials—began to report that they were not fully delivered, in fact, although it was only about 4 million that were undelivered. And that undeliverable rate is relatively small for such a large mailing. Public confidence was shaken considerably and began to play itself out in other ways.

A more fundamental problem with the census became apparent quickly. Instead of having the 70 percent mailed-back rate or the 75 percent hoped-for rate, the census encountered a mail-back rate of what, I believe, was under 65 percent. In some neighborhoods, that response rate hovered around 30 to 40 percent, not unlike some of the kinds of things that are being encountered in the dress rehearsal today.

That caused particular problems because it left the Bureau with a 30 percent greater workload for the door-to-door followup work than it had planned for, in terms of time, money, and work force. The fieldwork took more than twice as long, some 14 weeks instead of the 6 weeks that had been planned. It took 6 weeks alone just to gather the information on the final 10 percent of non-responding households.

Much of the information, therefore, was of dubious quality. The further removed from the time of the actual census date that the information is collected, the more it deteriorates. In some cases, the efforts of census takers to gather information directly from households were futile. This lead to a collection of data from surrogates and includes letter carriers, neighbors, building managers, or people that were encountered on the streets. The GAO noted that 3.2 percent of the Nation's occupied housing units, about 7 million people, were included in the census based on information collected indirectly. In some urban areas, these last-resort procedures were used at more than twice the national rate. Clearly, the Census Bureau struggled to count the last 10 percent of the households leading to a disproportionate amount of non-sampling error in the hardest to count communities.

Not surprisingly, as a result of all this, the Bureau ran out of money long before the census was finished. It cost at least $10 million dollars to visit every 1 percent of households that didn't respond by mail. And, it cost more than twice that much as census takers made visit after visit to the hardest to count, final 10 percent.

Second, the Bureau had to hire more enumerators and keep local census offices open longer for an emergency appropriation of about $110 million dollars in order to get the job done.

In a second large area, maintaining an adequate workforce of qualified enumerators, even with the more difficult economy that the Nation had in 1990, quickly became a problem as well. Because of the unexpectedly large workload in the door-to-door phase, they had to recruit and train many more temporary workers to meet the hiring needs. The Bureau was forced to increase its pay rates at the same time. These problems compounded one another and created what was widely regarded as a failure, as you noted earlier.

It was the first census in modern times that yielded less accurate results than the previous decade. Its costs escalated significantly, despite the best efforts to eliminate the persistent and disproportionate undercount of urban and poor minorities. The census, again, had failed to reduce the number of those who it missed. The undercount was also significantly higher than in 1980. In fact, the number of minorities missed in 1990 was greater than the total of all people missed in 1980. That difference—that inequality—was still quite unacceptable.

I think everybody in the room would agree that we can't let this happen again. I've taken the view, both at the time that it was going on and after considerable analysis afterward, that the 1990 census was not so much a failure of execution as it was a failure of design, a 30-year-old design whose roots were grounded in the 1960's, that had simply outgrown our Nation. Today, the rate of change in this country is more profound and deeper and more difficult to deal with in a larger nation than anything that was anticipated in 1960.

Today, we are a Nation on the move. Poor people, in general, move around a lot. Growing numbers of them are homeless or not tied to a permanent address. Migrant farm workers and construction workers have created problems that were difficult to anticipate. Even upper middle-class people are highly mobile today, and wealthy people are multi-residential. It comes down to this; traditional counting methods based on house-grounded census techniques can no longer, by itself, fully accommodate a changing, transient population.

Some people believe that advertising and promotion and outreach will solve the problem, and it is important. It must done. But I'm not convinced that it will significantly reduce—much less eliminate—the undercount.

Even after the emergency appropriation of $100 million, the count still yielded a disgraceful, disproportionate undercount.

The Census Bureau's sampling plan, as you suggest, is not perfect. Make no mistake about it, however, population numbers produced by traditional counting methods are rife with error. They may look precise, but they are too often precisely wrong. Accuracy is the real question that we need to pursue.

I believe that it's a mistake to force the Census Bureau, ahead of time, to continue to use counting methods that have proven, decade after decade, to yield poor and deteriorating results at high costs, when we have the potential to have sound science produce a better result.

Mr. Chairman, just in conclusion, let me say that it's reasonable to have concerns about whether or not the Bureau is sufficiently prepared for 2000. But at this point, in the decennial cycle, there are bound to be uncertainties, bound to be procedures that still need to be refined and decisions yet to be made. That's simply the nature of such a complex undertaking.

It's my hope that the Census Bureau and the subcommittee will welcome one another's help, will work together as partners to ensure the most accurate possible count for our Nation. Without a constructive partnership with the Congress, the census is, indeed, doomed to a repeat performance of 1990.

Thank you very much for the chance to be here today, Mr. Chairman.

[The prepared statement of Hon. Tom Sawyer follows:]

Statement of The Honorable Tom Sawyer
"Oversight of the 2000 Census: Revisiting the 1990 Census"

Committee on Government Reform and Oversight
Subcommittee on the Census

May 5, 1998
3:00 p.m.

Thank you Mr. Chairman, Congresswoman Maloney, and members of the subcommittee for the opportunity to share my experiences from the 1990 census as the former chairman of the Subcommittee on Census, Statistics and Postal Personnel. I am pleased to be here and pleased that our former ranking member, Congressman Petri, is able to join me.

The purpose of my testimony this afternoon is to share with you some of the problems that the Census Bureau encountered during the conduct of the 1990 census. We can expect that many of the same difficulties will reoccur during the 2000 census. Potential problems can be detected during the Dress Rehearsal but often grow in magnitude during the actual count. We must be careful, however, not to mistake inevitable uncertainties for problems we expect the Bureau to anticipate.

The 1990 census encountered operational problems almost from the start. In mid-March, the Census Bureau mailed approximately 90 million questionnaires to the households on its address list. Within days, local post offices began to report that millions of those forms could not be delivered as addressed. The primary glitch was caused mostly by rural households which receive their

mail at a post office box, not a street address normally used in urban areas. The Postal Service was unable to deliver four million forms that included rural route or street addresses not recognized as delivery points for mail. While the "undeliverable" rate was relatively low for such a large mailing, public confidence in the census was shaken considerably as the problem of missing census forms hit the front page of newspapers across the country.

A more fundamental problem with the census became apparent within weeks of the start date. Simply put, fewer households than the Census Bureau had anticipated were mailing back their questionnaires. Instead of the estimated 70 percent mail response rate, only 65 percent of American households bothered to return their forms. In some neighborhoods, response rates hovered at around 30 to 40 percent, causing despair among city and community leaders, and census officials alike.

This disappointing response left the Bureau with a 30 percent greater workload for the door-to-door follow-up work than it had planned for in terms of time, money, and workforce. In fact, the field work took more than twice as long as the Bureau had planned: fourteen weeks instead of six. It took six weeks alone just to gather information on the final ten percent of non-responding households.

Consequently, much of the information collected as spring turned into summer and summer turned into fall was undoubtedly of dubious quality. By virtue of the passage of time since Census Day, many households -- particularly more mobile, lower income

populations -- were likely to provide inaccurate information about who lived there on April 1. In some cases, the efforts of census takers to gather information directly from a non-responding household were futile. This led to the collection of data from surrogates such as letter carriers, neighbors, or building managers. The General Accounting Office noted that 3.2 percent of the nation's occupied housing units -- or about 7 million people -- were included in the 1990 census based on information collected indirectly. In some urban communities, however, these "last resort" procedures were used at more than twice the national rate, and in 14 local census areas, more than 10 percent of occupied housing units were counted in this way. Clearly, the Census Bureau struggled to count the last ten percent of households, leading to a disproportionate share of mistakes (called "non-sampling error") in the hardest-to-count communities.

Not surprisingly, the Bureau ran out of money long before the census was finished. It had cost at least $10 million to visit every one percent of households that didn't respond by mail. That figure more than doubled for the last ten percent of non-responding households, as census takers made visit after visit to gather information against the clock. The Bureau had to hire more enumerators than it had planned and had to keep local census offices open longer than expected. It turned to Congress for an emergency appropriation of $100 million to get the job done.

Maintaining an adequate workforce of qualified enumerators quickly became a problem, as well. Because of the unexpectedly

heavy workload during the door-to-door phase, the Bureau had to recruit and train many more temporary workers, a difficult prospect, at best. In order to meet its hiring needs in many areas, the Bureau was forced to increase its pay rates, adding to the escalating cost of the census.

These problems compounded one another and what we had in the end was a census that was widely regarded as a failure. It was the first census in modern times that yielded less accurate results than the previous decade, even as costs escalated significantly. Even more troubling is the fact that despite the Census Bureau's best efforts to eliminate the persistent and disproportionate undercount of the rural and urban poor and minorities, the '90 census again failed to reduce the number of those who were missed. In fact, the undercount was significantly higher than in 1980. More minorities were not counted in 1990 than the **total of all people missed** in 1980. That difference -- that inequality -- was, and still is, unacceptable.

I think everyone in this room agrees that we cannot let that happen again in 2000. Not when we have the scientific knowledge to significantly reduce (if not eliminate) the undercount.

I firmly believe that the 1990 census was not a failure of execution, but a failure of design -- a 20 year-old design that has outgrown our nation. The Census Bureau did the best job it could with the tools it had. Unfortunately, as we later learned, those tools could not accommodate a changing population.

The fact is, we are a nation on the move. But even that

mobility and its character is changing. Consider impoverished populations that are migratory and homeless: poor people move around a lot. Growing numbers of people are homeless or are not tied to a permanent address. Migrant farm workers and the growing numbers of moving construction workers around the country have created problems that are difficult to anticipate. Even upper middle-class people are highly mobile and wealthy people are multi-residential. It comes down to this: traditional counting methods are based on house-grounded census techniques that can no longer fully accommodate a changing, transient population.

Some people believe that increased advertising and promotion and outreach will solve the problem of the undercount. Indeed, paid advertising and increased promotion and outreach may help keep the mail response rate at an acceptable level but they cannot -- on their own, significantly reduce -- no less eliminate -- the undercount.

Even after an emergency appropriation of $100 million for the 1990 census, the count still yielded a disgraceful disproportionate undercount of minorities and the rural and urban poor.

From my experience of evaluating the 1990 census, I have come to believe that no amount of money that Congress throws at the census will count those who are difficult to reach or those who are fearful or mistrustful of the government.

The Census Bureau's sampling plan is not perfect. But make no mistake about it: the population numbers produced by traditional counting methods are rife with error. They may look precise, but

they are wrong. It is absolutely irresponsible for Congress to force the Census Bureau to continue to use counting methods that have proven decade after decade to yield poor results at high costs, when sound science will allow us to do better.

In closing, Mr. Chairman, it is certainly reasonable to have concerns about whether or not the Census Bureau is prepared for the 2000 Census. However, at this point in the decennial cycle, there are bound to be uncertainties, bound to be procedures that still need to be refined, bound to be decisions yet to be made. That is simply the nature of such a complex undertaking.

It is my hope that the subcommittee will welcome the opportunity to work as a partner with the Census Bureau to ensure the most accurate count possible for our nation. Without a constructive partnership with Congress, the census is doomed to a repeat performance of 1990.

Mr. MILLER. Congressman Petri.

Mr. PETRI. Mr. Chairman, members of the subcommittee, thank you. It seems like old times. Tom and I somehow ended up in this business and had many hearings because he did take, very seriously, his responsibility as a Member of this House and, at that time, as chairman of the subcommittee with oversight responsibility over the Bureau of the Census, to conduct extensive hearings and, to different aspects of the census, to encourage the Census Bureau and to refine and improve its procedures for the 2000 census and, also, to give a variety of different groups and individuals who have concerns about one aspect or another of the census, opportunities to air those concerns. And I think there have been fruit already from that effort. It's been a productive effort.

The census is—believe it or not—a very, very important exercise for our country in all kinds of ways. It's written into our Constitution which is unusual—not only do we want to have an accurate and updated count for fair political representation purposes and for a fair distribution of various formula population-driven funds across the country, but the census, and the various long form and other parts of the census, provide a wealth of data to industry to help our whole economy operate more efficiently than it could without that information.

Other countries are struggling to put in place their own versions of what we have here, going back to our Constitution. That's why it makes me very sad that we may be careening toward attempting to make a massive change in the methodology of the census that could—be constitutionally suspect. The Constitution requires an actual enumeration, and we're not quite sure what that means, but it could be constitutionally suspect on a partisan basis, and that's bad. I think we should attempt to avoid, to the extent we can, doing departures—we've done it for 200 years making changes that are not based on, at least, fair consensus of support or tolerance across the political spectrum and among the parties.

I think it's bad to criticize the census, and unfortunately, that's been happening by this change. I hope at a minimum, that as we go forward with the census, if somehow the agreement cannot be resolved and the Census Bureau attempts to adjust it, as they did after the last census, that provisions be made to conduct a complete census and then adjust it. Should the census adjustment not be allowed when challenged in court, we still would have a census that we could rely on. The country could move forward in an accurate way rather than, basically, foreclosing a realistic constitutional test giving the court the option of throwing the country into chaos, in some respects, or going along with the adjustment, even if they don't feel the Constitution actually allows that for the basic census. An actual enumeration, I think, a lot of people feel meant a head count. And there was a reason for doing that, and that was, that the Founding Fathers and a lot of other national experiences have been that this, when it's politicized, the numbers get manipulated, however the veneer or whatever the veneer, and I think that's a legitimate suspicion.

I lived for a couple of years in the country Somalia where the different tribal weights were obviously very, very important. And they were so important, they would not allow a census. They all just

sort of argued how big they were, and it was sort of bargained out politically.

So the idea of resort to fact, at the end of the day, is important. Just as in an election, we don't adjust or have a poll. It may be an unfair election. Different elements of the community may not have turned out as much as proportionately it would be indicated. But when the ballots are cast and they're counted, that's what determines who won the election. And we don't adjust it; however, some may feel it's unfair. What we do, is keep trying to make efforts to have broader involvement, outreach, get people to vote. And, I think the idea of reaching out and using this to get people to participate, as an active citizenship, in the census is very important, and there are a lot of things we can agree on in that regard.

I think a major public information campaign leading up to the census that could, in part, be funded for a TV special explaining why this is an active census, a part of your duty as a citizen; why the census is important; that, in fact, the results are confidential, by law, and cannot be used against any individual who fills out the form. They will not—they cannot be used in court, or in any other way, to compromise their activities. And we felt the census is so important that information is set aside and not allowed to be used in court, or in any other way. We've had a number of hearings on that to make sure local officials would not use census data; for example, if too many people were in a building, zoning violations, things like this. They can't use the census for that purpose. We need the information, and it's important for our country to have that information, and we're willing to sacrifice this particular way of getting information for other purposes.

The idea of trying to let people in undercounted communities work as census enumerators, without that income being counted against the amount that they would get for welfare or other payments, has been explored. Representative Meek has suggested that, and I think that's a good idea.

I think we worry about the undercount in minority communities, in communities with a high percentage of new entrance into the country. There's a tremendous undercount among taxpaying and, in many cases, voting Americans living around the world. Several millions of Americans live outside the United States and are not, today, counted. And I think that that should be added to the litany of people who need to be counted, because the world is changing. More and more people are going to be traveling and working and retiring outside of their township, or their State, or their country, and procedures need to be put in place to attempt to count those American citizens. We have that data—in most cases, I think, or at least a lot of it—over at the State Department now. People have to get passports to travel, and they get visas to travel. If you're talking about an adjustment, you must at least try to reach out, or at least mail to those people, there doesn't seem to be any effort to adjust in that regard. But, I will be suspect about the limited nature of the proposed adjustment, when they're not even attempting to reach out for a large number of people who, we know, are there and should be included.

In my State of Wisconsin, we had the highest participation in the last census, so far as returning the forms voluntarily, of any State

in the country. Over 75 percent filled out the forms and returned it. It didn't just happen. I, as a Representative, mayors, our Senators, our Governor, other local officials did repeated public service announcements, letters to the weekly columns outlining to people the importance of this census and that this was a duty of citizenship.

We talk a lot about our rights as Americans. We do have a few responsibilities, and this is one. I would be very worried, that once people realized that they could go to an adjustment, you would see compliance plummet, and you would see inaccuracy multiply. This is another example of, sort of, the "dumbing-down" of America, if you will, if we're not willing to ask American citizens to do the least bit to help their country and to be sure they're fairly represented. It benefits them; it only takes a couple of minutes, and it's private. I think people have an obligation to, participate as citizens in this country and to help make the society work, and work accurately. I should say in Wisconsin—our mayor in Milwaukee, Mayor Norcrest, made a special effort, had the employees of the city government participate actively in helping the Census Bureau identify people.

I think the Census Bureau could work with the post office, maybe even figure out a way of seeing if postal employees would like to volunteer to be enumerators in overtime, in exchange for some payment, because they're delivering the mail all over America everyday, and they have a pretty good idea of who lives where. And they could be enumerators in their own time, not as postal employees; but if they volunteered to do that, I think there could be an outreach effort there, and that would improve the accuracy of the census enormously. And those researchers are right within our own hands.

So, there are a lot of things that we could do to increase public awareness, and to increase public participation, and to make sure regardless of whether we adjust or not. And I hope we don't, because I think it would undermine the integrity of the census. But even if we do, be sure you do a complete census, and then, if you want to adjust it, because otherwise, if it turns out to be unconstitutional—I know there's a court case going forward, but that's before the fact, and the courts normally will not get into that kind of thing. But, after the fact, the last census was challenged. And this census will presumably be challenged, whether they adjust or don't adjust. And you're going to prejudge that and make a—you know, if it predetermines the outcome if you do not go forward in a way that, if the court decides the actual enumeration means actual enumeration for purposes of elected office, if they decide the statute that's on the book that requires an actual enumeration for purposes of redistricting is the law of the land, and enforce it in court, and you have not done an actual enumeration to the best that you can, you're going to create potential chaos, or else prejudge a constitutional case.

So that's, basically, my pitch, and I wish you well. [Laughter.]

I hope you can lower the partisan rhetoric and see where we can agree, and build on that agreement, because we do want to—we have a—this is an important thing, and we want it to be done as right as we can for the country. And that's the best I can say.

[The prepared statement of Hon. Thomas Petri follows:]

The Honorable Thomas Petri
Subcommittee on the Census -May 5, 1998

I am pleased to appear before the Subcommittee on the Census to discuss the 1990 Census. I served with my good friend from Ohio, Mr. Sawyer, as the Ranking Member on the Subcommittee on the Census in the 103rd Congress and have been interested in the census process since that time.

I believe that before we make any policy decisions for the 2000 decennial census, we must take a hard look at the Census Bureau's operation of the 1990 Census. Part of this operation included conducting a postenumeration survey (PES), a survey with dramatically flawed statistical results. These flawed results add to my concern about the Census Bureau's plans to conduct this same type of procedure in 2000 on a larger scale in half the time.

I believe that my state of Wisconsin, would have had a congressional seat taken had the sampling adjustment to the 1990 Census been implemented. Luckily for the people of Wisconsin, the Supreme Court ruled that the sampling adjustments were too inaccurate to have been used for reapportionment of seats and we were not penalized.

In 1990, Wisconsin had the highest voluntary census mail response in the country. Let me take a moment to discuss the efforts made by Wisconsin in 1990 to promote the census. We had a statewide public awareness plan as well as extensive grass-roots efforts to work with the Census Bureau to make sure that accurate address files were available to use for questionnaire distribution. I was personally involved in the concerted efforts made by the people and the local governments of Wisconsin which

brought our response rate to 75%, a rate far above the national average of 65%.

I believe that we need to use the lessons learned from Wisconsin when we look to the 2000 Census. We should not artificially inflate population counts for some areas by deleting people who made an effort to fill out their forms. Instead, as we did in Wisconsin in 1990, we should make every effort to add resources and enhance methods for enumeration.

Some such common sense efforts include having the Census Bureau work with local governments to construct the best possible address files and strengthening partnerships with the U.S. Postal System. I also suggest we use some creativity to capture the missing addresses. For example, we could check State Department records to document overseas individuals. In a global economy, efforts like these made by the Census Bureau are becoming increasingly important.

Additionally, we should be stressing the mandatory and confidential nature of the Census to promote a higher response rate. We should not instigate a downward spiraling of participation by promoting a partial count. Furthermore, I am concerned that the Census Bureau will not allow local governments to question the accuracy of the census count against their records. This was used by Markesan, Wisconsin in 1980.

I will be more than happy to answer any questions the Members of the Subcommittee may have for me.

Mr. MILLER. Thank you all. Thank you very much for your comments. I agree; it's unfortunate it is more partisan than politicized to a large extent. I don't know how it was back in 1990, 1991, 1992, I wasn't here. I was first elected in 1992.

Mr. SAWYER. I can answer that, Mr. Chairman.

Mr. MILLER. Yes; would you? [Laughter.]

Mr. SAWYER. The census is always a difficult political contest because the stakes are so high. But in 1990, we worked very hard—Tom Ridge and I occupied these counterpart positions at that time. We worked very hard not to prejudge the question of whether or not the census ought to be adjusted. We felt that that was something that ought to be left to the scientists, to the professionals, to the demographers and statisticians, and ultimately to the Director of the Census and to the Secretary of Commerce. We recognized that, while it is the constitutional responsibility of the census to conduct the count in such a way as the Congress shall by law direct, that it would probably be a mistake to try to direct that technique by a show of hands on the floor of the House, so we did not do that. I was under a good deal of pressure from one side; Tom was under a good deal of pressure from the other. We were able to refrain from that and to allow the count to carry itself out in a way that was least disruptive of the plan that the Bureau had taken into this enormously difficult undertaking.

Mr. MILLER. Now, I think I heard that you were critical of the administration for their cooperation with Congress back in 1991 and such, which we are having that concern today. One of the concerns that I have——

Mr. SAWYER. I really wasn't. I mean I was not——

Mr. MILLER. Well then, great. [Laughter.]

Mr. SAWYER. The only point I was critical of was, after the fact, when it became quite difficult to get the Commerce Department to come and present information, but that was after the fact when——

Mr. MILLER. OK.

Mr. SAWYER [continuing]. It could not be harmful to the conduct of the census.

Mr. MILLER. One of the concerns I have is that the administration has unilaterally, dramatically, radically, changed the system this time around because they're not doing an enumeration. As Tom was saying, back in 1990 the decision of adjustment was in 1991, after that. But now, there's no opportunity, no fallback position, and they've never come to us to even ask. They're moving full speed ahead with this plan, regardless of what Congress has to say or think, and we have a hard time getting the information out of the administration. There's a lot of stonewalling going on in the administration.

Mr. SAWYER. This design was put in place, not by a Democratic administration, but under the direction of Dr. Bryant, who was the Census Director under President Bush. It was in response to the enormous difficulties that she had encountered in trying to carry out the 1990 plan which is essentially, as I mentioned, a 30-year-old plan. Grounded as it was—and the mail-out/mail-back techniques that were put in place in the 1960's, they don't work as well

today as they did in the 1960's, and it was that, I think, that she was responding to.

Mr. MILLER. For example, I don't know how many details you're in on this current 2000 plan, but the 2000 plan was just released to Congress last year. It may have started in theory, with Dr. Bryant, but we're really starting to get the information today.

One of the concerns, for example, is that they did sampling of 150,000 households back in 1990. This year they're talking—in 2000, they're talking about 750,000 households, but they're going to do it in half the amount of time. They're going to have a sample five times larger and do it in half the time. In 1990 they used the professional staff of the Census Bureau; now they're going to use the part-time help. So you use less experienced help, and so you say, "Wait a minute; can it be accomplished?" I would think, as you've mentioned, that you had concerns they couldn't complete it back in 1990 with only 150,000 households; now we're going to go five times larger. The concern is to design a system, and that's the reason GAO has raised serious doubts. Since you won't do an enumeration in the first phase, you will have nothing to fallback on. That's the scary thing about this whole system.

Mr. SAWYER. The thing that I think Dr. Bryant was responding to—and let me just add that the release of the report on the plan that took place last year, I think, was a good thing. I congratulate the majority in having called for that, as it did, but that plan has been accessible throughout the decade, and it was available as it continued to evolve throughout the decade—to Members of Congress. I had the availability of it, and Tom did as well. The enormous difficulty, from my point of view, is that Dr. Bryant was trying to respond in putting together this plan to the terrible political difficulties that come when you have two counts, one number that one side advocates and another number that another side advocates, and it was her view—although I'm not here to defend that—and she was very clear about it throughout her term in office, that the plan that she wanted to put forward for 2000 should be grounded in a one-number census, so that you did not have competition between two numbers in a sense of winners and losers that would yield a political decision, rather than one that was grounded in——

Mr. MILLER. Let me——

Mr. SAWYER [continuing]. The statistics and demography.

Mr. MILLER. Let me ask, and my time's up, but let me ask just one final question.

Mr. SAWYER. Sure.

Mr. MILLER. As Congressman Petri asked, that he felt we should at least do the full enumeration so we have something to fallback on, you don't agree with that idea? You think that we should 100 percent rely on sampling?

Mr. SAWYER. No, I don't think we should ever want to 100 percent rely on sampling. I think the efforts to do the fullest possible count that underlie this plan are extremely important. I am torn, as you are, as Tom is, about whether or not we simply ought to go with a one-number census, as Dr. Bryant proposed, in order to avoid the political conflict that took place after 1990 or to go with, as you refer to it as—you didn't use the term—but it's virtually a

safety net census that uses two different techniques and that you can pick and choose between those at the end.

It's a terrible dilemma, but I can tell you that having been through the political fight of 1990, 1991, and 1992 that I can certainly understand Dr. Bryant's motive in leaving the professional counting techniques internal to the census itself, the career professionals within the census, rather than bringing them out and having a political fight among elected officials over which number ought to be chosen.

Mr. MILLER. Next, Mrs. Maloney.

Mrs. MALONEY. I want to thank both of you for your testimony. We don't have copies of your testimony, and may I ask staff if they could get copies for us now of both Congressman Petri's and Mr. Sawyer's testimony?

Mr. SAWYER. We brought copies.

Mrs. MALONEY. Mr. Petri's, if I could. OK, I'd like a copy of yours, too, Tom, if I could.

Mr. PETRI. Mine is sort of a work in progress. [Laughter.]

Mrs. MALONEY. OK. [Laughter.]

OK, I'd like to——

Mr. PETRI. I've got the only copy here.

Mrs. MALONEY. I'd like to ask—well, why don't we make a copy so that everybody has a copy?

Mr. PETRI. OK.

Mrs. MALONEY. I'd really like to ask both of you whether or not you rate the 1990 census as a success or a failure? And, how do you measure its successes and/or failures?

Mr. SAWYER. Want to go first?

Mr. PETRI. Well, I think it's like a lot of things in life; it wasn't perfect, and it could be improved, but it was certainly within the range of the other 18 censuses or 20 censuses that we've had since the Republic was founded. There have always been various problems with the census and different populations; it's nothing new, but if there are ways that we can actually improve it, we ought to do it. I'm just concerned that, for example, one of the things that we were able to do in the 1990 and the 1980 censuses, we will not be able to do if we go to a complete adjustment approach. That is to involve State, and local, and school board, and other local officials in correcting error. If the numbers and the tract numbers are massaged, and there's no reference to objective reality, and you're on a school board or you're on a city council, there's no way you can challenge and correct the number for your city, or town, or whatever. Now you can, because they do a headcount; they send the figures back to the local units of government; they look at them and they say, "Hey, wait a minute."

In one town in my district they missed a whole ward. It's a little town of 3,000, and the Census Bureau said there were only 2,200 people in the town. Town officials knew that wasn't right. And so the local officials were able to go in and document the discrepancy and prove that the Bureau had made a factual error and had left out this ward and get it corrected. And that's part of the checks and balances and getting people involved at all local levels of government. If they had mailed the town an adjusted number, what could they have done? The Bureau would have said, "Well, we ad-

justed it, and this is not an accurate number; we've pulled some people out of there because you were over-represented somehow."

And they are talking about adjusting downward and upward. In Wisconsin, if they had been adjusted downward, as well as upward, when the last adjustment was considered we would have had our actual count reduced, and I don't think that's going to lead to public confidence in the system.

Mrs. MALONEY. Mr. Sawyer, do you think the 1990 census was a success or a failure?

Mr. SAWYER. Well, in some ways it was an extraordinary success in that it undertook the largest count ever attempted in this Nation. But, the truth of the matter is that, as we encounter the kinds of problems that we did, that by several critical measures, it was the first census in modern times that was less accurate than the previous decade. And in some critical measures, particularly in terms of the differential undercount, it was an enormous error and the largest ever encountered in the entire measurement of that particular quality in the census. Let me, also, suggest that the opportunity for local involvement is not diminished, but substantially increased, in the 2000 plan. It involves both pre-census and post-censal involvement; the capacity to challenge is enhanced rather than diminished and, in fact, if it were diminished in meaningful ways, I would share the same kinds of concerns. I do share those concerns. I think there needs to be powerful local involvement, but it's even more critical that it take place ahead of time, in the development of address lists which was one of the places where great difficulty was encountered in the first place.

Mrs. MALONEY. I understand that the 2000 census will not be absolutely perfect, but do you believe that it will be more accurate than the 1990 census?

Mr. SAWYER. Well, my belief is that if we attempt to redesign it on the floor of the House, we will encounter problems that we have never anticipated. My belief is that the design proposed for 2000 is better suited to the era in which it is being used than the 1990 census was to 1990, and it's certainly more appropriate than trying to reuse the 1990 census in the year 2000.

Mrs. MALONEY. OK, my time is up. Would you like to comment on that, Mr. Petri, or not?

Mr. PETRI. Well, I think if we don't be sure that we go forward in a secure way, the chances are we will end up with an enormous mess in 2002 or 2003. If we do a pure adjustment, and it turns out actual enumeration and existing law requiring redistricting to be done on the basis of an actual count should be held to be the law of the land, then either we have to do a new census or, I guess, stay that redistricting. I don't know what they would do, at that point, if they didn't have the data that they could work on.

So, we are heading toward a potential train wreck if we're not careful. And I do think it's worth—even if it's inconvenient—trying to figure out some way that we can all agree to make sure that we have as complete a count as possible. If people feel it to be more accurate by adjusting it, well, I've never objected to adjusting the census for certain purposes because, I think, it probably is more accurate on a statewide or nationwide basis. But when you get down to local units of government, it's not more accurate. And for elec-

toral purposes, it just strikes me it's a violation of the spirit of, "one man, one vote," rather than adjusting results that for someone's idea of equity if people don't bother participating.

Mr. SAWYER. Mr. Chairman, I don't want to get into a——

Mr. MILLER. OK.

Mr. SAWYER [continuing]. Give and take here, and I know that you don't. I would welcome the chance to respond to some of those comments in writing.

Mr. MILLER. OK.

Mr. SAWYER. I think some of the concerns are well-placed, I think some are not. And in any event, it is more than I can do simply sitting here going back and forth. I'd be happy to expand on any of those things, but I leave it to your discretion if I could submit comments——

Mr. MILLER. Yes.

Mr. SAWYER [continuing]. For the record, it would be helpful.

Mr. MILLER. I appreciate it. We do have two other panels of witnesses——

Mr. SAWYER. Yes.

Mr. MILLER [continuing]. And we want to make sure we have enough time to properly be able to hear from them.

But at this time, let me call on Mr. Snowbarger.

Mr. SNOWBARGER. Thank you, Mr. Chairman. First of all, let me thank both Congressman Petri and Congressman Sawyer for being here and for being actively involved in the 1990 census. You were in Washington dealing with those things; I was in Topeka, KS, in the State legislature, as the ranking Republican for reapportionment and redistricting, as well as on the NCSL, National Conference of State Legislatures Task Force on reapportionment. We were watching post enumeration sampling very, very closely, and frankly, very much opposed to it in our State, the State of Kansas, and tried to keep that information available to the Census Bureau all the way through. I will tell you that having gone through the process of drawing the maps for State legislative districts, I want to echo the concerns of Congressman Petri, that if you sample—I think, particularly for the census block, census tracts—those smaller sampling units which, frankly, we use. We broke them down that finely. In particular for State House of Representative seats, and I'm concerned about the accuracy at that level.

Let me go to a different line of questioning, though. And, Congressman Sawyer, it's my understanding—again, I wasn't here for the debates—but it is my understanding that you were quite a proponent of the post-censal local review. Could you just talk a little bit about the local review and why you thought that was very important?

Mr. SAWYER. Well, it's important to have local involvement at virtually every level. As you suggest, it is sometimes possible, just through administrative oversight, to miss whole units of population. In my district—we all have stories—in my district we had an apartment complex that was named after an adjoining community but it was not in that community. So it was deleted from one and put in the other. Local communities observed that and protested it and that was altered. I think it's important, however, to point out that when we talk about small area inaccuracy, we're not

talking about 100,000 level. For the most part, we're talking about census block levels. We don't draw districts that are the census block size. We don't do virtually anything with census block size——

Mr. SNOWBARGER. No, you aggregate——

Mr. SAWYER. You aggregate——

Mr. SNOWBARGER. No, you aggregate——

Mr. SAWYER. You aggregate them and the errors tend to cancel themselves out. They're not great to——

Mr. SNOWBARGER. Well——

Mr. SAWYER [continuing]. Begin with.

Mr. SNOWBARGER. Well, I think I would disagree that——

Mr. SAWYER. Well——

Mr. SNOWBARGER [continuing]. They tend to cancel themselves out. That's quite an assumption. If they're all inaccurate, to say the inaccuracies go both ways, particularly in the size of a State legislative district which may not——

Mr. SAWYER. Let me——

Mr. SNOWBARGER [continuing]. Be very large at all.

Mr. SAWYER. Let me suggest, however, that the kinds of inaccuracies that result from pure head-counting techniques in 1990 did, in fact, yield undercounts of some 10 million, double counts of some 6 million, and we frequently refer to that as an undercount of 4 million; it's not.

Mr. SNOWBARGER. Sure, as you suggest——

Mr. SAWYER. It is an aggregate error of 16 million, and those kinds of mistakes are important.

Mr. SNOWBARGER. Right; let me continue on with the local review. Do you still feel strongly that that part of the process is important?

Mr. SAWYER. Well, I'm not sure that the same kind of local reviews used in 1990 is appropriate. But I believe there ought to be opportunities for local review.

Mr. SNOWBARGER. As I understand it right now, the Census Bureau really hasn't left enough time to complete the Integrated Coverage Measurement and still allow for the post-census local review. Does that concern you in any way?

Mr. SAWYER. It does.

Mr. SNOWBARGER. Do you have an answer to that?

Mr. SAWYER. More time.

Mr. SNOWBARGER. And, between now and the year 2000?

Mr. SAWYER. No.

Mr. SNOWBARGER. We'll see what we can do to petition——

Mr. SAWYER. No.

Mr. SNOWBARGER [continuing]. The maker of time, but——

Mr. SAWYER. No, in the post—well, that's part of the problem. Part of the problem is that, for about 100 years now, we have worked with what are essentially 10-year planning horizons, and we wind up in an execution-planning crunch every decade of the kind that we're running into right now. It was one of the fundamental problems that was encountered in the run up to 1990, and it's, I think, the single most important thing that can be taken from the kind of testimony that we've offered here. Because if we

allowed those kinds of problems to repeat themselves, we will face an even greater problem in 2000 than we did in 1990.

Mr. SNOWBARGER. Well, yes, I'm concerned; both of you have given examples now of, well, relatively large blocks, depending on the type of district——

Mr. SAWYER. Right.

Mr. SNOWBARGER [continuing]. You're putting together, relatively large blocks of people that were just left out, whether it was administrative error or whether, you know, whatever the matter. And it does concern me that we don't have any local review process. Do you have any thoughts on the—my understanding is, in the new census, that there will be the ability of people to check off more than one racial block. Are you familiar with that?

Mr. SAWYER. Intimately. [Laughter.]

Mr. SNOWBARGER. OK. [Laughter.]

If you want to share some of your intimate thoughts, I'd appreciate it.

Mr. SAWYER. Well, as you know, in the course of this decade, we have seen enormous demographic changes in the make-up of our population. And as a result, a significant number of people have sought better ways to reflect their personal identity in the way they are counted. One of the movements was to create what has come to be called a multi-racial block. The difficulty is that it makes it extraordinarily difficult to make any kind of comparison, from decade to decade, to disaggregate the numbers in ways that make it possible to use them in the ways in which they have been traditionally applied over the last 30 years, and to track, for a variety of purposes, ranging from everything from pure scientific research, to public health, to everything else—what the information that is needed to make sound—public and private—policy.

To that end, the OMB conducted a series of reviews. Tom and I conducted hearings, probably the most thorough hearings ever conducted on that topic—sometimes, I think, to Tom's chagrin—[laughter]—about how best to approach that dilemma. After a good deal of work, OMB, last year, decided that checking more than one provided the broadest possible range for people to identify themselves as they understood their own identity, and to make it possible to have continuity and comparability in data over the course of time in ways that would be most useful for decisionmakers.

Mr. SNOWBARGER. Mr. Chairman, I think my time has expired. Thank you.

Mr. MILLER. Thank you. Mr. Davis.

Mr. DAVIS of Virginia. Just a couple of questions; it sounds like some of the advocates at the Census Bureau, and others are basically saying, "We're not going to get a fair count. We just don't know how we can improve the count." And they're putting their eggs on the sampling basket and trying to make that better. And you talked about the information collected, indirectly, that we've tried to use in the past; could you elaborate on what exactly that is?

Mr. SAWYER. Well——

Mr. DAVIS. I'm talking about the postmen and the——

Mr. SAWYER. Sure. In the past when it's been impossible to get actual counts from——

Mr. DAVIS. Impossible, meaning people won't fill out the forms?

Mr. SAWYER. Well, first of all——

Mr. DAVIS. Or, answer the door?

Mr. SAWYER [continuing]. People didn't fill out the forms. The kind of mail-out/mail-back techniques that are in place today were really first put in place after the Second World War, and they, I think arguably, have never been an actual enumeration as the founders might have conceived of it or as it's sometimes characterized today. I believe it has been an actual enumeration, mail-out/mail-back. The rates were fairly high to begin with.

In the course of the last couple of decades, those rates have begun to fall, and they fell markedly in the 1990 census. They made it very difficult to achieve counts and, particularly, where the return rates were down in the 30 to 40 percent range. It meant that very large numbers of people had to be sent into very difficult areas to count, and they took substantially longer than had been anticipated.

Those problems compound one another. They wound up with greater costs, less accuracy; it took longer. And so the disparity in time between the actual census date and the completion of the count created problems but, in addition, it required that enumerators going door to door would have to go back three and four times ultimately resorting to what is loosely termed "curb stoning." That is to say they first went to last-resort procedures asking postmen they may have encountered, or building managers, or people who looked like they knew the neighborhood; how many people lived there, and what was the make-up of the household?

Finally, in the end, what it really results in is that a substantial, knowable number of households are guessed at. These are not actual enumerations.

Mr. DAVIS. So it's based on, per se, gossip?

Mr. SAWYER. I don't—those are terms that are not used. They're——

Mr. DAVIS. But they are, though. You're asking a neighbor what do they see in there, and they——

Mr. SAWYER. And presumably, they gave you the best guess they can. But we should understand that those traditional techniques involve a substantial amount of that——

Mr. DAVIS. But you have the——

Mr. SAWYER [continuing]. Kind of guessing.

Mr. DAVIS [continuing]. Same thing with sampling, don't you? Don't you have the——

Mr. SAWYER. I don't believe so.

Mr. DAVIS. In the tighter timeframe for 2000 could make this problem worse?

Mr. SAWYER. Tight timeframes always are a problem. Those who complained that the sample was not large enough in 1990, found a plan that was proposed as a result of the lessons that were learned, that is some five times greater in terms of the actual sample. It will be difficult to collect, but it is a—it will yield a far finer statistical analysis of the uncounted population than anything that was anticipated in 1990.

Mr. DAVIS. Why don't you have the same problems with sampling?

Mr. SAWYER. I'm not sure I understand your question.

Mr. DAVIS. Well, with sampling you have to, again, you have to get an accurate count somewhere and then extend this sample, to the uncounted households. Why wouldn't you have the same kind of problems in getting the correct number, ethnicity, and all those kinds of issues?

Mr. SAWYER. You do have those problems, but the use of sampling in an attempt to refine known areas of error is improved with a larger sample; virtually all of us understand that. This is not a poll. Polling in this country is grounded in numbers that measure the entire Nation in samples of 1,600 to 3,000——

Mr. DAVIS. Right.

Mr. SAWYER [continuing]. And if they're most accurate. This is a far larger undertaking. It is vastly more difficult, as you suggest, but the effort, I believe, is worth it if we can refine the numbers from the known level of error that we've encountered in 1990.

Mr. DAVIS. But it seems that the errors would be magnified by a shorter timeframe.

Mr. SAWYER. The errors become magnified by having too small a sample. The ability to have the largest possible sample is quite important. But, as I suggested, if you're suggesting to me that there is difficulty in recruiting sufficient numbers of people, training them well enough, getting them to the household, and getting the counts done, you're absolutely correct. But, if you mean to suggest that by attempting to do sampling, that it makes the matter of a bad count to start with worse, I think you're incorrect. I think the opportunity to refine that count is far improved when you use the kind of techniques that are available to the Nation today.

Let me just say one other thing; this is not the first time that new techniques have been used in the census. The mail-out/mail-back was a substantial departure from what had been done in the past, and it improved the count over what would have been possible today if we were still trying to do everything sending out people to go door to door. We just simply wouldn't be able to do it.

The same thing happened in the 1880's, when we weren't able to tabulate the census results. It took 8 years to tabulate the 1880 census, and so it was in 1890, that the use of punch cards and machine counting to tabulate the census was, for the first time, used. Now, that was not handwork either, but it resulted in a substantially improved count and a much more usable data because it was usable throughout the entire decade. That's where IBM came from. We just have always been a nation of innovators, and I think we have the opportunity and a compelling case to be made for innovation in the 2000 census.

I genuinely believe that if we attempt to make substantial changes in the plan that has been evolving over the entire course of this decade, if we attempt to make major changes in those plans at this late date, that we will exacerbate a problem that is already difficult.

Mr. MILLER. Thank you. Let me thank you both for being here.

Mrs. MALONEY. But, Mr. Chairman, if I could, please. I have a series of additional questions, but in the interest of time—because I know we have many other panels—I would like your permission to have both of our colleagues respond, in writing, to my questions and have them part of the permanent record.

Mr. MILLER. Without objection.

[The information referred to follows:]

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INDEPENDENT

May 19, 1998

The Honorable Thomas C. Sawyer
U.S. House of Representatives
1414 Longworth House Office Building
Washington, D.C. 20515-3514

Dear Mr. Sawyer,

Thank you for testifying before the Government Reform and Oversight Subcommittee on the Census on May 5, 1998. Because of time constraints, I was left with a number of questions unanswered. Therefore, I request that you answer the following questions:

In 1991 Commerce Secretary Mosbacher based his decision to adjust or not adjust the 1990 Decennial Census on eight guidelines. Guideline #2 stated:

"The 1990 Census may be adjusted if the adjusted counts are consistent and complete across all jurisdictional levels: national, State, local and census block. The resulting counts must be of sufficient quality and level of detail to be usable for Congressional reapportionment and legislative redistricting, and for all other purposes and at all levels for which census counts are published."

It was very clear and well documented from the Census Bureau's hand picked Undercount Steering Committee, and the court appointed "Panel of Experts", that for areas of less than 100,000 people the 1990 PES adjusted counts were less accurate than unadjusted counts.

During the Subcommittee hearing on May 5, 1998 you mentioned that block level data are not even used for redistricting. Are you maintaining that block level data are not extensively used for legislative and local redistricting? On further reflection would you wish to revise that comment with regard to congressional redistricting?

Would you agree that census tract, block group and township level data are widely used in redistricting?

Do you feel that the use of a coverage measurement methodology (PES/ICM) which is not more accurate and closer to the truth in geographic areas containing populations of less than 100,000 persons (which covers most block groups, census tracts, townships and towns) would be a good public policy choice?

If Secretary Mosbacher had used the adjusted figures in 1991, how would you have responded to the state of Pennsylvania after the processing error was found in 1992?

> *(Pennsylvania would have lost a Congressional seat to Arizona erroneously from the June 1991 PES adjusted counts)*

If Secretary Mosbacher had adjusted the 1990 Decennial Census, in your opinion, would the lawsuits have ceased from one group of cities and increased from another?

All three of our witnesses on the second panel testified during the hearing about the problem of correlation bias in the adjusted counts and how it inflates the undercount. They testified that the Census Bureau's own studies conclude that more than half of the undercount estimates were not true undercount but correlation bias. Would it bother you if the ICM proposed sampling adjustment plan to be used in 2000 will have the same problems?

According to the National Academy of Sciences half of the undercount in 1990 was because people never received a census form, not because they received one and did not send it back. Would it then follow that a complete Master Address File would have resulted in the best census in history?

My questions and answers will be part of the permanent record of the May 5, 1998 hearing. Again thank you for input into this important process.

Sincerely,

Dan Miller
Chairman
Subcommittee on the Census

CC: Rep. Carolyn Maloney

THOMAS C. SAWYER
14TH DISTRICT
OHIO

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Congress of the United States
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June 18, 1998

The Honorable Dan Miller
Chairman, Subcommittee on the Census
Committee on Government Reform and Oversight
U.S. House of Representatives
114 O'Neill Building
Washington, D.C. 20515

Dear Chairman Miller:

Thank you for the opportunity to testify before the Government Reform and Oversight Subcommittee on the Census on May 5, 1998. I have enclosed answers to your additional questions. I hope you find them helpful.

Please let me know if I can be of further assistance.

Sincerely,

Tom Sawyer

Thomas C. Sawyer
Member of Congress

TCS/djm
Enclosure

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Response to Written Questions by Chairman Dan Miller from Congressman Tom Sawyer

Subcommittee on the Census
Committee on Government Reform and Oversight
Hearing on May 5, 1998

1. **During the Subcommitteee hearing on May 5, 1998 you mentioned that block level data are not even used for redistricting. Are you maintaining that block level data are not extensively used for legislative and local redistricting? On further reflection would you wish to revise that comment with regard to congressional redistricting?**

While I appreciate the opportunity to revise my remarks with regard to redistricting, a clarification of my comments would perhaps be more helpful to the subcommittee. As you know, legislative districts are created for geographic areas much larger than a census block. While census blocks are aggregated to form districts of varying size, depending on the political body (i.e. congressional, state legislative, school board, etc.), it is really the size (in terms of population) and composition of the entire area that is of concern both to those who are charged with drawing the boundaries and courts that must determine if those districts meet the test of equal representation.

Let's take the case of a congressional district as an example. When a state legislature or a court evaluates districts within a state, they must ensure that the population of each district is as equal as possible. If a state is subject to monitoring under the Voting Rights Act, it must also show that the racial composition of districts meets certain requirements. Therefore, it is important that census counts be as accurate as possible at the congressional district level, which is an aggregate of census blocks and tracts, so that population size can be compared. A court would not be interested in the population size of a block, or even a tract, within each district.

State legislatures might closely study data from census blocks that form the perimeter of districts, to make the fine distinctions that need to be made in allocating population to one district or another, but their goal is to create entire districts that are as equal as possible. Population numbers produced by a census that combines traditional counting methods with modern statistical sampling will be more accurate for areas the size of a congressional district, as well as for many smaller areas that have had the highest undercounts in the past. Traditional counting methods alone are likely to produce numbers that are far less accurate at the congressional district level. Therefore, while those districts may appear to be equal in size, they in fact won't be at all.

It is most important to remember that even though census figures produced through a combination of direct counting and sampling are not perfect at the smaller geographic levels, neither are the figures produced by older counting methods alone. In fact, those

latter figures are highly flawed at the block level, and even more flawed as one aggregates to larger areas, making the equality of legislative districts a myth, at best.

2. **Would you agree that census tract, block group, and township level data are widely used in redistricting?**

Census tract and block group data are used *in aggregation* in the redistricting process, helping those who draw the lines to put together political units that are equal in size numerically and meet certain tests for demographic composition. That is why it is important to produce the census numbers that maintain their accuracy for larger geographic areas.

Older counting methods , such as those used in 1990, produce high levels of error that do not diminish as smaller geographic units are aggregated to form larger, useful units of governance. With regard to townships, your question is unclear because townships *are* political units that are created on the basis of aggregating smaller geographic units.

3. **Do you feel that the use of a coverage measurement methodology (PES/ICM) which is not more accurate and closer to the truth in geographic areas containing populations of less than 100,000 persons (which covers most block groups, census tracts, townships and towns) would be a good public policy choice?**

I do not agree with the premise of your question that the PES/ICM methodology planned for the 2000 census will produce less accurate population figures for areas smaller than 100,000 in population than a census that relies only on traditional counting methods. Census Bureau evaluations showed that block level data in the 1990 census had an average error rate of eight percent. Those non-sampling errors were not reduced as the data was aggregated to higher levels. The worst (and least defensible) public policy choice would be to require a census design that is likely, by all accounts, to result in an undercount that is as large, or larger , than in 1990.

4. **If Secretary Mosbacher had used the adjusted census figures in 1991, how would you have responded to the state of Pennsylvania after the processing error was found in 1992?**

I am confident that if Secretary Mosbacher had decided to adjust the 1990 census counts based on the results of the Post Enumeration Survey, the figures would have been scrutinized much more closely before they became official, and the processing error (not an error in the methodology, by the way) would have been discovered. However, your question suggests that because there was a processing error in 1991, the methodology proposed for 2000 will not work. To the contrary, it was the Census Bureau that discovered and fixed the error (rather than hiding it), thus helping them to develop improvements in methodology and operations as the began to plan for the next census.

5. **If Secretary Mosbacher had used the adjusted the 1990 Decennial Census, in your opinion, would the lawsuits have ceased from one group of cities and increased from another?**

I can't give you an answer to this question that goes beyond mere speculation. Suffice it to say that history has shown that the census has always been the subject of much litigation, from the way people are counted, to where they are counted, to who is counted. It is hard to imagine that any decision, one way or another, on census design will either stem or increase the flow of litigation. As long as the census is the foundation of political representation and the allocation of fiscal resources, someone is bound to be dissatisfied with the result and seek a remedy through the courts.

6. **All three of our witnesses on the second panel testified during the hearing about the problem of correlation bias in the adjusted counts and how it inflates the undercount. They testified that the Census Bureau's own studies conclude that more than half of the undercount estimates were not true undercount but correlation bias. Would it bother you if the ICM proposed sampling adjustment plan to be used in 2000 will have the same problems?**

In order to provide a useful answer to your question, it may help to clarify what "correlation bias" is. Contrary to the assertion in your question, correlation bias resulting from the dual system methodology used to measure census coverage **understates**, not "inflates," the undercount. Let me explain why. The DSE method clearly measures three situations: people who were counted in the initial phase of the census but not the post enumeration survey; people counted in the post-census survey but not the initial phase; and people who were counted in both phases. Those "cells" are easy to understand. It is the so-called "fourth cell" – people who are missed both in the initial census count and in the post-census survey – that creates correlation bias; that is, error related to the inability to capture some of the universe you are trying to count no matter which method is used. So to the extent there is correlation bias which cannot be corrected or reduced using known statistical assumptions, the Census Bureau underestimates – not overstates -- the size of the undercount.

Given that the presence of correlation bias causes the methodology to understate the number of people missed in the census, I continue to believe that we are better served by a census that gets us much closer to a true, if not perfect, count of the population – in terms of composition and geographic location – than a census that we know will once again miss millions of Americans.

7. **According to the National Academy of Sciences, half of the undercount in 1990 was because people never received a census form, not because they received one and did not send it back. Would it then follow that a complete Master Address File would have resulted in the best census in history?**

First, I believe that the figure concerning the portion of nonresponse attributable to within household versus whole household misses is incorrect. I am aware that the National Academy of Sciences report referred to a 50-50 split in the types of misses; however, NAS panel members have since indicated that the reference in their report was an unintentional mistake. In fact, according to the General Accounting Office and the Census Bureau, about two-thirds of the people missed in 1990 lived in households that were counted (within household misses), while one-third of those missed lived in housing units that were not counted.

That ratio was an improvement over 1980, when it was the 50-50 split to which you referred in your question. While this information clearly indicates that the Bureau improved the accuracy of its address lists in preparing for the 1990 census, it is also clear that there is room for greater improvement in this area. Nevertheless, the evaluations demonstrate that even the most comprehensive address file will not produce "the best census in history." In fact, the trend appears to indicate that the undercount is becoming more systemic, resulting from factors such as transient living arrangements, distrust of government, and other social causes that cannot be overcome with better address lists. And even the best efforts to develop a complete address file will still miss some nontraditional housing units, where people who tend to be missed are more likely to live.

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June 2, 1998

Representative Thomas E. Petri
U.S. House of Representatives
Washington, DC 20515

Dear Tom,

Thank you for testifying before the Government Reform and Oversight Subcommittee on the Census on May 5, 1998. Because of time constraints, I was left with a number of questions unanswered. Therefore, I request that you answer the following questions:

1. You have mentioned that your biggest concern is with using estimation techniques at the smaller geographic units. What is your opposition to using estimation at the state level, for reapportionment or funding formulas?

2. Your were very supportive of efforts by the Bureau to work with the Postal Service to create the comprehensive master address file and to work with State, local and tribal governments. We have found that the Postal Service lists were insufficient and local governments were not able to handle this task. Many local governments have said that they cannot help the Census Bureau develop its address list unless the federal government provides funds for that effort. Would you support funding local governments to assist in the address list development?

3. With regard to promotion and outreach, you have mentioned the Milwaukee example in the past as a possible prototype. My understanding of the Milwaukee example is that there were great efforts, time and cost, by local governments to increase the mail return rate. However, the undercount in Milwaukee was well above the national average, and nearly 4 times the undercount in the state. This suggest that the Milwaukee example is useful for increasing the mail return rate, but not for reducing the undercount. Do you have any suggestions on how the Bureau could reduce the differential undercount of minorities and the poor. Is it just a matter of spending more on traditional counting measures? If that is the case, why did that not work in 1990?

My questions and your answers will be part of the permanent record of the May 5, 1998, hearing. Again, thank you for your input into this most important process.

Sincerely,

Carolyn B. Maloney
Ranking Minority Member
Subcommittee on the Census

cc: Rep. Dan Miller

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Congress of the United States
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July 23, 1998

The Honorable Carolyn B. Maloney
Ranking Minority Member
Subcommittee on the Census
Washington, D.C. 20515

Dear Carolyn:

I appreciated the opportunity to testify before the Government Reform and Oversight Subcommittee on the Census on May 5, 1998. I am sorry I did not have time to answer all of your questions about the drawbacks to the use of statistical sampling, and the effective measures employed by the state of Wisconsin to produce an accurate enumeration in the 1990 Census. My answers to your three questions follow.

1. Your question here properly frames the issue at hand. The methodology the Bureau is proposing for use in the 2000 Census would use the integrated coverage measurement survey (ICM) to calculate adjustment estimate for subgroups of the population within each state. Since the census count is built from the bottom up, it is important that these estimates be accurate from the smallest units of government to the largest. If we cannot guarantee and acceptable level of accuracy in governmental jurisdictions of less than 100,000 persons, we are building our statewide estimates on a foundation of sand. The figures may, therefore, be no better than the inaccurate local estimates.

Our experience in reviewing the 1990 Post Enumeration Survey demonstrated that an "adjusted" count would have been closer to the real population in some states and farther from the real population in other states. I am not sure how "adjustment" would result in state totals that are better than the actual enumeration for purposes of reapportionment of House seats, since gaining or losing a seat can hinge on extremely small differences in population. Since the adjustment would have resulted in an incorrect apportionment of the House in 1991, how can we be sure that the same methodology will not produce apportionment errors in 2001? Since the Bureau proposes to rely on statistically produced numbers for 12 to 13 percent of the population in the 2000 Census - as opposed to less than two percent in the 1990 Census - I am wary of using these numbers for reapportionment. This is particularly true since there will be inadequate time to examine the accuracy of the ICM before Congress has to accept the numbers for reapportionment use.

Since taxation is tied to representation, I would have difficulty using two sets of numbers - one for representation and the other for allocation of federal and state funding.

2. Since the Census Bureau, as a result of problems identified in the Dress Rehearsal, now proposes to perform a 100% canvass of all blocks in the United States, we should reexamine the value of the LUCA program as it is now designed. We need to determine how much money would be required to have a meaningful impact. I suggest this would be a question better examined by your subcommittee. I am more concerned with the fact that the post enumeration local review program has been deleted to make more time available to the ICM. Local governments should have a chance to examine and challenge the counts

before they are finalized.

3. It is not at all clear that the estimates of the undercount in both Wisconsin and Milwaukee were entirely accurate. The fact that these estimates were based more on observations taken outside the state than any observations within the state calls into question their accuracy in measuring the true success of the Milwaukee example. The results simply are not conclusive.

The radical departure proposed for the 2000 Census is the deliberate use of imputation in place of non-response follow-up. Because of increased dependence on both imputation and statistical inference, the 2000 Census could contain as many as 12 to 13 percent manufactured persons. If the statisticians have their way, these percentages could go even higher in future censuses. The problem in using estimation is that we would be replacing one set of errors with another set some people like better. It also appears that the Bureau is depending more on sampling and less on enumeration in order to devote more time and resources to an increasingly complex sampling methodology.

My fear for the future is that if people learn that the census count in 2000 contained 13% or more "virtual" people, they will have even less motivation to participate. This may be especially true for people who have, in the past, taken time to fill out their own questionnaires. We could be engaging in an self-fulfilling prophecy and turning a census that counts 98% or more of the people into one that only "counts" 87% in 2000 and goes down hill from there each successive decade.

One suggestion I do have is that the Bureau do a better job in outreach than in 1990 and that they build a better address file. The National Academy stated that over 30 percent of uncounted persons were missed because their households did not receive questionnaires. Improving that one process alone would have made the 1990 Census the "best in history" - even by your measurements.

I hope my comments have helped to clarify the dangers of estimating the 2000 Census. If you have any further questions about the 1990 Post Enumeration Survey or the Wisconsin experience, please to not hesitate to ask.

Sincerely,

Tom Petri

Thomas E. Petri
Member of Congress

TEP:pjp

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BERNARD SANDERS, VERMONT
INDEPENDENT

June 2, 1998

Representative Thomas C. Sawyer
U.S. House of Representatives
Washington, DC 20515

Dear Tom,

Thank you for testifying before the Government Reform and Oversight Subcommittee on the Census on May 5, 1998. Because of time constraints, I was left with a number of questions unanswered. Therefore, I request that you answer the following questions:

1. What is your response to the charge that reducing the historic differential undercount through sampling technique might somehow be subject to manipulation for political benefit?

2. Is there any evidence that any partisan influence or manipulations occurred at Census Bureau during any stage of the 1990 census?

3. Will Congressional action or inaction jeopardize the success of the census? What is the effect of the timing of the Congressional decisions?

4. What is the affect of the Bureau acting without a permanent director?

5. There are several challenges which have made census taking more difficult over time such as escalating costs, declining levels of public cooperation, and the shrinking temporary workforce. Other than sampling, what efforts can be made to have a more accurate census?

My questions and your answers will be part of the permanent record of the May 5, 1998, hearing. In addition, I recall that during the hearing there were some comments made by Representative Petri that you wanted to address. Please include such remarks with the answers to these questions. Again, thank you for your input into this most important process.

Sincerely,

Carolyn B. Maloney
Ranking Minority Member
Subcommittee on the Census

cc: Rep. Dan Miller

THOMAS C. SAWYER
14TH DISTRICT
OHIO

COMMERCE
SUBCOMMITTEES:
TELECOMMUNICATIONS, TRADE, AND CONSUMER PROTECTION
FINANCE AND HAZARDOUS MATERIALS
OVERSIGHT AND INVESTIGATIONS

Congress of the United States
House of Representatives
Washington, DC 20515–3514

July 13, 1998

The Honorable Carolyn Maloney
Ranking Member, Subcommittee on the Census
Committee on Government Reform and Oversight
U.S. House of Representatives
511 Ford House Office Building
Washington, D.C. 20515

Dear Mrs. ~~Maloney~~: Carolyn

Thank you for the opportunity to testify before the Government Reform and Oversight Subcommittee on the Census on May 5, 1998. I have enclosed the answers to your questions. Please let me know if I can be of further assistance.

Thank you for your leadership on this important issue.

Sincerely,

Tom

Thomas C. Sawyer
Member of Congress

TCS/djm

cc: Chairman Dan Miller
Subcommittee on the Census
Committee on Government Reform and Oversight

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Response to Written Questions by Ranking Member Carolyn Maloney
from Congressman Tom Sawyer

Subcommittee on the Census
Committee on Government Reform and Oversight
Hearing on May 5, 1998

1. What is your response to the charge that reducing the historic differential undercount through sampling techniques might somehow be subject to manipulation for political benefit?

A. Concerns about the manipulation of statistical techniques to change the census results for political advantage have no basis in fact, history, and science. Sampling and statistical techniques have been used in the census in varying ways since 1940, sometimes adding hundreds of thousands of people to the census counts and causing a congressional seat to shift from Indiana to Florida following the 1980 census. Yet there simply is no evidence that any Administration or any Congress sought to interfere in the design or implementation of these methods to direct a certain outcome. The design and execution of sampling (and all census operations, for that matter) are complex scientific undertakings that require the involvement of experienced and knowledgeable scientists, including statisticians, demographers, and mathematicians. It would be very difficult, if not impossible, for political appointees to direct changes in methodology to achieve a certain outcome. Furthermore, the Census Bureau has developed its census plan in consultation with some of the nation's premier scientists at the National Academy of Sciences and professional scientific associations, as well as experts in government operations from the Commerce Department's Office of the Inspector General and the General Accounting Office. All of these independent bodies have continued to closely monitor development of census methods and operations. Any effort to modify techniques to gain political advantage would be easily detected by the Bureau's many outside observers. And finally, charges that political staff at the Commerce Department or even the White House would somehow change the census numbers before they become final are a direct attack on the integrity of career professional employees at the Census Bureau who plan, prepare for, and implement the nation's largest peacetime activity. Such charges imply that these Bureau employees would 'look the other way' if anyone outside of the Bureau attempted to interfere with the objective design and implementation of census methods and procedures. I am saddened by such charges and believe they are irresponsible and without any merit whatsoever.

2. Is there any evidence that any partisan influence or manipulations occurred at the Census Bureau during any stage of the 1990 census?

A. There is absolutely no evidence to suggest that the Bush Administration or any officials in the Administration exerted any influence over the choice, design, or implementation of census methods to affect the outcome of the count. Despite the decision by then-Secretary of Commerce Robert Mosbacher not to use the results of the Post Enumeration Survey to correct undercounts and overcounts in the census (a decision with which I disagreed), there is no evidence that the Commerce Department or the White House attempted to manipulate the conduct of the census for political benefit.

3. Will Congressional action or inaction jeopardize the success of the census? What is the effect of the timing of the Congressional decisions?

A. It is important for Congress to conduct oversight of the census in a timely and constructive manner. Even with an entire decade between censuses, the Census Bureau must follow a rigid schedule to conduct research on census methods and procedures, test components of a potential design, develop a plan, prepare for the census, evaluate a final plan in a census-like environment (the Dress Rehearsal), deploy a complex field structure, solicit local support, and execute the census in a nine-month period. Slippage in any of these key milestones can place subsequent operations at risk, since not enough time may be left for thorough completion of each stage.

It is very unfortunate, in my opinion, that Congress has not yet given the Census Bureau a green light to proceed with its plan. Time and resources that could be better spent completing key operations, such as address list development, is instead diverted to continued evaluations of fundamental design components such as sampling.

Early in the decade. Members of Congress from both sides of the aisle decided that a zero-based review of census methods was needed. My subcommittee considered legislation sponsored by Rep. Thomas Ridge (R-PA) and Rep. Harold Rogers (R-KY) to require such a review by a National Academy of Sciences panel; Congress ultimately passed the Ridge bill without any dissent. Dr. Barbara Everitt Bryant, director of the Bureau under President Bush, set in motion a detailed research agenda designed to evaluate many new methods and operations. In subsequent years, the General Accounting Office, the Commerce Inspector General, and Congress itself continued to press the Census Bureau to adopt new methods that would help improve accuracy, reduce the persistent differential undercount, and contain costs. The Bureau was well on its way toward meeting those goals when a new Congress raised concerns about components of the census plan without conducting any thorough oversight or hearings to assess fully the plan's soundness. The change of heart against new census methods came late in the planning process and the subsequent delay in finalizing a census design has certainly placed the 2000 census at risk,

despite the continued dedicated effort of the Bureau's career workforce.

4. What is the effect of the Bureau acting without a permanent director?

A permanent director, nominated by the President and confirmed by the U.S. Senate, would bring the level of leadership and authority necessary to build confidence in the census process among key stakeholders that include the Bureau's career and temporary employees, local and state officials, civic leaders, the public, and Congress itself. In making that observation I do not mean to suggest that the Bureau's competent and dedicated staff are not capable of preparing for and conducting a census, nor do I mean to suggest that the Bureau's senior officials do not exercise leadership or make wise decisions. Rather it is simply the nature of a Presidential appointment that lends a greater level of authority and attracts a higher level of confidence necessary to lead a large and complex organization through a very difficult and closely-watched national undertaking. A presidential appointment and Senate confirmation imply that the selected individual has the confidence of both the President and the Congress to do the job for which he or she is chosen competently and fairly. A vacancy in the Bureau's highest position, whether due to a failure to nominate or a failure to confirm, does suggest that either the President or Congress do not place a high enough priority in the Bureau's work to warrant competent leadership. In this case, the President has nominated a well-respected social scientist whose qualifications and experience are very similar to all other Census Bureau directors to come before him, including those of President Bush's director, Dr. Barbara Bryant. It is now incumbent on the Senate to determine quickly whether the nominee is qualified to direct the many important activities of the Census Bureau, including the decennial census, and to confirm the nomination absent any glaring evidence that the nominee is unqualified. Failure to act before Congress adjourns in the Fall would leave the Bureau in a more precarious position and, frankly, make it even more necessary for Commerce Department officials to assist with census preparations, an outcome that the Bureau's critics consistently decry.

5. There are several challenges which have made census taking more difficult over time such as escalating costs, declining levels of public cooperation, and the shrinking temporary workforce. Other than sampling, what efforts can be made to have a more accurate census?

A. It is important to remember that sampling is not an end in itself but simply one means to an end: a more accurate census that eliminates, the greatest extent possible, the persistent disproportionate undercount of the rural and urban poor and people of color. Sampling and various statistical techniques have been used in the census since 1940, adding many people to the count in an effort to improve coverage. For 2000, the Census Bureau has

followed the recommendations of independent and respected scientists and government operations specialists in adding new uses of sampling to the census design. These new counting methods are aimed at containing costs, improving timeliness, and reducing the differential undercount. But they do not guarantee a successful census on their own, just as other elements of the census plan cannot achieve all of these important goals on their own.

As many outside experts, including the National Academy of Sciences and the General Accounting Office, have suggested, the Census Bureau must improve its address list development effort to ensure a more thorough foundation for a mail-based census. Congress passed legislation early in the decade to facilitate wider access to address lists from other Federal and local government agencies. Initial hopes that Postal Service and local government address lists would contribute substantially to an improved address list have been dampened somewhat by reality, but the Bureau must move forward quickly to complete address list development using the most reliable methods possible.

Redesigned questionnaires that are easy to understand and fill out also may encourage more people to respond. However, even simpler forms may not be enough to overcome barriers to response such as illiteracy or language. More pervasive advertising also is important, as evaluations of previous censuses showed that people who are aware of the census are more likely to respond. Hiring enumerators indigenous to the neighborhoods they are canvassing is necessary to build some level of trust and encourage response.

Most importantly, perhaps, leaders at all levels of government and in the private sector must make an extraordinary effort to build confidence in the census process among their constituencies. From Members of Congress and state and local elected officials, to religious, civic, business and labor, and neighborhood leaders, everyone in a position of influence has an obligation to talk about the census in positive terms. If leaders in influential positions by virtue of their access to the media continue to question the integrity of the process and, by implication, those who carry it out, we risk a failed census in every community across the country, not just those that traditionally are harder to count.

Mr. MILLER. Any Member that wishes to submit additional questions, if you all don't mind responding, we'd appreciate it.

Mr. PETRI. We'll try. [Laughter.]

Mrs. MALONEY. And also, on behalf of my colleague, Mr. Sawyer, who wished to put forth additional information, may I request for Mr. Petri and Mr. Sawyer if they have additional information for the record, that it be made part of the record?

Mr. MILLER. Without objection.

Mr. PETRI. Thank you.

Mrs. MALONEY. OK, thank you.

Mr. MILLER. And I will also give you the chance to polish this if you want before it goes into the official record. [Laughter.]

Mrs. MALONEY. Thank you both for your work and your testimony today.

Mr. MILLER. Thank you very much, and I'm sure we'll be working with you a lot more over the next months.

We will move right on into our next panel of witnesses. If they would come forward and gather and have a seat, please.

If you'll stand, we have to swear you in to the committee, if you would. Just raise your right hands.

[Witnesses sworn.]

Mr. MILLER. Thank you, please be seated. Thank you very much for being with us here today. What I would like to do is have each of you make an opening statement; your official statement will go in the record, of course. And when you start, if you would just introduce yourself as to your background and why you've been asked to appear here today, it would be appreciated.

And we'd like to start with—Dr. Stark—first, please. Dr. Stark.

STATEMENTS OF PHILIP STARK, PROFESSOR OF STATISTICS, UNIVERSITY OF CALIFORNIA, BERKELEY; KENNETH DARGA, PH.D., DEMOGRAPHER, DEPARTMENT OF MANAGEMENT AND BUDGET, STATE OF MICHIGAN; AND JERRY COFFEY, PH.D., MATHEMATICAL STATISTICIAN

Mr. STARK. Thank you, Chairman Miller. My name is Philip Stark. I'm a professor of statistics at the University of California, in Berkeley, where I've been on the faculty for about 10 years. I have particular interest in problems that involve very large data sets with complex data acquisition and in which one's trying to estimate a lot of unknown quantities and, also, large computational problems.

Mr. MILLER. If you'd like to, I think we'll just—you go ahead and make your statement, and then we'll proceed next with Mr. Darga and then with Mr. Coffey.

Mr. STARK. Thank you. Thank you very much, Chairman Miller, and other members of the committee for inviting me to speak about the census.

We know from experience that, overall, the census misses some people. The undercount is different in different places which leads to errors and State population shares. As we've already heard today for many purposes, including distributing Federal funds and congressional representation, State shares matter more than the total U.S. population. For that reason, I'll focus on the accuracy of State shares.

It would be wonderful to know how many people the census missed, and where. Then we could add them where they belong. That would adjust for the undercount and improve State shares, but we don't know. The missing people weren't counted.

Sampling is selecting part of a population to represent the whole. The Census Bureau used sampling to estimate the 1990 decennial census undercount so they could adjust for it. The official 1990 census numbers were not adjusted. For the 2000 decennial census, there are two proposals—the proposal involves using sampling in two ways. First of all, to adjust for the undercount, and second, to followup some people who don't mail back their census forms. I'm only going to talk about using sampling to adjust for undercounting.

The 1990 and 2000 adjustments have different names and different details, but they're based on the same statistical methods, so, much of what I say about the 1990 adjustment applies to 2000 as well. Would the adjustments have improved the 1990 census? Probably not, because of statistical bias. Adjustment has two kinds of error: sampling error, which comes from the luck of the draw, the blocks that happen to be in the sample; and systematic error, or bias, which comes from bad data, processing errors, and wrong assumptions, among other things. Bias is a technical term; it doesn't mean someone is intentionally skewing the results. Sampling errors tend to average out; bias does not. Making estimates from a sample is like shooting a rifle. Each shot hits the target in a different place. Sampling error is the scatter in the shots; bias is a tendency for all the shots to be off in the same direction, for example, to the left. You fix bias in a rifle by sighting it in. That's straightforward because you can see where the shots land. Fixing statistical bias in a census adjustment is hard. You only get one shot because you only take one sample, and you can't see where the shot lands because you don't know the true undercount.

The 1990 adjustment process was extremely complex, so it's very hard to track down all its biases. For example, months after calculating the adjustment, the Census Bureau found that a coding error had inflated the undercount estimate by a million people, about 20 percent of the adjustment; that's bias. Studies show that 40 percent to more than 80 percent of the 1990 adjustment is bias.

Adjustment could easily make the census worse instead of better. New York, Pennsylvania, and Illinois lose shares in the adjustment. Texas and Arizona gain shares. Arguably, it's easier to count people in Dallas and Phoenix, for example, than in the Bronx, Philadelphia, and Chicago, where the inner cities are denser. Taking shares away from New York, Pennsylvania, and Illinois might be right, or it might be bias from bad assumptions.

Some claim that adjustment would have made the 1990 census more accurate. Their technical arguments depend on statistical models. The models are false, and they have bizarre consequences. For example, the model for correlation bias says that the 1990 census missed nearly 900,000 white males of whom only 13 less than 0.002 percent—were between 20 and 30-years old. It also says that the 1990 census missed over three-quarters of a million black males but counted almost 30,000 too many black males under age 10. Using that incredible model, the Census Bureau estimated that

about 38 percent of the adjustment is statistical bias. Without the model, the figure is 57 percent, almost 20 percent higher. With better assumptions, the estimated bias is even higher. The study I trust most puts the bias over 80 percent. Adjustment puts in far more error than it takes out.

There's another way to estimate the total population called demographic analysis. The 1990 adjustment adds more people than demographic analysis says were missed, including about a million extra women. Because of bias, the adjustment probably puts the people in the wrong place, making State shares worse.

In summary, adjusting the census using sampling did not work in 1990 because of statistical bias. Taking a bigger sample, as proposed for the 2000 census, could make bias even worse.

Thank you.

[The prepared statement of Mr. Stark follows:]

Sampling to Adjust the 1990 Census for Undercount

Prepared for 5 May 1998 hearing of the

United States of America
House of Representatives
Subcommittee on the Census

Philip B. Stark
Department of Statistics
University of California
Berkeley, CA 94720-3860

I thank Chairman Miller and the other members of the Subcommittee for inviting me to speak about the 1990 census adjustment.

We know from experience that, overall, the census misses some people.[1] The undercount is different in different places.[2] That leads to errors in state population shares. For many purposes, including distributing Federal funds and congressional representation, state shares matter more than the total U.S. population.[3] I will focus on the accuracy of state shares.

It would be wonderful to know how many people the census missed, and where. Then we could add them where they belong. That would adjust for the undercount, and improve state shares. But we do not know: the missing people were not counted.

Sampling is selecting part of a population to represent the whole. The Census Bureau used sampling to estimate the 1990 Decennial Census undercount, so they could adjust for it. The official 1990 census numbers were not adjusted. For the 2000 Decennial Census, there is a proposal to use sampling to adjust for undercount, and to use sampling to follow up some people who do not mail back their census forms. I will talk only about using sampling to adjust for undercount.

The 1990 and 2000 adjustments have different names and different details,[4] but they are based on the same statistical methods, so much of what I say about the 1990 adjustment applies to 2000 as well.

Would the adjustments have improved the 1990 census? Probably not, because of *statistical bias*.
Adjustment has two kinds of error: ***sampling error***, which comes from the luck of the draw — the blocks that happen to be in the sample — and ***systematic error*** or ***bias***, which comes from bad data, processing errors, and wrong assumptions, among other things.

Bias is a technical term: it does not mean someone is intentionally skewing the results. Sampling errors tend to average out. Bias does not.

Making estimates from a sample is like shooting a rifle. Each shot hits the target in a different place. Sampling error is the scatter in the shots. Bias is a tendency for all the shots to be off in the same direction, for example, to the left. You fix bias in a rifle by sighting it in. That is straightforward, because you can see where the shots land.

Fixing statistical bias in a census adjustment is hard. You only get one shot (because you only take one sample), and you cannot see where the shot lands (because you do not know the true undercount). The 1990 adjustment process was extremely complex,[5] so it is very hard to track down all its biases.[6]

For example, months after calculating the adjustment, the Census Bureau found that a coding error had inflated the undercount estimate by 1,000,000 people[7] --- about 20% of the adjustment. That's bias. Studies show that 40% to more than 80% of the 1990 adjustment is bias.[8] Adjustment could easily make the census worse instead of better.

New York, Pennsylvania, and Illinois lose shares in the adjustment.[9] Texas and Arizona gain shares. Arguably, it is easier to count people in Dallas and Phoenix, for example, than in the Bronx, Philadelphia, and Chicago, where the inner cities are denser.[10] Taking shares from New York, Pennsylvania and Illinois might be right --- or it might be bias from bad assumptions.

Some claim that adjustment would have made the 1990 census more accurate.[11] Their technical arguments depend on statistical models.[12] The models are false,[13] and have bizarre consequences. For example, the model for "correlation bias" says that the 1990 census missed nearly 900,000 white males, of whom only 13 --- less than 0.002% --- were between 20 and 30 years old. It also says that the 1990 census missed over three quarters of a million black males, but counted almost 30,000 too many black males under age 10.[14]

Using that incredible model, the Census Bureau estimated that about 38% of the adjustment is statistical bias. Without the model, the figure is 57%, almost 20% higher.[15] With better assumptions, the estimated bias is even higher. The study I trust most[16] puts the bias over 80%: adjustment puts in far more error than it takes out.

There is another way to estimate the total population, called Demographic Analysis.[17] The 1990 adjustment adds more people than Demographic Analysis says were missed, including about a million extra women.[18] Because of bias, the adjustment probably puts the people in the wrong place, making state shares worse.[19]

In summary, adjusting the census using sampling did not work in 1990,[20] because of statistical bias. Taking a bigger sample, as proposed for the 2000 census, could make bias even worse.

Technical Notes

[1] **Edmonston, B. and Schultze, C. eds., 1995. Modernizing the U.S. Census, National Academy Press, Washington, D.C.**

[2] ***Ibid.***

[3] ***Ibid.***

[4] The 1990 procedure is called the Dual-System Estimator (DSE), which uses data from the Post-Enumeration Survey (PES). The 2000 procedure is called Integrated Coverage Measurement (ICM).

Both PES/DSE and ICM take a random sample of blocks after the census is taken, and tabulate the people found in the households in those blocks who were missed by the census (omissions), as well as the people in the census who should not have been counted in those blocks (erroneous enumerations). Results are pooled for the blocks in the sample to get the fractions missed and erroneously enumerated, for various groups of people, called "post-strata." For example, black male renters age 30-44 living in the central city of a major metropolitan area in New England comprised one 1990 PES post-stratum. There were 1,392 PES post-strata in all.

The basic idea in the adjustment is that the fraction of people in a post-stratum who were in the sample blocks, but not in the census, is an estimate of the fraction of all the people in the post-stratum that the census missed. The fraction in the census in a post-stratum in the sample blocks, but not in the PES, is an estimate of the fraction of people in the post-stratum the census enumerated erroneously. The difference estimates the undercount rate for the post-stratum. Dividing the census count by (100% - undercount rate) adjusts for the undercount.

This is just a sketch: the details of determining whether or not there is a match, treating missing data, and combining numbers from different blocks to estimate fractions in post-strata are extremely complex; see **Hogan, H., 1993. The 1990 Post-Enumeration Survey: Operations and Results,** ***J. Amer. Statist. Assoc., 88,*** **1047-1060.**

[5] **Hogan, H.,** ***loc. cit.***

[6] There is a great deal of information in **Committee on Adjustment of Postcensal Estimates, 1992.** ***Asessment of Accuracy of Adjusted Versus Unadjusted 1990 Census Base for Use in Intercensal Estimates,*** **Bureau of the Census (C.A.P.E. Report).** Here are some excerpts:

> "...additional research detected some errors and made some refinements to the levels of undercount originally reported in the spring of 1991." **C.A.P.E. Report,** p2.

The table on p3 of the C.A.P.E. Report show that uncertainty estimates (for sampling error alone) were increased by as much as 300%.

> "As a result of an error in computer processing, the estimated national undercount rate of 2.1% was overstated by 0.4%. After correcting the computer error, the national level of undercount was estimated to be about 1.7%. After making other refinements and corrections, the national undercount is now estimated to be about 1.6% [the figure is 1.58% in attachment 3, Table 2] ... The level of total bias, excluding correlation bias, on the revised estimate of undercount is negative 0.73 (-0.73%)." **C.A.P.E. Report,** p15.

Thus (2.1 - 1.58 + 0.73)/2.1 = 60% of the original estimate of 2.1% is bias. The report continues, evaluating the "revised" estimates, which correct the coding error and use different post-strata:

> "Therefore, about 45% (0.73/1.58) of the revised undercount is actually measured bias and not measured undercount. In 7 of the 10 evaluation strata, 50% or more of the estimated undercount is bias." **C.A.P.E. Report,** p15.

[7] **C.A.P.E. Report,** p15.

[8] According to the Director of the Bureau of the Census,

> "A significant amount of bias remains. The research estimates that, at the national level, removing all biases from the PES estimates would lower the estimated undercount from 1.6 to 1.3 percent. When the effect of correlation bias is not taken into account ... the estimated undercount would fall to 0.9 percent."

Bureau of the Census, 1993. ***Decision of the Director of the Bureau of the Census on Whether to Use Information From the 1990 Post-Enumeration Survey (PES) To Adjust the Base for the Intercensal Population Estimates Produced by the Bureau of the Census ACTION: Notice of final decision.*** **Federal Register 58 FR 69.** (cited as 58 FR 69 henceforth)

That yields bias estimates of 38%-57%, depending on the treatment of "correlation bias." Correlation bias has to do with the fact that a key assumption in the capture-recapture model is false: everyone in a post-stratum in the sample blocks does not have the same chance of being found by the PES, and the same chance of being found by the census. For example, if there are people unreachable by any survey, the PES cannot detect that they are are missing from the census. That would tend to make the undercount estimate smaller than the true undercount. The correlation bias estimate uses a model to disaggregate Demographic Analysis figures to local levels. Evidence cited below (note 14) shows how unreasonable the model is.

The figure of over 80% comes from **Breiman, L., 1994. The 1991 Census Adjustment: Undercount or Bad Data?** ***Statistical Science, 9,*** **458-537.** Breiman combines information from various Bureau of the Census evaluation studies. Sources of bias include fabrications by interviewers, matching errors, census day address errors, bias in the ratio estimator, people discovered to be out-of-scope in reinterview, late census data, and the computer coding error. The following paragraphs are drawn from Breiman's work.

Small errors in the match rate can produce extremely large errors in the undercount estimates. For example, in one block cluster, an unmatched family of 5 people added 45,000 to the undercount estimate. In Census Bureau studies of matching errors, match and rematch classifications disagree by 1.8%. A June, 1991, Census Bureau memorandum states: "...approximately 75 percent of the non-matching people could have been converted to a match if the search area had been expanded." This is a huge source of bias.

The match status of about 2% of the cases could not be resolved from the records or by interview. Depending on how these cases are treated, the PES estimates range from an *overcount* of 1,000,000 people to an undercount of 9,000,000 people. See also Wachter, K.W., 1991. *Recommendations on 1990 Census Adjustment, report to the Secretary of Commerce as a Member of Special Advisory Panel*, U.S. Department of Commerce, for "half-high" and "half-low" estimates.

The "probabilities" that unresolved cases were matches were imputed using a statistical model [Belin, T.R., *et al.*, 1993. Hierarchical Logistic Regression Models for Imputation of Unresolved Enumeration Status in Undercount Estimation, *J. Amer. Statist. Assoc., 88*, 1149-1159] with obviously false assumptions [Wachter, K.W., 1993. Comment: Ignoring Nonignorable Effects, *J. Amer. Statist. Assoc., 88*, 1161-1163]. At least one explanatory variable in the model is missing for 28% of the unresolved PES cases, and 38% of the unresolved census-sample cases; those missing variables were also imputed.

[9] See Figure 1, p111, in Wachter, K.W., 1993. The Census Adjustment Trial: An Exchange, *Jurimetrics, 34*, 107-115. California would have gained most by adjustment; Texas, second most. Pennsylvania would have lost most; Ohio, second most.

[10] *Ibid.*

[11] For example, National Academy of Sciences reports recommend using sampling-based adjustments for the 2000 Decennial Census; see Edmonston, B., and Schultze, C., ed., 1995. *Modernizing the U.S. Census*, National Academy Press, Washington, D.C. 460pp., and White, A.A., and Rust, K.F., ed., 1997. *Preparing for the 2000 Census*, National Academy Press, Washington, D.C. 98pp.

I reviewed those reports. Their evidence is weak. The issue is whether the PES improves or degrades the accuracy of the census. That is very hard to determine, because the PES is subject to large biases that cannot be measured directly. Arguments in favor of the PES depend on the assumption that the errors in the PES generally go in the same direction as the true undercount, and seldom go too far.

[12] See, for example, Mulry, M.H., and Spencer, B.D., 1993. Accuracy of the 1990 Census and Undercount Adjustments, *J. Amer. Statist. Assoc., 88*, 1080-1091.

[13] In addition to models relating various parameters, the assumptions include:

Independence: This assumption has two parts. First, for each individual, in the sample blocks, being caught in the census is independent of being caught by the PES. Second, the probability of being caught in the census is the same for every individual in a given post-stratum within the sample blocks, as is the probability of being caught in the PES.

Synthetic Assumption (Homogeneity): In each block that was not sampled, the nonresponse rate is a weighted average of the nonresponse rates of the post-strata that intersect the block. The weights are the proportions of people in the block in the post-strata.

Violation of the independence assumption leads to "correlation bias:" see note 14. There are a number of studies of the synthetic assumption using proxy variables, for example, Hengartner, N., and Speed, T.P., 1993. Assessing Between-Block Heterogeneity Within Post-Strata of the 1990 Post-Enumeration Survey, *J. Amer. Statist. Assoc., 88*, 1119-1129, and Freedman, D. and Wachter, K., 1994. Heterogeneity and Census Adjustment for the Intercensal Base, *Statistical Science, 9*, 476-485.

Those studies find that heterogeneity within post-strata is significant. According to the Director of the Bureau of the Census,

> "...it is possible that errors due to heterogeneity in fact could be larger than all other sources of error in the adjustment." 58 FR 69

The C.A.P.E. also studied heterogeneity:

> "The Panel cautioned that artificial population analysis ... was inconclusive about whether the homogeneity assumption held." C.A.P.E. Report, p30.

But their analysis had flaws:

"A first analysis showed similar homogeneity for the 1,392 design as well as the 357 design as well as for a design with only 2 strata." **C.A.P.E. Report**, p26.

They also state:

"The level of bias in the PES was close to the point where artificial population analysis shows that homogeneity assumption fails to hold." **C.A.P.E. Report**, p26.

[14] The model for disaggregating "correlation bias" from national DA estimates down to local levels is in **Bell, W.R., 1993. Using Information from Demographic Analysis in Post-Enumeration Survey Estimation, *J. Amer. Statist. Assoc., 88*, 1106-1118.** The consequences of that model for the cited demographic groups is on p533 of **Freedman, D., and Wachter, K., 1994. Rejoinder, *Statistical Science, 9*, 527-537.**

The C.A.P.E. also had reservations about the model of correlation bias:

"The fourth cell in the DSE is an estimate of the number of people missed in both the PES and the census...Both the Committee and the Panel of Experts were very concerned about the negative values in the fourth cell...correlation bias should be a component of total error. However, there was concern about our method of estimating it and very serious concern about the method of allocating it." **C.A.P.E. Report**, pp22-23.

"The Census Bureau ... knew of no adequate methodology to remove the bias by state, city, etc." **C.A.P.E. Report**, p30.

[15] See note 8.

[16] **Breiman, L., *loc. cit.***

[17] **Robinson, J.G., Ahmed, B., Das Gupta, P., and Woodrow, K.A., 1993. Estimation of Population Coverage in the 1990 United States Census based on Demographic Analysis, *J. Amer. Statist. Assoc., 88*, 1061-1079.**

[18] "... there was concern that the PES estimated a higher population than DA and estimated about a million more women than DA." **C.A.P.E. Report**, p27.

[19] According to the Director of the Bureau of the Census,

"...no survey -- either the high quality, well controlled and interviewed PES of 170,000 households or a larger one -- can be used to make post-census fine tuning of an average undercount as small as 1.6 percent in all types of places, counties, and states at a level of accuracy beyond that by which surveys are usually judged....there is little or no evidence adjustment would improve the quality of substate estimates..." **58 FR 69.**

[20] "...there is no intention to adjust the 1990 census because research shows insufficient technical justification." **C.A.P.E. Report**, p33.

Mr. MILLER. Mr. Darga.

Mr. DARGA. Thank you. My name is Kenneth Darga, and I am a demographer working for the State of Michigan in the Department of Management and Budget. We routinely provide input to the Census Bureau through various Federal-State cooperative programs involving population estimates, population projections, and the State Data Center program. My first involvement with population undercount adjustment was in response to the Census Bureau's invitation for States to provide input to their decision on whether or not to adjust the population estimates base for undercount in the 1990 census.

I would like to thank Chairman Miller and all the members of the Subcommittee on the Census for inviting me to speak with you today about census undercount adjustment. At this time, I would like to submit two papers for the record which I will then summarize briefly.

Mr. MILLER. Without objection, thank you.

[The information referred to follows:]

Two Papers on Census Undercount Adjustment:

- **Straining Out Gnats and Swallowing Camels: The Perils of Adjusting for Census Undercount**
- **Quantifying Measurement Error and Bias in the 1990 Undercount Estimates**

Kenneth Darga
Office of the State Demographer
Michigan Information Center
Michigan Department of Management and Budget

April 29, 1998

EXECUTIVE SUMMARY

"Straining Out Gnats and Swallowing Camels: The Perils of Adjusting for Census Undercount"
"Quantifying Measurement Error and Bias in the 1990 Undercount Estimates"

April 29, 1998

There is reason to believe that the proposed remedy for Census undercount would be far worse than the undercount problem itself.

The proposed method of adjusting for undercount involves conducting a sample survey to identify people who were missed by the Census and people who were counted twice or counted in the wrong location. In order to succeed, this survey has to secure participation by the people who were missed by the Census, and it has to be very accurate in matching individuals counted by the sample survey with individuals counted by the Census. Unfortunately, these are impossible tasks: there are too many people who do not want the government to know where they are, and there are too many obstacles to matching the results of the two surveys successfully.

The undercount adjustments that were developed by this method for the 1990 Census seemed plausible at first glance, but they were strongly affected by several types of error in classifying people as missed or not missed by the Census. The first paper ("Straining Out Gnats and Swallowing Camels: The Perils of Adjusting for Census Undercount") shows that the proposed approach makes high levels of error inevitable and that the resulting adjustments have indeed been seriously flawed. The second paper ("Quantifying Measurement Error and Bias in the 1990 Undercount Estimates") identifies and quantifies several specific types of error:

- survey matching error
- fabrication of interviews
- ambiguity or misreporting of usual residence
- geocoding errors
- unreliable interviews
- unresolvable cases.

Together, these papers show that many of the people who were missed by the Census were missed by the coverage survey as well, and that many of the people who were identified as missed by the Census actually do not seem to have been missed at all.

Thus, in addition to reflecting differences in actual undercount rates, the adjustments derived from the sample survey reflect differences in the rate of error in classifying people as undercounted. Applying such adjustment factors to the Census would decrease the accuracy of local population counts and of the many detailed tabulations that are relied upon by all levels of government and by myriad private users of demographic data. These errors would usually be small, but they would sometimes be errors of 10%, 20%, or more. Since no one would know which areas and which population groups had serious errors, and since the errors would not be consistent from one Census to the next, all findings based on Census data and all comparisons between different time periods would come into question. In an attempt to address an inaccuracy at the national level, we would utterly destroy the reliability of Census data at the state and local level.

Straining Out Gnats and Swallowing Camels: The Perils of Adjusting for Census Undercount

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April 29, 1998

Although the Department of Commerce is often criticized for Census undercount, it is not surprising that every Census misses a portion of the population. In fact, what is noteworthy is not that the undercount persists, but rather that the net undercount appears to have been less than 5 million people in 1990, or only about 1.8% of the population.[1]

A major reason for the undercount—although not by any means the only reason—is that quite a few people do not want their identities known by the government. For example, the United States has over 1 million people who do not make any of their required payments on court ordered child support[2] and an estimated 5 million illegal immigrants.[3] Each year, the police make over 14 million arrests for non-traffic offenses.[4] Millions of additional criminals remain at-large, many people would lose government benefits if the actual composition of their households were known, and many people have other reasons for concealing their identity and whereabouts from the government. If the Census misses fewer than 5 million people under these circumstances, then the Census Bureau is doing a truly remarkable job.

Nevertheless, eliminating even this small error would be a valuable achievement. Although the impact on many components of the population would be small, people in some demographic and economic categories are undercounted more than others. This leads to anomalies and imprecision in some analyses and affects political apportionment and fund distribution. The Census Bureau has therefore tried very hard to devise ways to measure and compensate for the problem of undercount.

Obviously, these methods are intended to make the Census count better. However, we need to evaluate their actual effects instead of their intended effects. Before we decide to use these particular methods in the official population count for the year 2000, we need to determine whether they would make that population count better or worse.

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1 U.S. Department of Commerce, "Census Bureau Releases Refined 1990 Census Coverage Estimates from Demographic Analysis," Press Release of June 13, 1991, Table 1.

2 Economics and Statistics Administration, U.S. Department of Commerce, "Statistical Brief: Who Receives Child Support?," May 1995.

3 U.S. Immigration and Naturalization Service, "INS Releases Updated Estimates of U.S. Illegal Immigration," Press Release of February 2, 1997.

4 U.S. Department of Justice, Bureau of Justice Statistics, *Sourcebook of Criminal Justice Statistics*, 1995, p. 394.

After reviewing some of the reasons for believing that censuses miss a portion of the population, this paper briefly describes the Census Bureau's proposed method of adjusting for undercount. It will then be shown that, although the results of this method for 1990 appeared plausible, at least at the broadest national aggregation, the method cannot produce reliable adjustments for undercount: It is not capable of counting many of the people who are missed by the Census, it is very sensitive even to extremely small sources of error, and it is subject to many sources of error that are very serious. Thus, it is not surprising to find that many of the detailed undercount measurements for 1990 were implausible and, in some cases, demonstrably false. In an effort to correct a net national undercount of less than 2%, spurious undercounts of 10%, 20%, and even 30% were identified for some segments of the population. Adjustments derived from these measurements would have had a devastating impact on the usefulness and accuracy of Census data at the state and local level, and they would have had an adverse effect upon nearly all purposes for which Census data are used. Similar problems can be expected with the undercount adjustment proposed for Census 2000: The problems are not due to minor flaws in methodology or implementation, but rather to the impossibility of measuring undercount through the sort of coverage survey that has been proposed.

The Evidence of Undercount. Before examining the Census Bureau's method of adjusting for undercount, it is instructive to consider how we can know that each Census misses part of the population.

One way to find evidence of undercount is to project the population for a Census year by applying mortality rates and migration rates to the results of other censuses. The pattern of differences between these projections and the actual Census counts can provide good evidence for undercount. For example, if the count of black males age 20 to 24 is lower than would be expected based on the number of black males age 10 to 14 in the previous Census, and if it is lower than would be expected based on the number of black males age 30 to 34 in the following Census, then there is good evidence of undercount for that segment of the population.

The most widely accepted method for measuring Census undercount is called "demographic analysis." Using a combination of birth registration data, estimates of under-registration, mortality rates, estimates of international migration, social security enrollment data, and analyses of previous censuses, the Census Bureau develops estimates of the national population for each Census year by age, race, and sex. Although they are not perfect, the gap between these estimates and the

national Census count provides the best available measure of undercount. The pattern of undercount suggested by demographic analysis is generally consistent from one Census to another, and it is consistent with the discrepancies that are found between population projections and Census counts: Undercount rates appear to be higher for males than for females, higher for blacks than for whites, and higher for young adults than for people in other age groups.[5]

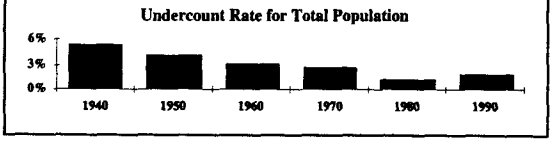
Demographic analysis suggests that the net national undercount fell in each successive Census from 5.4% of the population in 1940 to only 1.2% in 1980. This reflects improvements in Census-taking methodologies, special efforts focused on segments of the population that are hard to count, and assurances that Census information will be kept strictly confidential. However, the estimated net undercount rose to 1.8% in the 1990 Census: still quite low by historic standards, but disappointing because it represents an increase relative to the previous Census. (See Figure 1.)

A major shortcoming of this method is that it works only at the national level: There is too much interstate and intrastate migration to allow a phenomenon as subtle as Census undercount to be visible at the state or local level through demographic analysis. Since we can expect undercount to vary considerably from state to state and neighborhood to neighborhood, we cannot simply apply the national undercount rates to state and local population counts. This would not adjust some areas enough, and it would introduce inaccuracies into areas where there had not been inaccuracies before.

Figure 1

Estimates of Census Undercount Based on Demographic Analysis[6]

Population Category	1940	1950	1960	1970	1980	1990
Total Population	5.4 %	4.1 %	3.1 %	2.7 %	1.2 %	1.8 %
Black	8.4 %	7.5 %	6.6 %	6.5 %	4.5 %	5.7 %
Non-Black	5.0 %	3.8 %	2.7 %	2.2 %	0.8 %	1.3 %



5 J. Gregory Robinson et. al., "Estimation of Population Coverage in the 1990 United States Census Based on Demographic Analysis," *Journal of the American Statistical Association*, 88(423):1061-1079.

6 *Ibid.*, p. 1065.

Calculating Adjustments for Undercount. The Census Bureau has therefore tried to develop additional methods to estimate how well the Census covers each segment of the population. Immediately after the Census count is complete, the Bureau conducts a "coverage survey" which essentially repeats the population count for a small sample of census blocks. The coverage survey was called the "PES" or "Post-Enumeration Survey" in 1990, and it will be called "ICM" or the "Integrated Coverage Measurement Survey" in 2000. Data from the coverage survey are matched person-by-person with the original Census to identify the individuals counted by the coverage survey who seem to have been missed by the Census. These results are tabulated by relevant population characteristics to produce estimated undercount rates which can be applied to local areas based on their counts of persons with those characteristics. A sample of original Census forms are also matched with the coverage survey to identify individuals who were counted by the Census but omitted by the survey. These discrepancies are investigated and used to estimate "erroneous enumerations" or overcount.

Plausibility of the Adjustments. The resulting adjustment to the 1990 Census was quite plausible at the broadest national level. After moving up and down as corrections were made to the data and new statistical techniques were applied, the estimate of overall net undercount at the national level was 1.6%[7]—very close to the 1.8% suggested by demographic analysis. The credibility of the 1990 coverage survey was increased by the fact that it suggested high rates of undercount at the national level for the groups that would be expected to have high undercounts, such as Hispanics, blacks, people with difficulty speaking English, people in complex households, and people living in non-standard housing units.[8] Thus, one is tempted to conclude that the data from a coverage survey can provide an incredibly accurate measure of Census undercount.

Implausibility of the Adjustments. Before drawing that conclusion, however, we must consider a much less incredible interpretation: The differences between the coverage survey and the original Census may not represent net undercount as much as they represent the difficulty of matching individual records between two surveys. At a very broad level of aggregation, this methodological difficulty can produce results that look very much like net undercount because the population groups which are hard to match between surveys are generally the

[7] Howard Hogan, "The 1990 Post-Enumeration Survey: Operations and Results," *Journal of the American Statistical Association*, 88(423):1047-1060, 1993.

[8] Manuel de la Puente, U.S. Bureau of the Census, "Why Are People Missed or Erroneously Included by the Census: A summary of Findings From Ethnographic Coverage Reports," report prepared for the Advisory Committee for the Design of the Year 2000 Census Meeting, March 5, 1993. J. Gregory Robinson and Edward L. Kobilarcik, U.S. Bureau of the Census, "Identifying Differential Undercounts at Local Geographic Levels: A Targeting Database Approach," paper presented at the Annual Meeting of the Population Association of America, April 1995.

same groups that are hard to count. It is only by considering the tremendous barriers to measuring undercount accurately and by examining the detailed findings of the 1990 PES that we are led to accept this alternate interpretation. If this interpretation is correct, it has very clear implications for how the next Census should be conducted: Adjusting the new Census based on a coverage survey would negate the findings from 100 million Census forms based on a statistical artifact.

For a coverage survey to measure net undercount with anything approaching an acceptable level of accuracy, it must accomplish two impossible tasks. The impossibility of these tasks should lead us to question its validity even if it appears on the surface to provide a good measure of undercount. In particular, we should not conclude that the Census Bureau has accomplished the impossible merely on the basis of plausible results for the broadest national aggregation. If the detailed results do not make sense as well, then it is untenable to suggest that undercount has been measured with a high level of precision.

The first impossible task that a coverage survey must accomplish is to secure participation by two particularly problematic components of the population that are not counted well by the Census: homeless people and people who do not want to be counted. Each Census includes a major effort to count people in shelters and on the streets, but it undoubtedly misses a large portion of this population. A coverage survey is not well equipped to measure this component of the undercount because many homeless people are not likely to be found in the same place a few weeks or months later when the survey is conducted. The Census Bureau understands the impossibility of this task, and *the 1990 PES therefore did not even attempt to address this portion of the undercount.*[9] A coverage survey does not fare much better with the the other problematic component of the population. It is hard to imagine that very many of the people who avoided being counted by the Census are likely to be counted by a second survey that has essentially the same limitations. If drug dealers, fugitives, and illegal immigrants were afraid to fill out the Census form that everyone in the nation was supposed to receive, they are not likely step forward a few weeks or months later when their household is singled out for a visit by another government enumerator. On the contrary, they are likely to avoid the coverage survey even more studiously than they avoided the Census. Thus, we cannot believe that a coverage survey provides a good measure of undercount unless we are first willing to believe that somehow—without the tools necessary to do so—it manages to secure participation by these two groups of people who were not counted well by the Census.

[9] Howard Hogan, *op. cit.*

If a coverage survey misses many of the same people who were missed by the Census, then the only way it can suggest a plausible level of undercount is by identifying other people as missed by the Census when they really were counted. This leads us to the second impossible task which a coverage survey must accomplish: achieving a practically-perfect replication and matching of Census results for that vast majority of the population which is counted correctly the first time. The problem is that, for every hundred people missed by a Census, there are about 3,000 people who were counted and can therefore be mistakenly identified as missed. These 3,000 people will inevitably include a certain number of challenging cases involving aliases, language barriers, individuals and households that have moved, people with no stable place of residence, and a host of other difficulties. It doesn't take a large error rate in classifying these 3,000 people who were correctly counted by the Census to completely invalidate our attempt to count the 100 people who were missed—especially since many of the people who were missed are making every effort to be missed again. A hypothetical example will help to demonstrate why even a 99% level of accuracy is not sufficient, and a review of the barriers faced by a coverage survey will demonstrate why 99% accuracy is not likely to be achieved.

Let's say that the next Census has an undercount of 3% and an overcount of 1%, for a net undercount of 2%. Let us also assume that the next coverage survey somehow manages to identify all of the people who are missed by the Census and all of the people who are counted twice or counted in error. This is a very generous assumption, since we have already seen that we have good reason to believe that this is an impossible task. Finally, let us assume that the coverage survey achieves 99% accuracy in classifying the individuals who were counted by the Census.

The apparent undercount will then include that 3% of the population which had been missed by the Census, plus nearly another 1% that had actually been counted correctly. This is because 1% of the 97% *not* missed by the Census will be falsely identified as undercounted because we achieve "only" 99% accuracy in replicating and matching the Census results. Thus, even under these unrealistically favorable assumptions, about 25% of the apparent undercount will actually represent classification error.[10] The measure of overcount will be even more problematic: It will include that 1% of the population that had actually been

[10] Expressed as a proportion of the actual population, the people counted by the Census who are mis-classified as uncounted in this hypothetical example will be (1.00 - .03) * (1.00 - .99) = .0097, where .03 is the assumed rate of undercount and .99 is the assumed level of accuracy. If we assume that all of the actual undercount will be detected through the coverage survey, the total estimate of undercount will be .03 + .0097 = .0397. Expressed as a proportion of the identified undercount, the people who are mis-classified as uncounted will therefore be .0097 / .0397 = .2443, or approximately 25%.

overcounted, plus nearly another 1% that had been counted correctly the first time. This means that about 50% of the apparent overcount will actually represent classification error.[11] This would hardly be a firm basis for fine-tuning the Census count.

Why the Word "American" Is Abbreviated in Census Questions

When you are trying to measure a small component of the population—such as people who have been missed by the Census—it is necessary to avoid even very small errors in classifying that vast majority of the population which is not part of the group being measured.

This principle is illustrated by one of the problems that the Census Bureau found while it was testing different ways of asking its new Hispanic-origin question for the 1980 Census. A very small number of people with no Mexican heritage thought that the category "Mexican or Mexican-American" meant "Mexican or American." Since they were "American," they thought that this category applied to them. Unfortunately, since people of Mexican heritage represented only about 4% of the national population, even this very small error among the remaining 96% of the population was enough to completely invalidate the count of Mexican-Americans. In fact, for many areas, a *majority* of the people selecting this category were found to be "Americans" with no Mexican heritage.

The 1980 Census therefore used the category "Mexican or Mexican-Amer." This was a big improvement, but the 1980 post-enumeration survey found that non-Mexicans still represented a majority of the people choosing this category in some areas with a very low population of Mexican-Americans. The 1990 Census therefore used the category "Mexican or Mexican-Am." This cleared up the problem.

A very similar difficulty arises when you try to measure undercount with a coverage survey. It is sometimes very hard to match up the people that you counted in the coverage survey with the people that you counted in the Census. When you make a mistake, people can be counted as missed by the Census or as mistakenly included in the Census when they really weren't. Since there are about 97 of these potential mistakes for every 3 people who were really missed by the Census, even a very low error rate is enough to completely invalidate the measure of undercount. Unfortunately, although the problem is very similar, the solution is not: Errors in matching surveys cannot be prevented by anything as simple as using more abbreviations.

[11] Expressed as a proportion of the actual population, the people counted by the Census who are mis-classified as counted in error will be (1.00 - .03) * (1.00 - .99) = .0097, where .03 is the assumed rate of undercount and .99 is the assumed level of accuracy. If we assume that all of the actual overcount will be detected through the coverage survey, the total estimate of overcount will be .01 + .0097 = .0197. Expressed as a proportion of the estimated overcount, the people who are mis-classified as counted in error will therefore be .0097 / .0197 = .4924, or approximately 50%.

A coverage survey must therefore achieve far more than 99% accuracy in classifying the people who are correctly counted by the Census. But is it possible to achieve such a high level of accuracy? Even for simple surveys conducted under ideal conditions, a 99% level of accuracy would be impressive. Unfortunately, the Census and the coverage survey are not simple, and they are not conducted under ideal conditions. The attempt to match the results of these two surveys must contend with a wide array of daunting problems, some of which are listed in the box on the following page. These problems are more than just hypothetical illustrations: many of them have been documented and quantified by analysts from the Census Bureau and elsewhere, who confirm that the undercount analysis involves very serious levels of matching error and other error. (See accompanying paper, "Quantifying Measurement Error and Bias in the 1990 Undercount Estimates.") Thus, in addition to knowing from logical arguments and hypothetical illustrations that serious problems are inevitable, we know from experience that serious problems actually do occur.

In place of our previous assumptions that a coverage survey measures overcount and undercount perfectly and that it matches the correct findings of the Census with 99% accuracy, we should therefore consider the implications of a somewhat more modest level of success. Let's say that the next coverage survey identifies 30% of the actual undercount and 40% of the actual overcount, that the undercount analysis averages an impressive 96.2% rate of accuracy in replicating and matching the correct results of the Census, and that the overcount analysis averages a similarly impressive 97.3% rate of accuracy. Although classification error would then account for an overwhelming 80% of the people identified as undercounted and 87% of the people identified as overcounted, the estimated net undercount at the national level would be the same 1.6% that was suggested by the coverage survey for 1990.[12] In other words, the estimate of undercount would primarily reflect errors in matching survey responses with Census responses, yet the broadest national estimate of net undercount would appear very plausible.

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[12] Expressed as a proportion of the actual population, the the people counted by the Census who are mis-classified as uncounted in this hypothetical example will be (1.00 - .03) * (1.00 - .962) = .03686, where .03 is the assumed rate of undercount and .962 is the assumed level of accuracy. If we assume that 30% of the actual undercount will be detected through the coverage survey, the total estimate of undercount will be (.03 * .30) + .03686 = .04586. Expressed as a proportion of the identified undercount, the people who are mis-classified as uncounted will therefore be .03686 / .04586 = .8038, or approximately 80%.

The people counted by the Census who are mis-classified as counted in error will be (1.00 - .03) * (1.00 - .973) ≈ .02619, and the total estimate of overcount will be (.01 * .40) + .02619 = .03019. Expressed as a proportion of the identified overcount, the people who are mis-classified as counted in error will therefore be .02619 / .03019 ≈ .8675, or approximately 87%. The estimate of net undercount will be .04586 - .03019 = .01567 or 1.6%.

AN IMPOSSIBLE TASK

The Census Bureau tries to measure undercount by carefully taking a second survey for a sample of small geographic areas and comparing its results to the Census to see which persons had been missed. But is it possible to achieve a near-perfect match between these two surveys? This effort has to deal with daunting problems such as these:

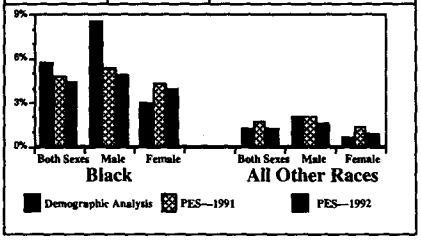
- Illegible handwriting.
- Similarity of names.
- Use of different nicknames and other variations on names in different surveys.
- Names which do not have a consistent spelling in the English alphabet.
- Use of aliases by illegal immigrants, fugitives, and others who place a very high value on privacy. Some people have more than one alias, some may use different names on different surveys, and some may be known to neighbors by names that are different from the ones used on the Census.
- Irregular living arrangements, complex households, and households with unstable membership.
- Differences which arise from collecting most Census information through written forms and collecting information for the coverage survey through personal interviews.
- Households and individuals that move between the Census and the coverage survey. (This is particularly a problem for college students, recent graduates from high school or college, and people who migrate between northern and southern states on a seasonal basis. Many of these people move within a few weeks after the April Census.)
- Differences which arise from having different household members provide information for the different surveys, or from having a responsible household member provide information for the Census and a child, neighbor, or landlord provide information for the coverage survey. (For example, differences in the reported name, age, race, or marital status can make it difficult to determine whether a person found by the coverage survey is really the same person found by the Census.) This problem was compounded in 1990 because the survey to measure undercount was centered around the Fourth of July weekend and the survey to measure "erroneous enumerations" was centered around the Thanksgiving weekend. It is very difficult, for example, to survey a college town during Thanksgiving week to determine who was living there the previous April.
- Language barriers. Language barriers are a particularly serious problem for a coverage survey because it relies upon personal interviews instead of on a written survey that respondents can complete with help from friends or other family members.
- People who are included on the Census but avoid inclusion on the coverage survey because they do not want to be identified by government authorities.
- Homeless or transient people who are enumerated in one housing unit by the Census but are in a different housing unit or on the streets at the time of the coverage survey.
- Homeless or transient people who are enumerated in the streets by the Census but are found in a housing unit by the coverage survey.
- Information that is fabricated by the enumerator or by the respondent.
- Clerical errors and processing errors.
- Failure to follow complex procedures precisely.
- Census forms which are coded to the wrong geographic area, making it impossible to to match them with the proper survey results.
- People who give an inaccurate response when they are asked where the members of their household were living on April Fools Day.

To people who are interested only in the national count of total population, the hypothetical example above may not appear very troubling. After all, since this example assumes that the errors in measuring undercount are largely offset by the errors in measuring overcount, the national population total it produces is actually closer to the assumed true population than the unadjusted Census count. What makes this example troubling is the fact that the undercount adjustments are relied upon for far more than a national population total. They purport to tell us which segments of the population and which parts of the country are undercounted more than others. The critical point that needs to be understood is that, if the coverage survey really does fail to measure a large portion of the undercount and if it mistakenly identifies people as missed by the Census who really weren't, then the differential undercounts it suggests will largely reflect differences in the amount of error in measuring undercount rather than differences in the amount of undercount itself. What would we expect such adjustments to look like? To put it simply, we would expect them to look just like adjustments developed from the 1990 Post-Enumeration Survey.

Figure 2

Alternate Estimates of Undercount for the 1990 Census[13]

Race and Sex	Basis of Undercount Estimate		
	Demographic Analysis	Post-Enumeration Survey	
		6/91 Revision	9/92 Revision
Black			
Both Sexes	5.7%	4.8%	4.4%
Male	8.5%	5.4%	4.9%
Female	3.0%	4.3%	4.0%
All Other Races			
Both Sexes	1.3%	1.7%	1.2%
Male	2.0%	2.0%	1.5%
Female	0.6%	1.4%	0.9%



[13] The undercount estimates based on the PES are from Barbara Everitt Bryant, "Census-Taking for a Litigious, Data Driven Society," *Chance: New Directions for Statistics and Computing*, Vol. 6, No. 3, 1993. The estimates based on demographic analysis are from U.S. Department of Commerce, "Census Bureau Releases Refined 1990 Census Coverage Estimates from Demographic Analysis," Press Release of June 13, 1991, Table 1.

At the national level, it would not be surprising for the undercount adjustments to look fairly reasonable: Since the population groups that are hard to match between two surveys are generally the same groups that are hard to count in the Census, we would expect the findings for very broad components of the population to be at least roughly similar to the results of demographic analysis. Of course they wouldn't be identical, since the level of difficulty in matching each group between surveys does not correspond precisely to the level of difficulty in counting it for the Census. For example, some problems such as language barriers and aliases pose more difficulty in survey-matching than in taking a Census, and segments of the population that are counted very well in the Census are at the greatest risk of having classification error exceed the actual level of undercount. Thus, while advocates of adjustment have not considered the pattern of differences displayed in Figure 2 to be unreasonable, the final national PES results for 1990 are actually quite different from the estimates based on demographic analysis even for very broad population groups. The apparent undercount for black males is 42% less than the rate suggested by demographic analysis, and the rate for white, Native American, and Asian/Pacific females is 50% higher. Under most circumstances, these differences would be considered very substantial.

We would expect an even worse situation below the national level. If the measure of net undercount is more sensitive to variations in the rate of classification error and other survey problems than to variations in the actual rate of undercount, it would not be surprising to find some serious deviations from the orderly pattern that would be found in a practically-perfect analysis. For example, it would not be surprising for the adjustment factors to look something like the ones displayed in Figure 3.

Figure 3 shows some of the initial undercount adjustments for children under age 10 which the Census Bureau developed based on the 1990 PES. This age group was chosen for this analysis because there is no obvious reason to expect householders to mis-report their young male children at a significantly different rate from their young female children. It is therefore disconcerting that these undercount adjustments for 1990 include some very large differences between boys and girls in this age group. In fact, these eighteen pairs of figures were selected for the table because they each have a discrepancy of *over ten percentage points.* It is even more disconcerting that these differences follow no discernible pattern. Sometimes the adjustment for boys is higher, but sometimes the adjustment for girls is higher; in one place black renters have a higher adjustment for boys, but in another place they have a higher adjustment for girls; in some places the gender discrepancy for whites is similar to the gender discrepancy for

blacks, but in other places it is the opposite; sometimes one race category in a large city has a higher adjustment for boys, but another race in the same city has a higher adjustment for girls. It is not surprising when signs of estimation error are visible for small components of the population in small geographic areas, but here we see apparently arbitrary adjustments for even the largest population groups in some of the largest cities and across entire regions. Thus, the adjustment factors in

Figure 3

Selected Undercount Adjustments for Children Under Age 10 from the 1990 Post-Enumeration Survey[14]

Region	Area Type	Tenure	Race	Adjustments	
				Male	Female
Pacific	Non-Central Cities	Renter/ Owner	Asian/Pacific	+ 5 %	+ 17 %
Mid Atlantic	Central Cities in New York City PMSA	Renter/ Owner	Asian/Pacific	+ 25 %	+ 9 %
East North Central	Central Cities in Metro Areas w/ Central City > 250K	Owner	Black	+ 26 %	+ 15 %
Pacific	Central Cities in Los Angeles PMSA	Owner	Black	+ 28 %	+ 8 %
Mid Atlantic	Central Cities in New York City PMSA	Owner	Black	+ 0 %	+ 23 %
South Atlantic	Central Cities in Metro Areas w/ Central City > 250K	Renter	Black	+ 26 %	+ 16 %
Pacific	Central Cities in Los Angeles PMSA	Renter	Black	+ 20 %	+ 10 %
Pacific	Non-Central Cities	Renter/ Owner	Black	+ 31 %	+ 6 %
Mid Atlantic	Non-Central Cities in Metro Areas w/ Central City > 250K	Renter/ Owner	Hispanic (except black)	+ 2 %	+ 16 %
Mid Atlantic	All Central Cities	Renter/ Owner	Hispanic (except black)	+ 14 %	+ 2 %
West South Central	Central Cities in Houston, Dallas, & Fort Worth PMSA's	Renter/ Owner	Hispanic (except black)	+ 8 %	+ 19 %
South Atlantic	All Non-Metro Areas & All Non-Central Cities	Renter/ Owner	Hispanic (except black)	+ 9 %	+ 22 %
West South Central	Central Cities in Metro Areas w/ Central City > 250K	Renter	White, Native Am., & Asian/Pacific except Hisp.	- 5 %	+ 11 %
East North Central	Central Cities in Metro Areas w/ Central City > 250K	Renter	White, Native Am., & Asian/Pacific except Hisp.	+ 21 %	+ 4 %
East North Central	Central Cities in Detroit and Chicago PMSA's	Renter	White, Native Am., & Asian/Pacific except Hisp.	- 4 %	+ 14 %
West South Central	Central Cities in Houston, Dallas, & Fort Worth PMSA's	Renter	White, Native Am., & Asian/Pacific except Hisp.	+ 7 %	+ 21 %
South Atlantic	Central Cities in Metro Areas w/o Central City > 250K	Renter/ Owner	White, Native Am., & Asian/Pacific except Hisp.	+ 10 %	- 1 %
South Atlantic	Non-Metro Areas Except Places > 10K	Renter/ Owner	White, Native Am., & Asian/Pacific except Hisp.	+ 3 %	+ 16 %

[14] U.S. Department of Commerce, Bureau of the Census. Unpublished file dated 6/14/91 containing adjustment factors derived from the 1990 Post-Enumeration Survey, prior to application of a statistical smoothing procedure. These adjustment factors reflect the amount of apparent net undercount actually measured in the PES sample for the indicated geographic areas and demographic groups.

Figure 3 suggest a high level of measurement error[15] rather than the high level of precision required for an adequate estimate of undercount.

Would the Adjustments Increase or Decrease Accuracy? The PES findings in Figure 3 provide a good basis for testing whether we can trust a coverage survey when it tells us that some population groups have higher undercounts than others. We have seen that these apparent undercounts seem to be implausible, but that by itself does not prove that they did not happen. If we can confirm that these differential undercounts did take place, then the credibility of coverage surveys as a tool for measuring undercount will be greatly increased. On the other hand, if it can be demonstrated that they did not take place, then the credibility of coverage surveys will be lost: If a coverage survey can indicate large undercount differentials where they do not exist, then it is obviously not a very reliable tool for measuring undercount.

Fortunately, because the ratio of male to female children is one of the most stable of all demographic statistics, these adjustment factors can be tested quite definitively. For each of the nation's nine regions, 51% of the young children enumerated in the 1990 Census were boys and 49% were girls. Likewise, for each of the major race categories, 51% of the young children enumerated were boys and 49% were girls. Among the nation's 284 metropolitan areas and consolidated metropolitan areas, the percent of young children who were boys varied very little, ranging from a low of 50.3% in Pine Bluff, Arkansas, to a high of 52.1% in Topeka, Kansas. Therefore, if the large differential undercounts indicated in Figure 3 really did take place, they should be very obvious: Boys should represent less than 51% of the total for areas with a large undercount of boys, but they should represent more than 51% of the total for areas with a large undercount of girls. Furthermore, if the undercounts indicated by the coverage survey really did take place, we should expect each area to move closer to the norm after it is "corrected" for Census undercount.

In fact, however, we find just the opposite. Figure 4 shows that the percentage of children under age 10 who are boys is about the same not only in each region, each race, and each metropolitan area, but also in the areas for which the

[15] There are several types of measurement error. Although the point being made here is that the large amount of error in the adjustments is consistent with the thesis that large amounts of *non-sampling* error are inevitable, it should be noted that *sampling* error is also a very serious problem for the undercount adjustments. Actually, there is more than enough error to go around: these adjustments can reflect a very large amount of sampling error as well as a very large amount of non-sampling error. For purposes of data quality, both types of error are very problematic.

Figure 4

Before Adjustment for Undercount

Percent of Children Who Are Boys Offers No Surprises[16]

U.S. Total	51%
Race Categories:	
White	51%
Black	51%
Native American	51%
Asian/Pacific	51%
Other Race	51%
Hispanic	51%
Regions:	
New England	51%
Middle Atlantic	51%
East North Central	51%
West North Central	51%
South Atlantic	51%
East South Central	51%
West South Central	51%
Mountain	51%
Pacific	51%
Extremes Out of 284 Metro Areas:	
Lowest: Pine Bluff, Arkansas	50.3%
Highest: Topeka, Kansas	52.1%

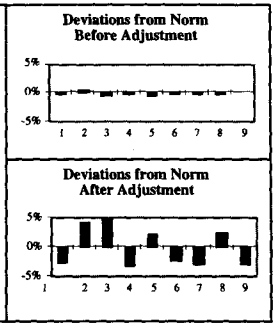
Selected Areas for Which the PES Indicated a Large Differential Undercount Between Boys and Girls:	
1. Asians/Pacific Islanders in non-central cities of the Pacific Region	51%
2. Asians/Pacific Islanders in central cities of the New York City PMSA	52%
3. Blacks in non-central cities of the Pacific Region	51%
4. Hispanics in non-central cities of large MSA's in the Mid-Atlantic Region	51%
5. Hispanics in central cities of the Mid-Atlantic Region	51%
6. Hispanics in central cities of the Houston, Dallas, and Fort Worth PMSA's	51%
7. Hispanics in non-central cities or non-metropolitan areas of the South Atlantic Region	51%
8. Non-Hispanic Whites, Native Americans, and Asians/ Pacific Islanders in central cities of small MSA's in the South Atlantic region	51%
9. Non-Hispanic Whites, Native Americans, and Asians/ Pacific Islanders in non-metropolitan areas of the South Atlantic region (excluding places with over 10,000 persons)	51%

Figure 5

After Adjustment for Undercount

Dramatic Variations in Percent of Children Who are Boys[17]

1. Asians/Pacific Islanders in non-central cities of the Pacific Region	49%
2. Asians/Pacific Islanders in central cities of the New York City PMSA	55%
3. Blacks in non-central cities of the Pacific Region	56%
4. Hispanics in non-central cities of large MSA's in the Mid-Atlantic Region	48%
5. Hispanics in central cities of the Mid-Atlantic Region	53%
6. Hispanics in central cities of the Houston, Dallas, and Fort Worth PMSA's	49%
7. Hispanics in non-central cities or non-metropolitan areas of the South Atlantic Region	48%
8. Non-Hispanic Whites, Native Americans, and Asians/ Pacific Islanders in central cities of small MSA's in the South Atlantic region	54%
9. Non-Hispanic Whites, Native Americans, and Asians/ Pacific Islanders in non-metropolitan areas of the South Atlantic region (excluding places with over 10,000 persons)	48%



16 The percent of children who are boys was calculated based on the 1990 Census of Population and Housing, U.S. Department of Commerce, Bureau of the Census, Summary Tape File 1-C. Because Census counts by age, race, sex, and tenure have not been published, this table does not include the nine pairs of adjustments in Figure 3 which apply only to renters or only to homeowners. Although the race distinctions which are made in Summary Tape File 1-C do not correspond precisely to the race distinctions upon which the undercount adjustments were calculated, these discrepancies involve a very small number of people and they do not significantly affect the present analysis. Black Hispanics are counted as Hispanic in STF 1-C, but they should not be included with other Hispanics for purposes of applying undercount adjustments. Likewise, Asians/Pacific Islanders of Hispanic origin are counted as Asians/Pacific Islanders in STF 1-C, but they should not be included with that group for purposes of applying undercount adjustments.

17 The data in Figure 5 were calculated after applying the adjustment factors from Figure 3 to Census counts from Summary Tape File 1-C

coverage survey found large undercount differentials between boys and girls. It is only after applying these adjustments derived from the coverage survey that serious anomalies are found. As shown by Figure 5, the percentage of children who are boys deviates dramatically from the norm after adjustment. Even though Pine Bluff and Topeka are "outliers" among the nation's metropolitan areas, the adjusted Census counts are *two to six times* as far from the norm as Pine Bluff and Topeka. Thus, these "undercounts" measured in the PES sample do not correspond at all to actual undercounts in the areas which the sample represents. The Census is not really broken until after it is fixed.

The point being made here is not merely that the 1990 coverage survey produced faulty undercount measurements for young boys and girls. The problem is much broader than that, since the difficulties discussed in this paper apply just as much to other age groups as to children, and just as much to other demographic characteristics as to the sex ratio. The foregoing analysis focuses on the sex ratio of children merely because sex ratios provide a convenient and definitive basis for demonstrating the implausibility of the undercount measurements below the age where school attendance, military service, and employment patterns cause different communities to have a different mix of males and females. The focus on the sex ratio of young children should not by any means imply that undercount measurements are worse for this age group or that they would affect sex ratios more than the other population and housing characteristics that are measured by the Census. In the absence of any known problem that would scramble the undercount measurements for boys and girls without affecting the figures for other age groups and other demographic characteristics, we have to suspect that the measurements are faulty in other respects as well. The point being made is therefore nothing less than this: Because the large undercount differentials shown in Figure 3 are clearly spurious, we cannot trust a coverage survey to tell us which segments of the population have higher undercounts than others.

Does It Make a Difference? It may take a few moments to comprehend the impact that adjustment factors like those displayed in Figure 3 would have if they were applied to the Census.[18] To those of us who have become accustomed to

[18] The adjustment factors in Figure 3 reflect the amount of apparent net undercount actually measured in the PES sample for the indicated geographic areas and demographic groups. It should be noted that these factors were subsequently subjected to a statistical "smoothing" procedure to produce new factors that followed a more consistent pattern by age, race, and sex. It was these "smoothed" factors that were actually proposed in 1991 for use in adjusting the 1990 Census. Further modifications proposed in 1992 for use in adjusting the population base for population estimates would have combined males and females under age 17. The resulting "collapsed" adjustment factors represent the Census Bureau's latest official estimate of undercount in the 1990 Census. The "smoothed" adjustment factors would be appropriate for use in estimating the practical impact of adjusting the 1990 Census data for undercount. The "unsmoothed" adjustment factors are pertinent for the current analysis,

Census data that generally make sense at the local level, it is mind-boggling to consider the prospect of largely arbitrary adjustments—and sometimes arbitrarily large ones—applied to every number in the Census. In an effort to address a relatively small inaccuracy at the national level, we would utterly destroy the reliability of Census data at the state and local level.

Perhaps most alarming is the impact on comparisons over time. If coverage surveys can indicate large differential undercounts between boys and girls even where no differences exist, they can also indicate large differential undercounts between one Census and the next where no differences exist. To illustrate the potential implications of this problem, let us consider what would happen if there turns out to be no real difference in certain undercount rates for Census 2000 and Census 2010, but the coverage surveys indicate the same spurious differences between these two points in time that the 1990 PES found between boys and girls. Under these assumptions, the numbers in Figure 3 could all remain the same,[19] but they would represent spurious undercount differentials between Census 2000 and Census 2010 instead of spurious undercount differentials between boys and girls in 1990. This would generate many interesting demographic "findings":

- The counts of Asians/Pacific Islanders in non-central cities of the Pacific region would be inflated by 5% in 2000 but by 17% in 2010. (See line 1 of Figure 3.) The adjusted Censuses would therefore suggest far greater growth in the number of Asians than actually occurred. What effect would this have on attitudes toward Asian immigrants in these communities?

- The count of black homeowners in central cities of the Los Angeles PMSA would be inflated by 28% in 2000 but by only 8% in 2010. Similarly, the count of black renters would be inflated by 20% in 2000 and by 10% in 2010. (See lines 4 and 7 of Figure 3.) The adjusted Census data would therefore show a large exodus of the black population and a substantial drop in black home ownership for Los Angeles relative to the actual trend. What impact would this have on race relations? What would be the impact on government housing programs and anti-discrimination programs?

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since they reflect the amount of apparent undercount actually identified by the PES. The unsmoothed factors are also relevant in the context of Census 2000, since the Census Bureau does not plan to use a statistical smoothing process in the next Census.

[19] Our assumption that "the undercount adjustments indicate the same spurious *differences* between these two points in time that the 1990 PES found between boys and girls" does not require the adjustments themselves to be the same as the 1990 adjustments for boys and girls, but merely for the differences to be the same. The numbers "could" remain the same, but they would not necessarily have to. For simplicity and clarity of presentation, the illustrations are based the special case in which the adjustments are the same.

- The count of black homeowners in central cities of the New York City PMSA, on the other hand, would be inflated by 0% in 2000 and by 23% in 2010. (See line 5 of Figure 3.) This area would therefore seem to have a dramatic rise in black home ownership relative to the actual trend. Of course, home ownership would not by any means be the only variable affected by these faulty adjustment factors: Poverty, marital status, and every other characteristic that is correlated with race and with home ownership would also be affected. Social scientists could spend the decade trying to explain why the economic status of blacks seemed to rise so rapidly in New York city while it seemed to decline in Los Angeles. What would be the impact on the credibility of the Census when they discovered the answer?

- The counts of White, Native American, and Asian/Pacific renters in Detroit and Chicago would be *decreased* by 5% in 2000, but they would be inflated by 11% in 2010. Thus, there would seem to be a dramatic increase in renters and a shift away from home ownership in these cities relative to the actual trend. (See line 15 of Figure 3.) In contrast, other central cities in these same metropolitan areas would have their counts for these demographic categories inflated by 21% in 2000 and by only 4% in 2010. (See line 14 of Figure 3.) The faulty adjustment factors would therefore make it appear that huge numbers of white renters had moved from Detroit and Chicago to other nearby central cities before 2000, but that they moved back in the next decade.

Of course, these illustrations are only hypothetical. Perhaps Los Angeles will have reasonable undercount adjustments for black homeowners in 2000 and 2010. Maybe its adjusted Census data will show a spurious decline in its elderly population instead, and maybe it will be New York that shows a spurious decline in black home ownership. We won't know before it happens. Even worse, we won't know even *after* it happens. When adjusted Census data suggest a dramatic change in population trends, we will not know how much of the change represents actual demographic shifts and how much represents spurious differences in undercount adjustments. Are we ready to discover dramatic new (and totally false) trends in disease prevalence, mortality rates, school enrollment, income distribution, housing patterns, marital status, welfare dependency, gender differences, and all of the other issues that are studied on the basis of Census data? We expect a Census to increase our knowledge about population trends, but an adjustment methodology which can indicate large differentials where differentials do not exist would increase our ignorance instead.

Conclusion. We cannot escape the conclusion that the method proposed for correcting Census undercount has some rather serious shortcomings. The impact on the validity of the 1990 Census would have been devastating, and we can expect the impact on Census 2000 to be similar: The problems are not due to minor flaws in methodology or implementation, but rather to the impossibility of measuring undercount through the proposed coverage survey. Unless we can convince people who don't want to be counted to answer our surveys, and unless we can replicate and match the valid Census results with near-perfect accuracy, any undercount estimates that are developed in this manner will be dominated by measurement error. Instead of describing variations in the amount of undercount from one area to another, they will largely describe variations in the amount of error in replicating the Census and in matching individuals identified by the survey with individuals identified by the Census. Once the impossibility of the task is recognized, one can only be impressed by how close the Census Bureau seemed to come to succeeding in 1990. However, one must also be impressed by how close we are to destroying the credibility and the value of the Census.

Quantifying Measurement Error and Bias in the 1990 Undercount Estimates

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The opening pages of the preceding paper[1] set up a paradox: Since the number of people who want to avoid being identified by the government is more than sufficient to account for the level of undercount identified through demographic analysis, and since many of these people can be counted upon to avoid the coverage survey as well as the Census, how is it that the 1990 coverage survey suggests about the right level of total undercount at the national level?

The solution I have proposed is that this "correlation bias"—i.e. missing many of the same people in both the coverage survey and the Census—is offset by counting some people as missed by the Census when they really were included. I have suggested that, rather than just reflecting undercount, the undercount factors derived from the coverage survey reflect a variety of methodological difficulties involving imperfect replication of the census, survey matching, unreliable interviews, geocoding problems, and the like.

The preceding paper demonstrates that this is a *plausible* solution to the paradox and that it is *consistent* with both the plausible undercount estimates at the national level and the implausible estimates for individual poststrata. It shows that, although an extremely high level of accuracy is required for an adequate measure of undercount, the obstacles to an accurate coverage survey are immense. It points out many specific types of error that are difficult or impossible to avoid, and it shows that the proposed undercount adjustments for 1990 were suggestive of high levels of error.

Even these limited accomplishments of the paper are significant: Proponents of the proposed undercount adjustment are left with the task of explaining how the 1990 coverage survey could indicate very large and demonstrably spurious differential undercounts for young children. In addition, they must explain how we can rely upon the 5%, 10%, and 20% differential undercounts identified between other poststrata when the 5%, 10%, and 20% differential undercounts identified between young boys and girls are known to be spurious. They must make a believable argument that the coverage survey somehow really did count critical groups of people who were missed by the 1990 census, i.e. homeless people and the illegal immigrants, drug dealers, fugitives, and others who don't

[1] Kenneth J. Darga, "Straining Out Gnats and Swallowing Camels: The Perils of Adjusting for Census Undercount," Office of the State Demographer, Michigan Information Center, Michigan Department of Management and Budget, 1998.

want the government to know where they are. They must demonstrate either that they achieved extremely low error rates in the face of seemingly insurmountable obstacles, or else that—notwithstanding the demonstrated inaccuracies of the undercount measurements for some individual poststrata—they have enough luck and skill to ensure that large errors will offset each other very precisely. Merely a general tendency for errors to offset one another is not enough: An extremely high level of accuracy is required to measure a phenomenon as small and elusive as census undercount at the sub-national level. Each of these issues is critical to the success of the effort to measure undercount. The credibility of the proposed method cannot be restored unless its proponents are successful on *all* of these points.

A major limitation of the preceding paper is that, although it suggests what sorts of errors are difficult or impossible to avoid, it stops short of showing that those errors actually occurred or how serious they were. To fill this gap in the analysis, this paper relies upon evaluation studies by the Census Bureau and the work of other analysts. That work confirms that the errors are very large indeed, and that they did not offset each other precisely in the analysis of the 1990 coverage survey.

The Census Bureau has extensively evaluated the process and results of the 1990 coverage survey, which is commonly referred to as the "Post-Enumeration Survey" or "PES." Its findings are written up in 22 unpublished reports, eight of which are referenced in this paper. These reports, which are known as the "P-project reports," were issued in July 1991 under the main title "1990 Post-Enumeration Survey Evaluation Project." These reports are referred to in this paper by their number within the series, e.g. "P-4" or "P-16." Most of the references to these reports and many of the other quantitative observations which appear below are based upon the work of Dr. Leo Breiman, an emeritus professor of statistics at the University of California, Berkeley (Breiman, 1994).

Six major sources of error are quantified below: matching error, fabrication of interviews, ambiguity or mis-reporting of usual residence, geocoding errors, unreliable interviews, and the number of unresolved cases. It will be seen that the level of error and uncertainty contributed by each of these factors is very substantial relative to the magnitude of net undercount. Thus, each of these error sources by itself is sufficient to demonstrate that the sort of coverage survey used by the Census Bureau is not capable of accurately measuring Census undercount. It will then be shown that the various identified sources of error actually did increase the 1990 undercount estimate enough to explain the paradox.

1. Matching Error

A critical step in measuring undercount through a coverage survey is to match people counted in the coverage survey with people counted in the Census. Most people are counted by both surveys, but problems such as misspellings, misreporting of age, language barriers, aliases, missing data, errors in recording the address, changes in household composition, and a host of other difficulties can make it difficult to match up the records. Any failure to match the records can lead to an overestimate of undercount: The person's record in the Post-Enumeration Survey—sometimes referred to as the "P-Sample"—can be mistakenly counted as having been missed by the Census. Yet their Census response—the Census enumerations from the same geographic areas are sometimes referred to as the "E-sample"—cannot be classified as erroneous unless strict criteria are met.[2] (After all, it is a valid record.) Thus, when records fail to match, it is possible for people to be counted twice. The many barriers to matching the coverage survey results with the Census are described in a sidebar of the preceding paper, and their seriousness is confirmed by the results of the Census Bureau's evaluation studies.

As explained in the P-8 report, a computer-matching process was able to resolve about 75% of the P-sample records, and the remaining records went to two independent teams of trained matchers. Although these teams used the same definitions and guidelines, they had a surprisingly high rate of disagreement regarding which people counted by the PES had been counted by the Census. Of people classified as "matched" by the first team, 5.7% were classified as "not matched" and 4.5% were classified as "unresolved" by the second team. Of those classified as "not matched" by the first team, 4.8% were classified as "matched" and 1.3% were classified as "unresolved" by the second team. Of those classified as "unresolved" by the first team, 22.7% were classified as "matched" and 8.0% were classified as "unmatched" by the second team. (Ringwelski, 1991). Although the matching process must achieve near-perfection in order to accurately measure the 1% or 2% of the population that is missed by the Census, it is obviously a very difficult task, and even teams using the same guidelines can differ widely in their judgments.

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2 For example, Howard Hogan, then director of the Undercount Research Staff of the Census Bureau, wrote: "Proving that someone does not exist is not easy. . . . The rules require the interviewer to find at least three knowledgeable respondents in an effort to determine whether an enumeration was fictitious." (Hogan, 1991a). This would be difficult to do in a case where an unmatched person really existed.

This high level of disagreement has several serious implications:

- First, it indicates that the number of "difficult" cases for which match status is not obvious is very large, greatly exceeding the estimated level of net undercount. This demonstrates the impossibility of measuring undercount accurately through a coverage survey even apart from any other considerations.

- Second, since trained teams differ substantially in their judgments, it follows that some of the judgments reached by the final team of matchers are likely to be wrong: Some of the people counted by the Census will be identified as missed, some of the people missed by the Census will be identified as counted, some of the people counted correctly by the census will be identified as counted in error, and some of the people counted in error will be identified as counted correctly. If the number of difficult cases were small, we could hope that the errors would come close to cancelling each other out. However, given the high level of disagreement between the matching teams, any of these types of error could potentially exceed the actual level of undercount: "close" is therefore not enough.

- Third, since high levels of subjectivity and art are obviously involved in the matching process, it is subject to additional sources of bias. Will the match rate be different if the cases are examined in the first week of matching or in the final week? Will the match rate be different depending on which regional office examines them? If a difficult case falls into a category that is expected to have a high undercount rate, will that decrease its likelihood of being classified as matched? If a similar case falls into a category that is expected to have a low undercount rate, will that increase its likelihood of being classified as matched? Such issues can have a significant impact on the differential undercount rates of individual poststrata and of different geographic regions. If matching were an objective process whose results could be fully determined by the Census Bureau's matching rules, these questions would be insignificant. However, because the process is obviously a somewhat subjective one, these questions become very important. In fact, since the number of difficult cases is quite large and the level of disagreement between teams exceeds the total level of undercount, these questions must be considered critical.

- A fourth implication of the high level of disagreement between different match teams is that the results for a given set of records are likely to be different each time the match is performed. Clear evidence of this is provided

by the results of rematching selected blocks which initially had large numbers of non-matches and erroneously enumerated persons: Rematching only 104 out of the 5,290 block clusters resulted in a decrease of 250,000 (about 5%) in the estimated net national undercount. (Hogan, 1993).

2. Fabrication of Interviews

The problem of fabricated data is another example of a data collection problem whose magnitude is very substantial relative to the magnitude of Census undercount. Many large surveys conducted by the Census Bureau appear to have a significant number of records that are fabricated by the interviewer. Previous research has shown that, overall, between 2% and 5% of the interviewers are dishonest in their data collection and that between 0.5% and 1.5% of the interviews themselves are fabricated (Stokes and Jones, 1989). One-time surveys such as the Census and the PES are particularly vulnerable to this problem, since temporary employees are found to be more likely to fabricate records than permanent employees. Workers who are detected fabricating data sometimes do so on a large scale. Biemer and Stokes (1989) found that, on average, inexperienced interviewers who were detected fabricating data did so for 30% of the units in their assignment; for more experienced interviewers, the rate was 19%.

While the prospect that perhaps 0.5% or 1.5% of the Census and PES interviews are fabricated may not sound extremely serious at first, it must be remembered that we are trying to measure a net undercount of only about 1% or 2% of the population. Thus, instead of saying that 0.5% and 1.5% are small relative to 100%, it is more pertinent to say that they are very substantial relative to 1% or 2%. (Of course, it should be noted that undercount rates are higher than 1% or 2% for some demographic groups and some types of area. However, that does not greatly affect this comparison, since fabrication rates also tend to be highest in the areas that are most difficult to enumerate. See Tremblay, 1991, and West, 1991c).

Both fabrication in the Census and fabrication in the PES have very serious implications for estimating undercount. When a block cluster with interviews that were fabricated by a Census enumerator is included in the PES, it will raise the rates of undercount and erroneous enumeration for the poststrata represented within it. Since, as already noted, it is difficult to prove that people do not exist, the increase in the apparent rate of erroneous enumeration may not be as great as the increase in the apparent undercount rate. This would lead to an overestimate

of net undercount for these poststrata. Fabrication within the PES is even more problematic. When people counted by the PES are matched against Census questionnaires, any fabricated PES records can look like people who were missed by the Census. However, when the corresponding Census records are tested for validity, they are likely to be classified as valid: It is particularly difficult to prove that someone does not exist if they really do exist. Thus, fabrication once again can lead to an overestimate of net undercount. Fabricated PES records would be particularly difficult to detect in cases where the housing unit was vacant during the Census or during PES follow-up.

The actual amount of fabrication in the PES is difficult to determine. The P-5a report, which is based on data which were not specifically designed to detect fabrication, identified only 0.03% of the cases in the P-sample evaluation follow-up data as fabrications (West, 1991b). These cases were estimated in the P-16 report to have inflated the national undercount estimate by 50,000 persons, or about 1% of the total net undercount (Mulry, 1991). The P-5 report, on the other hand, used quality control data collected during the PES to identify 0.26% of the PES household interviews and 0.06% of the remaining cases on a national level as fabrications (Tremblay, 1991). Although this is a much lower rate of fabrication than would be expected based on the studies cited above, it is nevertheless about eight times the proportion of cases identified as fabrications in the P-5a report, suggesting that perhaps fabrications represent about 8% of the total net undercount. Yet another Census Bureau report on this issue, the P-6 report, was designed to gain knowledge about fabrication that may have been undetected in the quality control operation. This report found that only 39% of the interviewers whose match rates were suggestive of high levels of fabrication had been identified in the quality control operation. (West, 1991c). This suggests that the level of fabrication in the PES may have been close to the level that has been found in other similar surveys, making it a very significant problem indeed.

The P-6 report also found that fabrication rates seemed to vary substantially from one region to another. Interviewers who appeared to have high levels of fabrication accounted for 2% to 5% of the interviews in most regions, but they accounted for 7.7% of the interviews in the Atlanta regional office and 8.8% of the interviews in the Denver regional office (West, 1991c.). Regional variation in the amount of fabrication is not surprising, since important factors which are likely to influence the fabrication rate vary by region. For example, while PES interviews to identify undercount were being conducted at the end of June and

into July of 1990, most of the northeast and midwest had very pleasant weather. Much of the south and west, on the other hand, had long periods with temperatures near or above 100 degrees. Denver, for example, had eleven consecutive days at the end of June and the beginning of July with temperatures of 95 degrees or higher, including five days with temperatures in the 100's. Atlanta had seventeen consecutive days with temperatures of 89 degrees or higher, followed by several days of rain. Thus, it is not surprising that fabrication seems to have been a more serious problem in these areas. Moreover, since fabrication also varies substantially by neighborhood, with interviewers being more likely to fabricate records in neighborhoods they perceive as dangerous than in safer neighborhoods, it also varies by race and by owner/renter status. It therefore appears that fabrication can account for a substantial portion of the undercount differentials identified between regions, between types of city, and between population groups.

3. Ambiguity or Misreporting of Usual Residence

The question of where someone lives is often not as straightforward as it may seem. The Census uses the concept of "usual" address: If you are staying somewhere temporarily and usually live somewhere else, you are instructed to report your "usual" address instead of your address on April 1. For many people, this instruction is ambiguous and subject to varying interpretation. "Snowbirds" who migrate between the north and south can give the address where they spend the largest part of the year, the address where they spend the largest part of their life, the address where they are registered to vote, the address where they feel most at home, or the address where they happen to be on April 1. They might give one answer when they fill out their Census form in April and a different answer when they are interviewed for the coverage survey in July. Other people who move to or from temporary quarters at about the time of the Census can also claim a "usual" address different from the place where they were located on Census day. For example, college students who are packing up to move out of a dormitory room that they will never see again may use their "home" address instead of the college address that the Census Bureau would prefer. In comparison with an estimated national undercount of only 1% or 2% of the population, these components of the population with an indistinct "usual" place of residence represent a very significant component of the population.

Thus, the task of determining the "appropriate" address for each Census respondent amounts to replacing the traditional concept of "usual" address, which is defined largely by the respondent, with a set of assignment rules developed by

the designers of the coverage survey. This can involve the reassignment of large numbers of people, and it can potentially have a larger impact on regional population distribution than Census undercount itself.

Given the large number of people with an indistinct "usual" place of residence, it not surprising that the Census Bureau's Evaluation Follow-Up Study found many P-sample respondents who were classified as non-movers for purposes of calculating the undercount adjustments, but were identified by new information as having moved in after census day. Weighted to a national level, they represented 274,000 persons,[3] or about 5% of the estimated national net undercount. (Of course, the impact on the individual poststrata that were most affected would have been greater.) It should be noted that these figures do not reflect the full magnitude of the problem of indistinct "usual" place of residence: they reflect only those cases—presumably a small minority—for which the PES was judged to have classified movers incorrectly.

Finally, it should be noted that different cities and different neighborhoods can vary greatly in their proportion of people with an indistinct "usual" place of residence. If the sample drawn for particular poststratum happens to include some block clusters in a college town or in a retirement community, then its adjustment factor will be very strongly affected by this problem. The adjustment for a class of cities in an entire region can thus be determined largely by whether or not the sample includes a few "outlier" blocks.

4. Geocoding Errors

Another task which proves to be very difficult is coding addresses to the proper Census Block. Coding a record to the wrong Census block is a very serious problem for an undertaking that depends upon matching records between two surveys. If a Census record that belongs in a sample block has been mistakenly coded to a different block, it may not be found. The corresponding PES record would therefore be erroneously classified as missed by the Census. On the other hand, if an otherwise valid Census record has been mistakenly coded to the sample block, it may be counted as an erroneous enumeration when it fails to

[3] The P-4 report (West, 1991a) and P-16 report (Mulry, 1991) indicated that "census day address error" increased the undercount estimate by 811,000 persons. However, the Census Bureau subsequently indicated that this figure included other errors found by the P-sample re-interview as well (Breiman, 1994, p.475). The conclusion that 274,000 persons were found to have been added to the undercount estimate through incorrect assignment of Census-day address by the PES is based on subtracting these other errors, which represent 537,000 persons labeled "P-sample re-interview" in Dr. Breiman's paper, from the 811,000 persons initially identified as "census day address error" in the Census Bureau reports. (See Breiman, 1994, pp.467, 471, and 475.)

match with a PES record and when residents of the block indicate that no such person lives there. To reduce the magnitude of these problems, both PES records in the P-sample and Census records in the E-sample were checked against one or two rings of surrounding blocks. According to the P-11 report, 4.08% of the P-sample was matched to the Census through geocoding to the surrounding blocks, but only 2.29% of the E-sample was classified as correctly enumerated as a result of matching with PES records in surrounding blocks. If matching to surrounding blocks had not been done, this difference would have been equivalent to an approximate excess of 4,296,000 in the P-sample population (Parmer, 1991, Attachment).

This difference highlights the sensitivity of the PES analysis to variations in methodology and procedure. As pointed out by Dr. Leo Breiman: "The implication of this result is that, if the surrounding blocks search had not been done, then geocoding errors would have caused a doubling of the . . . national estimated undercount to over 4%. On the other hand, using a larger search area might well have produced a much lower undercount estimate." (Breiman, 1994, p.468.) Since 38% of the households that were matched outside their proper block in the 1986 PES rehearsal were matched more than five blocks away (Wolter, 1987), an expanded search area might have had a very significant effect on the measure of undercount.

The sensitivity of the PES analysis to small variations in methodology and procedure is also illustrated by another geocoding problem encountered by the PES. It was found that two particular block clusters initially increased the undercount estimate by nearly one million people due to faulty census geocoding. Most of the people in those blocks had been counted by the Census, but many of them were identified as uncounted because they had been erroneously coded as living in different blocks. It is somewhat disconcerting that only two block clusters out of a total of 5,290 included in the PES can erroneously contribute nearly one million people to the undercount estimate, especially since the total estimated net undercount is only about five million. Of course, in this case the problem was obvious enough to be identified: the influence of these block clusters was downweighted so that they contributed "only" 150,000 to the estimated undercount. (Hogan, 1991b). One has to wonder, however, how many similar problems may have gone undetected and uncorrected.

5. Unreliable Interviews

Another problem which the PES must contend with is unreliable interviews. Interviews can be unreliable for many reasons, including interviewer errors,

language barriers, lack of information on the part of respondents (some of whom are children and some of whom are neighbors, landlords, or other non-members of the household), and lack of cooperation on the part of respondents (some of whom are criminals, illegal immigrants, psychotics, or practical jokers). The serious implications of this problem for measurement of undercount through a coverage survey are demonstrated in the P-9a report. The Evaluation Follow-Up project conducted new interviews for a sample of PES E-sample records. The new interview information was given to matching teams with instructions to change match status only if new, relevant, and reliable information was present in the new interview. The result was that 13% of the records changed match status. In fact, a majority of these changes (7% of the records examined) involved changes from "erroneous enumeration" to "correct enumeration" or vice versa; the remainder (6% of the records examined) involved changes from one of these categories to "unresolved" or vice versa (West, 1991d; Ericksen *et. al.*, p.512). Although Ericksen et. al. stress the fact that the changes had a general tendency to cancel each other out and that they had fairly little effect on the net undercount estimates, the more pertinent implication for the present analysis is that a very substantial proportion of cases from the Post-Enumeration Survey had very uncertain match status. Whether these changes in match status are attributable to unreliable information in the initial interviews or merely to a tendency for match status to change each time a different team of matchers examines a difficult case, the fact remains that we are trying to measure a subtle phenomenon with a very crude instrument. Based on the findings in the P-9a report, weighted to reflect the national population, over 2 million persons would have changed from "correctly enumerated" to other classifications, and over 1.6 million persons would have changed from "erroneously enumerated" to other classifications (West, 1991d). In the context of a net national undercount of only about 5 million people, the magnitude of these reclassifications suggests very serious problems resulting from unreliable interview data.

6. Unresolvable Cases

After all of the followup, review, and rematching involved in the 1990 PES, there were still 5,359 E-sample cases and 7,156 P-sample cases which remained unresolved and had to be imputed. This represents approximately 1.6% of the total combined P-sample and E-sample cases. On the one hand, the fact that the number was not larger is a testimony to the persistence and ingenuity of the PES staff. On the other hand, it must be noted that the percentage of unresolved cases was very close to the total percentage of the population that is believed to be

undercounted. Thus, unresolved cases are not a small problem, but rather a problem that can have a critical impact on the undercount estimate. As Dr. Breiman notes, the undercount estimate would nearly double if all of the unresolved P-sample cases were assumed to be unmatched and all of the E-sample cases were assumed to be correctly enumerated, but the opposite assumptions would suggest a census *overcount* of one million persons (Parmer, 1991; Breiman, 1994, p.468).

The match status of the unresolved cases was imputed through a complex regression model that involved estimating coefficients for dozens of variables (Belin, et.al., 1993). However, regardless of the complexity of the methodology or the carefulness of its assumptions, it must be recognized that the cases we are talking about here are all ones that could not be classified as matches or non-matches even after careful and repeated review of all of the information available about them. Very little is known about what proportion of unresolvable survey responses really do match with one another. An imputation process may be able to produce a "reasonable" allocation of records to matched and unmatched status, but it cannot classify them definitively. A "reasonable" allocation would be sufficient if the proportion of unresolved cases were very small relative to the rate of undercount, but it is not sufficient when the proportion of unresolved cases is nearly as great as the net rate of undercount. The large number of unresolvable cases is by itself a fatal flaw in the undercount analysis.

Impact of Identified Sources of Error on the Undercount Estimate

We have seen that the undercount measurements are subject to several serious sources of error. In order to determine whether these errors can serve as a solution to the paradox identified at the beginning of this paper, it is necessary to see whether their combined effect would elevate the undercount estimates enough to offset the tendency for the coverage survey to miss many of the same people that are missed in the Census.

Several attempts have been made to quantify the net effect of identified measurement errors on the 1990 estimates of undercount. The analysis in the Census Bureau's P-16 report indicates that corrections for measurement errors in the 1990 PES would have decreased the undercount estimate from 2.1% to 1.4% (Mulry, 1991). A later analysis by the same author incorporated additional corrections related to a major computer processing error discovered by the

Figure 1
Impact of Identified Sources of Error on the 1990 Undercount Adjustments

Error Source	Impact on Undercount Estimate[4] (i.e. number of persons erroneously added to undercount)
P-sample rematching	553,000
Census-day address errors	274,000
Fabrications	50,000
E-sample rematching	624,000
E-sample re-interview	-473,000
P-sample re-interview	537,000
Ratio estimator bias	290,000
Computer coding error	1,018,000
Late-late Census data	183,000
New out-of-scopes in re-match	164,000
New out-of-scopes in re-interview	358,000
Re-interview of non-interviews	128,000
TOTAL	3,706,000
Estimate of identified net undercount prior to correction for identified errors:	5,275,000
Estimate of identified net undercount after correction for identified errors:	1,569,000

Note: The first seven of these error sources are considered in the P-16 report (Mulry, 1991), and the first nine error sources are considered in the subsequent Census Bureau report by the same author (Mulry, 1992).

4 With the exception of the count of Census day address errors, these figures are taken from Table 15 of Breiman (1994). That table indicated 811,000 Census day address errors, based on the P-4 and P-16 reports. As explained in Footnote 3 above, that figure is corrected here to 274,000. This correction is also reflected in Dr. Breiman's finding that correction of identified errors would lower the undercount estimate to 0.6%. Excluding that correction, Dr. Breiman's adjusted undercount estimate was only 0.4%.

It should be noted that, like the original PES estimates of undercount, these estimates of PES error are subject to both sampling error and non-sampling error. Moreover, it is likely that they fail to identify all of the problems of the PES. Nevertheless, these estimates are more than adequate for the present purpose of demonstrating that the 1990 coverage survey involved a very large amount of measurement error and that its identified errors are sufficient to explain the paradox laid out at the beginning of this paper. However, they should not be interpreted as producing a definitive estimate of the amount of "true" undercount that was identified by the 1990 PES.

Census Bureau in late 1991, the rematching of records in some suspect blocks, and the inclusion of very late Census data that had not been available when the initial PES estimates were developed. This analysis suggested that corrections for identified measurement errors would have reduced the undercount estimate from 2.1% to 0.9% (Mulry, 1992). An analysis by Dr. Leo Breiman, which built upon the Census Bureau analyses cited above, incorporated additional sources of error to arrive at an adjusted undercount estimate of only 0.6% (Breiman, 1994, p.475). This does not mean that the "true undercount" was only 0.6%, but merely that this is the amount of apparent undercount identified by the 1990 coverage survey which remains after making rough adjustments for the errors that have been identified and documented. Dr. Breiman's estimates of the impact of each error source, based on data from the Census Bureau evaluations, are shown in Figure 1. Dr. Breiman concludes that about 70% of the net undercount adjustment that had been proposed for the 1990 Census count—3,706,000 out of 5,275,000 persons—actually reflects identified measurement errors rather than actual undercount.

Despite their differences, these three studies all point clearly to the same conclusion: There are enough measurement errors which inflate the undercount estimate to roughly offset the large number of people who appear to be missed by both surveys. This provides the solution for the paradox identified at the beginning of this paper.

Thus, it appears that the 1990 coverage survey missed a very substantial number of people who were missed by the Census, but that it also identified a large number of people as missed by the Census who actually had been counted. Moreover, there is a large amount of additional error—far greater in magnitude than the level of undercount—which is less visible at the broadest level of aggregation because the errors in one direction are offset by errors in the other direction. Thus, while the 1990 coverage survey suggests an overall level of undercount similar to that indicated by demographic analysis, it cannot be relied upon to shed light on patterns of undercount for different demographic components of the population or for different geographic areas. The differential undercounts indicated by the coverage survey largely reflect differences in the incidence and direction of survey matching errors and other methodological problems rather than differences in the incidence of Census undercount. As noted in the preceding paper, this does not reflect deficiencies in the skill and effort applied to the task by the Census Bureau, but rather it reflects the impossibility of adequately measuring undercount in this manner.

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Mr. DARGA. It's no surprise that the census doesn't count everybody. The census has a hard time counting people who don't trust the Government or who don't want the Government to know where they are. The census doesn't do a very good job counting homeless people, either, and there are many other factors that make a complete count very difficult. So, the Census Bureau tries to fix the problem by counting people in some neighborhoods a second time and then comparing the results person-by-person with the census.

In 1990, this method seemed to find just about all the people in this sample of neighborhoods who were missed by the census. This sounds great until you realize what's really happening, the 1990 Post Enumeration Survey didn't really find all the people who were missed. People who didn't want to be counted the first time, didn't want to be counted the second time, either. And, the Post Enumeration Survey didn't even try to count homeless people. But it did find quite a few people who looked like they were missed by the census when they really weren't. In fact, most of the people that the Post Enumeration Survey identified as missed by the census really weren't missed by the census. That's a surprising claim. How can you know that it's true? There are at least two ways; a theoretical approach and an empirical approach.

First, the theoretical approach; on pages 6 through 9 of my first paper, you will find a very simple and very basic statistical phenomenon that explains why serious problems are inevitable when you try to measure undercount with a coverage survey. These pages show that an effort to measure a small component of the population, such as people missed by the census, is very sensitive even to extremely small sources of measurement error. The coverage survey has to contend with a lot of very large sources of measurement error. So it shouldn't be surprising that the coverage survey identifies a lot of people as missed by the census when they really weren't. It would be a lot more surprising—unbelievable, in fact—if it didn't.

You can also see the problems with the undercount adjustments by taking an empirical approach. The Census Bureau evaluated the 1990 Post Enumeration Survey quite extensively, and it did a very impressive job of documenting its shortcomings. I also want to acknowledge the valuable work of Leo Breiman, of the University of California, at Berkeley, in evaluating the Census Bureau's evaluations.

My second paper discusses six very serious sources of error that were documented by the Census Bureau: survey matching error, fabrication of interviews, ambiguity or misreporting of usual residence, geo-coding errors, unreliable interviews, and unresolvable cases. And the Census Bureau didn't document just a little bit of error. One thing that the theoretical approach and the empirical approach have in common, is that they both demonstrate very large amounts of error in the Census Bureau's adjustments for undercount. The adjustments based on the Post Enumeration Survey reflect errors in measuring undercount even more than they reflect undercount itself.

Now, you might think that since the estimated net undercount is less than 2 percent of the population, even a bad adjustment for it, wouldn't cause big problems. Before you make that mistake, it

is important to consider the examples on pages 11 to 15 of my first paper. These pages demonstrate that the 1990 Post Enumeration Survey identified some undercount differentials of 10 percentage points, 20 percentage points, and more that turned out to be totally spurious. Now I want to be clear about what I mean by a difference of 20 percentage points. These examples don't just involve inflating one group by 1 percent and another group by 1.2 percent; that would be a difference of 20 percent. If the difference should really be zero percent that could be a problem for some purposes. But that is not what I mean by a difference of 20 percentage points. These examples in my paper involve inflating a population group by, say, 8 percent and another group by 28 percent, when neither group has been undercounted more than the other. This is not a problem that only demographers would be concerned about. This problem is big enough to affect every user of census data. It's clear that the Census Bureau's method does not provide suitable measurements of undercount. In an effort to solve a net undercount of less than 2 percent, the reliability of the census would be utterly destroyed. This is a strong statement, but that does not mean that it is an overstatement. It would be very difficult to overstate the implications of having errors of this magnitude integrated with the census counts.

Thank you, again, for the opportunity to testify this afternoon.

[The prepared statement of Mr. Darga follows:]

Summary of Testimony on Census Undercount for the House Subcommittee on the Census

Kenneth J. Darga, Senior Demographer
Michigan Department of Management and Budget
May 5, 1998

I would like to thank Chairman Miller and all the members of the Subcommittee on the Census for inviting me to speak with you today about Census undercount adjustment. At this time I would like to submit two papers for the record which I will summarize briefly.

The Fallacy of Undercount Adjustment

It's no surprise that the Census doesn't count everybody. The Census has a hard time counting people who don't trust the government or don't want the government to know where they are. The Census doesn't do a very good job counting homeless people either, and there are many other factors that make a complete count very difficult.

So the Census Bureau tries to fix the problem by counting people in some neighborhoods a second time and comparing the results person-by-person with the Census. *In 1990, this method seemed to find just about all the people in this sample of neighborhoods who were missed by the Census.*

This sounds great until you realize what's really happening. The 1990 Post-Enumeration Survey didn't really find all the people that were missed. People who didn't want to be counted the first time didn't want to be counted the second time either, and the Post-Enumeration Survey didn't even try to count homeless people. But it did find quite a few people who looked like they were missed by the Census when they really weren't. In fact, *most* of the people that the Post-Enumeration Survey identified as missed by the Census really weren't missed by the Census.

That's a surprising claim. How can you know that it's true?

There are at least two ways: a theoretical approach, and an empirical approach.

Theoretical Verification

First, a theoretical approach. On pages 6 through 9 of my first paper,* you will find a very simple and very basic statistical phenomenon that explains why serious problems are inevitable when you try to measure undercount with a coverage survey. These pages show that an effort to measure a small component of the population--such as people missed by the Census--is very sensitive even to extremely small sources of measurement error, and that the coverage survey has to contend with a lot of very large sources of measurement error.

* Kenneth J. Darga, "Straining Out Gnats and Swallowing Camels: The Perils of Adjusting for Census Undercount." Submitted to the Subcommittee on the Census, House Committee on Government Reform and Oversight, May 5, 1998.

So it shouldn't be surprising that the coverage survey identifies a lot of people as missed by the Census when they really weren't. It would be a lot more surprising--unbelievable, in fact--if it didn't.

Empirical Verification

You can also see the problems with the undercount adjustments by taking an empirical approach. The Census Bureau evaluated the 1990 PES quite extensively, and it did a very impressive job of documenting its shortcomings. I also want to acknowledge the important work of Dr. Leo Breiman of the University of California at Berkeley in evaluating the Census Bureau's evaluations.

My second paper** discusses six very serious sources of error that were documented by the Census Bureau:

- survey matching error
- fabrication of interviews
- ambiguity or mis-reporting of usual residence
- geocoding errors
- unreliable interviews
- unresolvable cases.

And the Census Bureau didn't document just a little bit of error. One thing that the theoretical approach and the empirical approach have in common is that they both demonstrate very large amounts of error in the Census Bureau's adjustments for undercount. *The adjustments based on the Post-Enumeration Survey reflect errors in measuring undercount even more than they reflect undercount itself.*

Impact on Census Data

Now you might think that, since the estimated net undercount is less than two percent of the population, even a bad adjustment for it wouldn't cause big problems. Before you make that mistake, it is important to consider the examples on pages 11-15 of my first paper.* These pages demonstrate that the 1990 PES identified some undercount differentials of 10 percentage points, 20 percentage points, and more that turned out to be totally spurious.

I want to be clear about what I mean by a difference of 20 percentage points. These examples don't just involve inflating one group by 1% and another by 1.2%. That would be a difference of 20 percent. If the difference should really be 0 percent, that could be a problem for some purposes. But that is not what I mean by a difference of 20 percentage points.

* Kenneth J. Darga, "Straining Out Gnats and Swallowing Camels: The Perils of Adjusting for Census Undercount." Submitted to the Subcommittee on the Census, House Committee on Government Reform and Oversight, May 5, 1998.

** Kenneth J. Darga, "Quantifying Measurement Error and Bias in the 1990 Undercount Estimates." Submitted to the Subcommittee on the Census, House Committee on Government Reform and Oversight, May 5, 1998.

These examples involve inflating one population group by 8% and another group by 28% when neither group has been undercounted more than the other. This is not a problem that only demographers would be concerned about: This problem is big enough to affect every user of Census data.

In an effort to solve an undercount of less than 2%, the reliability of the Census would be utterly destroyed. This is a strong statement, but that does not mean it is an overstatement. It would be very difficult to overstate the implications of having errors of this magnitude integrated with the Census counts.

Thank you for the opportunity to testify this afternoon. I would be happy to answer any questions you may have.

Mr. MILLER. Thank you. Dr. Coffey.

Mr. COFFEY. Yes, thank you. I'm afraid the only title I have right now is the den leader of my local Cub Scout den. [Laughter.]

But until last year, and for the last 17–18 years, I was the senior mathematical statistician in the Statistical Policy shop in the Office of Management and Budget, and in fact, I've been a "math stat" in the Federal Government for over 30 years when I retired.

I'd like to thank you, Mr. Chairman, and members of the subcommittee for the opportunity to comment on these census issues, and also, particularly, to thank the subcommittee staff for the many documents they provided, especially the extraordinary papers that Kenneth Darga has just introduced.

I want to talk—if I have enough time—I want to talk about two things; definitely, talk about the first one——

Mr. MILLER. Dr. Coffey, could you bring the mic a little closer——

Mr. COFFEY. Certainly.

Mr. MILLER [continuing]. For the transcriber, thank you.

Mr. COFFEY. The first is a remarkable report generated by the senior Census Bureau staff and a panel of experts called the Report of the Committee on Adjustment of Postcensal Estimates, or CAPE, for short. This was an analysis of the adjustment methodology known as Dual System Estimation, DSE. It was undertaken after the adjustment decision was made in 1991. While I have some reservations about the ground rules of the study, I believe it was an excellent piece of work by some outstanding professionals.

Conceptually, the Dual System Estimation approach looked at what they called four cells, characterized by different mixes of matching and non-matching, or missing, records. Three of the cells really dealt with records that existed. The fourth cell consisted of the hypothetical cases that were missed by both systems, both the actual enumeration and the followup sample, or Post Enumeration Survey.

Clearly, you can do a lot more with data than you can without it, and the committee did quite a lot with their analysis of those first three cells. As you heard earlier, it found some errors that exaggerated the original estimates of undercount by about 20 percent or so. Subsequently, it found that another 45 percent of what was left—now this is after the number had been deflated from 2.1 down to 1.6 percent—45 percent of what was left was attributable to measurable bias. The report, itself, put it in even stronger terms. "Therefore, about 45 percent of the revised estimated undercount is actually measured bias and not measured undercount. In 7 of the 10 evaluations strata, 50 percent or more of the estimated undercount is bias." This is from the Census Bureau, the CAPE report, page 15.

That first bias was removable, and it was removed in the revised estimate. The Census Bureau's expert panel urged them to attempt to remove the second, larger bias. But the Bureau determined that it could not be removed without risking even larger errors.

At this stage of the evaluation, the expert panel and the committee were asking the questions statisticians should always ask, "Are we measuring what we think we are measuring?" The answer produced considerable discomfort, and the fact that the bias was inex-

tricably interwoven with the apparent undercount effects made matters worse.

In theory, there can be offsetting unmeasurable bias, for example, what's been called the correlation bias. This kind of thing involves assumptions that are not strictly satisfied and, particularly, the size of that fourth cell where there is no data—where you don't have any data to infer from. But if you think about this situation you can begin to see that there's a "Catch 22" here.

For Dual System Estimation to work, the unobserved fourth cell must be small. If both the actual enumeration and the later sample miss a substantial proportion of the uncounted populations, then the DSE estimation process begins to unravel. The attributes of the measured portion, now small compared to the total undercount that you think might be there, can't be attributed to this whole uncounted group without substantial risk of additional bias. On the other hand, if the fourth cell is small, then the offsetting bias is small, and one is left with a measured undercount about half the size implied by demographic analysis.

We've seen numbers around the room here today—this one may not be correct, though it is footnoted with a correct footnote—demographic analysis had it, at one point, 8 percent, I believe, in 1990. The original, official estimate would have put it at 2.1. This was clearly wrong and was later corrected down to 1.6. The 1.6 is net of these bias adjustments, rather the bias adjustments have not been made. What this says is that a big chunk of that 1.6 was bias, about half, and you start to get into logical difficulties if you try to, in fact, deal with the potential offsetting bias, also unmeasurable. You end up with a number that's down around half the size of the 1.8 given by demographic analysis—about 0.9.

Demographic analysis isn't perfect, by any means, but I don't think very many people would be comfortable with the idea that demographic analysis missed the undercount estimate by a factor of two or more, which is where this logic leaves you.

In the report, the Census Bureau assumes a moderately small correlation bias which did not fully offset the measured bias and, thus, was equivalent to a measured undercount of about 1.2 percent, a third contender in the undercount and measurement running. The remainder of the analysis put the assumptions and facts under a microscope. It was a very complex chain of reasoning. Unfortunately, many, many of the results turned out to be inconclusive and worse yet, in some cases, it produced results that were impossible when they tried to test the consistency of the facts and the assumptions. One of the biggest headaches was negative values in the fourth cell, which drew a lot of attention from the expert panel.

One other interesting thing happened late in the review process. A committee member suggested that they consider, quote "a composite 50–50 estimate which would be the simple average of the census count and the adjusted base."

After all the time they had spent on research and analysis, this simple "split-the-difference" idea didn't sit too well with many of the committee members as you can imagine. On the other hand, quote "Analysis done by the committee members showed that hypothesis test results at the State level were much more favorable to the composite estimate than to the full adjustment, even without

including correlation bias." Actually, this result is neither trivial nor surprising, and I touch on it a little bit in my written statement.

The bottom line: this extraordinary effort in what I believe was a politically neutral environment—the tough decisions had already been made—based on a massive amount of data and a large volume of additional research left profound doubts about the DSE methodology and its future.

There was a prescient comment from a member of the expert panel who cautioned that he would not be surprised to see additional research, after July 1992, turn up new results and new estimates of undercount. Now it is 8 years after 1990 census, and researchers are still finding significant new problems. By mid-1992, about half of the DSE estimate was attributable to measured bias. The later research cited in Mr. Darga's paper raised the figure to 70 percent measurement error. I understand, and you heard earlier, that there are further papers that now put the split on the undercount estimate at 20 percent undercount and 80 percent error. I think anybody who is concerned with the accuracy of the census really needs to read and understand the mechanisms that are described in Ken Darga's paper, and what kinds of consequences they produce.

If I have time, I'd like to go into one additional item which concerns me, which is the interrelationship of this to the plan not to pursue the last 10 percent of the countable population during the actual enumeration.

In my 32 years as a Government statistician, I've never found anyone willing to argue that truncating followup will improve quality of data. Saving time or money is usually the issue, but not improving quality, and that's the case here. The issue is not quality, but resources. What this is going to amount to, making this decision not to pursue that last 10 percent of the population, with intensive followup operations such that have been used in prior census, is that it will expand the uncounted portion of the population by a factor of five or more, the factor depending on how much you believe previous estimates.

That isn't to say that some things won't look better. I was just looking around the room here at some of these charts and thinking that some of these can now be retired to archives if we follow this plan, because you will not have these kinds of independent measures that could be compared in this way under the 2000 plan.

There will no longer be an independent demographic analysis estimate of undercount that can be compared to prior censuses producing this kind of time series, because there won't be an actual enumeration figure to compare with. The long time series of this single, most-trusted measure of undercount will be broken. On the brighter side, you won't be able to answer or ask a lot of questions about the accuracy of the demographic analysis either, because a lot of the discrepancies that have allowed the assumptions of demographic analysis to be tested and refined over many decades will no longer be visible. There will be so much sampling error, imputation error, and bias to contend with, you won't be able to see those things anymore.

DSE will probably look better than it did in 1990; you'd certainly hope so. A few million people attributable to bias doesn't look so bad against a backdrop of 20-odd million uncounted people. But the bias will still be there. Adding a large chunk of more predictable, uncounted cases will make DSE look better, but it won't reduce the kernel of tough, uncounted cases that really brought it to disaster in the 1990 census.

Since major portions of the bias, in fact, arose from DSE operations and procedures, some of those will scale right up with the larger version of DSE and will look like the artificially inflated total of the uncounted. On top of all this, the strategy for truncating followup will add additional sampling error, imputation error, in millions of cases, where full followup would have produced accurate data.

Some of my colleagues at OMB are going to have at me on this, but let me tell you, if Congress can't find resources to intensively followup every citizen who can be convinced to participate in the census, it deserves the inaccurate census it will get.

I thank the committee for the opportunity to express these views, and will be pleased to respond to questions.

[The report referred to follows:]

ASSESSMENT OF ACCURACY OF ADJUSTED VERSUS UNADJUSTED 1990 CENSUS BASE FOR USE IN INTERCENSAL ESTIMATES

000257

REPORT OF THE COMMITTEE ON ADJUSTMENT OF POSTCENSAL ESTIMATES
BUREAU OF THE CENSUS
DEPARTMENT OF COMMERCE
AUGUST 7, 1992

ORIGINAL

RECOMMENDATION

The Committee on Adjustment of Postcensal Estimates (with an ac[illegible] out referred to in this report as the Committee) investigating potential census adjustment for intercensal population estimates concluded that on average, an adjustment to the 1990 base at the national and state levels for use in intercensal estimates would lead to an improvement in the accuracy of the intercensal estimates. (Attachment 1 contains a list of the members of the Committee.) This conclusion was based on a set of extensive research and analyses as well as input from outside consultants. This outside technical advice included a Panel of Experts whose work culminated in a day-long meeting with Census Bureau staff. (Attachment 2 contains a list of the Panel of Experts.) Under the auspices of the Office of Management and Budget (OMB), there also was consultation with other Federal agencies, which are prime users of intercensal estimates.

In coming to its conclusion, the Committee did not vote. Instead, there was an attempt to reach consensus. The conclusion of the Committee was not unanimous, but the large majority of the Committee agreed with the finding. Since there was no vote, this report does not contain a specific listing of minority opinions. Rather, a series of concerns is listed. There was general consensus on several key points.

1. This decision was separate and distinct from the June 1991 decision about whether to adjust the 1990 census for all uses. Making a decision about whether to adjust the full census is quite different from deciding whether to adjust the base that is used in mathematical algorithms to produce estimates of population at several points in the decade between censuses (intercensal estimates).

2. The majority of the Committee concluded that on average, an adjusted state base would be more accurate than an unadjusted state base for use in intercensal estimates, but the Committee recognized there is not necessarily improvement for each and every state base. In fact, the Committee was concerned about a few specific states where the evidence was inconsistent as to whether adjustment was making an improvement. Even so, the Committee felt that overall there was improvement at the state level.

3. States are an important political entity and the first tier in most funding programs. Therefore, the Committee felt that every state or none of the states should be adjusted. Even though some states are smaller than several large cities, the Committee did not recommend adjusting selected cities or counties.

4. For smaller areas (generally, areas of less than 100,000 population), some of the Committee judged that the use of an unadjusted base for the estimates was better than the use of an adjusted base. Other Committee members concluded there was no way to determine whether an adjusted or unadjusted base was more accurate. In the absence of data showing improvement by adjustment, the Committee concluded that the relative distribution of population by substate areas within each state was more

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accurate using census counts than the comparable relative distribution using adjusted counts.

5. The Committee was quite concerned about adjusting some, but not all substate areas, especially since there was no way to determine the cutoff of which areas to adjust and there had been no research on the effect of adjustment for a partial set of substate areas.

The Committee's technical assessment was based on a massive amount of data. While there was a re-examination of the information already collected in conjunction with the evaluation of the Post Enumeration Survey (PES), the Committee relied mostly on a large volume of additional research conducted since July 1991. In performing this additional research, the Census Bureau had more time so it could take full advantage of what it had learned from its analysis to date of the 1990 census and the PES. The Census Bureau also had fewer constraints to use prespecified procedures compared to the process in conjunction with the July 1991 decision whether to adjust the 1990 census for which a court order required prespecified procedures. This additional research turned out to be extremely useful, not only for this decision, but for future surveys of all kinds, including those designed for potential adjustment. The Committee wants to acknowledge specifically the massive effort that the professional statistical staff at the Census Bureau put into this research. It was research of such quality that all those involved should be rightly proud. The quality and usefulness of the research also were noted by the set of outside experts that helped review Census Bureau research.

A full description of this research is beyond the scope of this report, but a summary is provided. There are, however, extensive minutes of the Committee meetings, which contain, as attachments, the major results of the additional research. The Committee would like to commend David Whitford and Michael Batutis for preparing these excellent minutes.

In addition to providing useful information, this additional research detected some errors and made some refinements to the levels of estimated undercount originally reported in the spring of 1991. These changes are summarized in the following table and described more fully later in the report.

Population Group	Estimated Undercount			
	June 1991		July 1992	
	Undercount Estimate	Sampling Error	Undercount Estimate	Sampling Error
U.S. Total	2.08%	.18%	1.58%	.19%
Black	4.82	.29	4.43	.51
Asian and Pacific Islander	3.08	.47	2.33	1.35
American Indian, Eskimo, or Aleut	4.77	1.04	4.52	1.22
Hispanic (Can be of any race)	5.24	.42	4.96	.73

This report is a summary of the process that led to the Committee's recommendation. Though the report concentrates on activities that took place late in the decision process, the report also covers several topics that were discussed throughout the year of deliberations by the Committee. Some readers of this report may desire further background on the issue of undercount in a census and the efforts of the Census Bureau to measure and potentially correct (adjust) for any such undercount. There are numerous documents that could be read for background. One good summary document is the notice in the Federal Register concerning the decision of the Secretary of Commerce about whether to adjust the 1990 census (Reference: Federal Register, Volume 56, #140, Part III, pages 33582-33692). The remainder of this report is divided into several sections.

BACKGROUND - UNDERCOUNT — This section contains a description of coverage in the decennial census as well as the methods the Census Bureau uses to measure coverage.

BACKGROUND - ESTIMATES — This section contains a description of why the Census Bureau undertook the task of examining whether to adjust intercensal estimates as well as a very brief description of the estimates program and its use.

RESEARCH — This section summarizes the additional research done since July 1991. This research was the major foundation for the Committee's assessment.

DECISION — This section briefly describes the decision process of the Committee as well as the Executive Staff. These final discussior as well as the year long deliberations of the Committee will be key pieces of input to the Director's decision.

FUTURE — This section contains a few general findings concerning the process of measuring undercount in the future.

BACKGROUND ON UNDERCOUNT

The issue facing the Committee was whether potential error in the PES and adjustment technology was at a sufficiently low level to recommend the inclusion of results from the PES into intercensal estimates. The decennial census is also subject to error, and the PES tries to measure the net coverage error in the census.

This section describes the operations of the 1990 PES to measure census coverage error and how these PES results might have been used for a potential adjustment of the 1990 census. This section is provided solely for background, so the section can be skipped for those already familiar with coverage error in a census as well as the Census Bureau's methods to measure coverage error by the PES and Demographic Analysis.

Since the very first census, there have been problems in accurately counting every person living in the United States. The resulting undercount, or percentage of the population that is not counted by the census, is not a new phenomenon. Beginning with the 1940 census, each decennial census has included an evaluation program to attempt to measure the extent of undercount, or what is often called coverage error. These evaluations showed a steady improvement in net census coverage over four decades, from an estimated undercount of more than 5 percent for the total population in 1940 to an estimated undercount in 1980 of just over 1 percent. They also have shown larger undercount rates for the Black population than the non-Black population and a differential that has stayed about 3-4 percentage points over the period. A difference in estimated undercount for one population subgroup (like Blacks) and another population subgroup (like non-Blacks) is called the differential undercount.

Because of concern about this differential undercount, it was suggested that if the Census Bureau can estimate the number of people missed in a census, why not simply correct the census to account for missed persons and thereby make the census more accurate. This, in simple terms, is what is called "adjustment." But estimating the census undercount with acceptably small error and, in turn, using that knowledge to improve the census counts for all levels of geography are two highly complex and difficult tasks.

The Census Bureau had two major programs to measure coverage in the 1990 census. The first was the PES, which was a sample survey taken after the census. Approximately 165,000 housing units in a sample of 5,290 census blocks or block clusters were interviewed. Block clusters are combinations of small blocks. For the rest of this report, block will be used to mean a block or a block cluster. Persons enumerated during the PES were also referred to as the P-sample. After persons in the housing units in the selected sample blocks were interviewed, their responses were matched to census records in the same set of blocks to determine whether they were counted in the census. This process measured erroneous omissions in the census.

The Census Bureau also measured erroneous inclusions in the census by determining whether any of the persons in the PES sample blocks who were enumerated in the census should not have been counted or should not have been

counted at that particular location. An erroneous census enumeration, for example, could have included a child born after April 1, 1990, a person who died before April 1, or a college student away from home who was enumerated at his or her parents' address, instead of being correctly enumerated at the college. Persons in this sample constitute the E-sample.

The data on erroneous inclusions and erroneous omissions were used to produce an estimate of the net undercount or net overcount of the population in the census. This was a very complex process that combined elements of survey design, interviewing, matching, imputation, mathematical modeling and professional judgment.

Second, the Census Bureau used a system called Demographic Analysis (DA) to also measure census coverage. Basically, in DA, an independent estimate of the total population is produced by combining various sources of administrative data. This process included using historical data on births, deaths, and legal immigration; estimates of emigration and undocumented immigration; and Medicare data.

Demographic analysis estimates were used to evaluate the reasonableness of the PES estimates. Only the PES provided estimates of undercount and overcount at a level of detail suitable for use in potential adjustment. For example, demographic analysis estimates were produced only at the national level and for the Black and non-Black populations; the PES process was designed to measure coverage error for more population subgroups (Whites, Blacks, Hispanics, Asians and Pacific Islanders, and American Indians) by detailed levels of geography. Therefore, only the PES data could permit an adjustment.

Each of these programs will be summarized below. For a more detailed discussion of PES see Howard Hogan, "The 1990 Post-Enumeration Survey: An Overview," a paper presented at the American Statistical Association in August 1990; for a more detailed discussion of Demographic Analysis see J. Gregory Robinson, "Plans for Estimating Coverage of the 1990 United States Census: Demographic Analysis," a paper presented to the Southern Demographic Association, in October, 1989.

POST-ENUMERATION SURVEY (PES)

Sample Design

The PES sample was selected in stages. First a random sample of blocks was drawn. Blocks are small polygons of land surrounded by visible features. Most are like the four-sided blocks in a city. Within the selected set of sample blocks, all housing units were listed.

To select the sample of blocks, all blocks in the United States were assigned to one of 101 groups called strata. The strata were defined by geography, city size, racial composition, and percent of housing units that were renter occupied as opposed to owned. A representative sample of blocks was selected from each of the sampling strata. A separate sampling stratum was defined for American Indian Reservations.

Persons living in institutions were excluded from the PES, as were military personnel living in barracks, people living in remote rural Alaska, and persons in emergency shelters and persons who had no formal shelter.

Listing and Interviewing

In February 1990, Census Bureau interviewers who are part of the permanent Census Bureau staff of interviewers visited each of the sample blocks to list all housing units. To preserve independence, none of the temporary enumerators hired to take the 1990 census was used for this listing operation and the listing operation was not conducted out of the temporary census offices. The reason for this was to make sure that temporary people taking the census did not know where a PES sample block was, because if they did, that block might be treated differently during the census.

After the completion of the regular 1990 census interviews, PES interviewers interviewed persons at households in the PES sample blocks. Although this interviewing drew from interviewers who had already worked on the 1990 census, steps were taken to preserve independence, such as not allowing an interviewer to work in a block in the PES that he or she had worked in during the census.

During the PES interview, the interviewers determined who was living in each housing unit, obtained their characteristics, and asked where they lived on April 1, 1990, Census Day. This latter question was necessary in order to determine whether those people who had moved since census day had been counted in the census. The PES interviewing began nearly 3 months after Census Day.

There was a quality assurance program for the interviewing phase to ensure that the interviewers really visited the household and that the people listed were indeed real. If interviewers made up people, they would not match to the census and would inflate the undercount rate.

Matching

The next step was to match the persons enumerated during the PES (the P-sample) to the census. Those persons in the P-sample matched to the census were considered to have been counted in the census; those nonmatched were considered to have been missed.

Matching was carried out in several stages. It involved an initial stage of computer matching followed by clerical matching to attempt to resolve cases that the computer could not match. Many of the persons not matched to the census by computer and clerical matching were assigned for a follow-up interview, if it was determined that additional information might help establish whether a match to the census was appropriate. An additional stage of clerical matching was then conducted using the information from the follow-up interview.

The E-sample, those persons in the PES blocks who were enumerated in the census, was examined to determine if they were correctly enumerated. E-sample persons were matched back into the census to determine if they were enumerated more than once (duplicates). The E-sample persons who were not matched to the

P-sample were potential candidates for erroneous enumerations. Some of these unmatched census persons were also included in the PES follow-up operation described above.

A final matching and reconciliation operation took place at the conclusion of the PES follow-up. An important aspect of this operation was that situations arose where correct match status for persons in the P-sample, or correct enumeration status for persons in the E-sample, could not be determined. This situation occurred because the initial interview was inconclusive or because an incomplete interview was obtained during the follow-up.

Imputation and Dual System Estimates

A final PES computer file was created that reflected the match status for persons in the P-sample and the enumeration status (correct or erroneous) for persons in the E-sample. Computer editing or imputation was performed to correct, insofar as possible, for missing or contradictory data. A critical aspect of imputation involved the estimation of a final match status for those persons whose match status could not otherwise be resolved.

The data in the final PES file were then summarized and incorporated with data from the full census to produce dual system estimates (DSE's) of total population. Dual system refers to the fact that two systems (the census and the PES) are used to make the population estimate. The DSE's were produced separately for each of 1,392 unique subgroupings of the population called post-strata. (See the following section titled Post-strata)

The DSE model to estimate total population conceptualized each person as either in or out of the census cross classified as either in or out of the PES. Essentially it involves determining how many people were (1) in the PES and in the census(matches), (2) in the PES and out of the census(Non-matches), (3) in the census but not in the PES, and (4) in neither the census or PES.

To get an estimate of total population, you could add up the four cells listed above. But, only two of those were directly estimated (cell 1, matches, and cell 2, non-matches). Making some assumptions and using some basic algebra, total population can be estimated without direct estimates for each of the four cells. These operations and the DSE are explained more fully in the Hogan paper cited above.

Post-Strata

The Census Bureau prepared the dual system estimates of the total population for each of 1,392 groupings of people called post-strata. The reason for forming the post-strata was to group persons who had similar chances (probability) of being counted in the census. A person's likelihood of being counted in the census (or in the PES) is called capture probability. The post-strata were defined by census division, geographic subdivisions such as central cities of large metropolitan statistical areas, whether the person was the owner or renter of the housing unit, race, age, and sex. Each person in the PES sample belonged in one of the unique post-strata.

For purposes of illustration, the following are examples of the 1,392 post-strata. One example is a post-stratum which contains Black males, age 20-29, living in rented housing in central cities in the New York primary metropolitan statistical area. A second example is that which contains non-Black non-Hispanic females, age 45-64, living in owned or rented housing in a non-metropolitan place of 10,000 or more population in the Mountain Division. A third example is that which contains Asian males, age 45-64, living in owned or rented housing in metropolitan statistical areas but not in a central city in the Pacific Division. A fourth example is that which contains non-Black Hispanic females, age 30-44, living in owned or rented housing in central cities in the Los Angeles-Long Beach primary metropolitan statistical area or other central cities in metropolitan statistical areas in the Pacific region. As can be seen from these examples, the 1,392 post-strata are very specific.

Adjustment Factors

The next step in the process was to compare the estimated total population for each post-stratum (the dual system estimate or DSE) to the census count to determine a "raw" adjustment factor. For example, if the DSE for a particular post-stratum was 1,050,000 and the census count was 1,000,000, then the adjustment factor was 1.05, reflecting about a 5 percent estimated net undercount. Though most adjustment factors are larger than one, indicating an estimated undercount, an adjustment factor may be less than one, which would have the effect of lowering the census count for the post-stratum if an adjustment is applied. This situation results when there is evidence of an overcount in the post-stratum.

"Smoothing" the Adjustment Factors

The next step was "smoothing" these "raw" adjustment factors to reduce sampling variance and to produce final adjustment factors. Because the PES was a sample, it was subject to sampling error. Sampling error is the error associated with taking some of the population (a sample) rather than all of the population (a census). The process of smoothing the "raw" adjustment factors to create final adjustment factors was a step to minimize the effect of sampling error. Basically, smoothing is a regression prediction model. A multi-variate regression using items correlated with undercount predicts the undercount for each of the 1,392 post-strata. Then, the final adjustment factor is an average of the "raw" adjustment factor and the predicted adjustment factor. For a post-stratum with low estimated sampling error, there was heavy weight on the "raw" adjustment factor in the averaging, and vice versa. The smoothing technique was based on certain assumptions and would add an additional component of error called model error. The Census Bureau hoped that the reduction in sampling error from smoothing would offset any additional errors from the smoothing model chosen. If the Census Bureau had not used smoothing, the final adjustment factors for some of the post-strata would have been based on estimates of undercount that were subject to very large sampling error.

Small Area Estimation

The Census Bureau used the final adjustment factors to produce adjusted counts for every block in the Nation. The PES can only produce "direct" estimates of the total population for relatively large geographic areas (*i.e.*, the 1,392 post-strata). If there had been a decision to adjust, however, the adjustment would have been applied to each of the Nation's approximately 5 million populated blocks. The Census Bureau developed a model that took the adjustment factors produced for each of the 1,392 post-strata areas and used them to estimate adjustment counts for each block. Since each of the post-strata contain many blocks parts, the Census Bureau based its model on a critical assumption that coverage error is similar for all blocks parts within a post-stratum. (A block part is simply that part of the block that falls within the definition of a post-stratum. For example, females within a block would be part of a block and in one set of post-strata while males within a block would be in different set of post-strata.) This assumption of all block parts within a post-stratum being alike (homogenous) with regard to the chance of being counted is analogous to the homogeneity assumption for persons.

Finally, the Census Bureau produced a set of census tabulations with adjusted counts. It did this by adding or subtracting "adjustment" persons with detailed characteristics. The number of people added or subtracted was determined by final adjustment factor for the post-stratum that the block part was in. If someone had to be added, the information from someone else in the block part who was counted in the census was duplicated. If someone had to be subtracted, the information for someone in the block part who was counted in the census was deleted.

Evaluations

The PES and adjustment process are based on many assumptions and have the potential for error. To evaluate the assumptions and potential error, the Census Bureau conducted numerous studies called P-studies because they referred to the PES. The studies were associated with the following general areas.

- Missing data on the PES questionnaire
- Misreporting of census day address on the PES questionnaire
- Fabrication of data in the PES by interviewers
- Errors in matching
- Errors in determining erroneous enumerations
- Balancing omissions with erroneous enumerations
- Correlation Bias (the tendency of the DSE to underestimate total population because some people are missed in both the PES and the Census)
- The homogeneity assumption

The results of these evaluations are essential to determining whether adjusted or unadjusted census counts are more accurate.

DEMOGRAPHIC ANALYSIS

The Census Bureau's other coverage measurement program was demographic analysis (DA). DA uses historical data on births, deaths, and legal immigration; estimates of emigration and undocumented immigration; and medicare data to develop an independent estimate of the population. The DA estimate of population is compared with the census count to yield another measure of net census coverage. DA can be only used to make reliable estimates at the national level. The DA coverage estimates were compared to the post-enumeration survey coverage estimates to assess the overall consistency of the two sets of estimates at the national level.

Birth and death records are available for the entire United States from 1933 on, but are not complete for years before 1933. Therefore, the Census Bureau had to find other ways to estimate the number of people who were born or died prior to 1933. In estimating births for each year, The Census Bureau added to the number of registered births an estimate of under-registration. Under-registration was estimated based on tests conducted in 1940, 1950, and 1964-1968. If the estimates of under-registration are off, they could have a significant effect on undercount estimates because birth data are by far the largest component in estimating the population through demographic analysis. Since national birth and death records are not available before 1933, the Census Bureau had to find other ways to estimate the size of the population 55 and older. For the population 65 and older, medicare estimates are used. For the population 55 to 64, estimates are made from revisions to earlier estimates.

The United States does not keep emigration records. Therefore, an estimate had to be made of persons who have left the country. While the United States does have good records of legal immigration, there is no accurate estimate of illegal immigration. The Immigration and Naturalization Service now collects different information than it did prior to 1980. That change further complicated the effort to estimate legal immigration. Also recent legislative reform allowing amnesty also complicated the issue since the Census Bureau did not know whether all of those obtaining amnesty actually reside in the United States. The Bureau used professional judgment to estimate the components of illegal immigration.

It is important to emphasize that results of demographic analysis are not exact but are estimates. To a large extent, they were based on assumptions and best professional judgment. As in the PES, the Bureau tried to estimate potential error in the data produced by demographic analysis in a series of studies call D-studies. Based on these studies, the Census Bureau developed a range of error around the demographic analysis estimates.

UNDERCOUNT STEERING COMMITTEE

To address the evaluation of the coverage in the census and the methods used to evaluate that coverage (the PES and DA), the Census Bureau formed the Undercount Steering Committee (USC). Their work was an important part of the July 1991 decision whether to adjust the full 1990 census for all uses. The work of the USC was also the major basis for the work done by CAPE. For a

detailed description of the findings of USC, see Technical Assessment of the Accuracy of Unadjusted versus Adjusted 1990 Census Counts: Report of the Undercount Steering Committee, June 21, 1991.

BACKGROUND ON INTERCENSAL ESTIMATES

When the Secretary of Commerce announced his decision on July 15, 1991, not to adjust the 1990 census, he indicated his concern about the differential undercount. Because of that concern, he instructed the Census Bureau to continue its research into the area of potential adjustment. If the Census Bureau was able to resolve the technical problems associated with adjustment that were identified in the spring of 1991, then the Secretary asked the Census Bureau to consider incorporating results from the PES into the intercensal estimates program.

Basically, intercensal estimates are made by updating the most recent census base with estimates of population change (births, deaths, and net migration). Of course, the actual procedure is much more complicated and sophisticated. The Census Bureau makes estimates at the national, state, and county level every year and at the incorporated place (city) level every other year. These estimates have a variety of uses. Most notably, the estimates are used in funding allocations, as sample survey controls, and as denominators for many important statistics.

About one-third of the Federal funding programs use intercensal estimates of population as part of their funding formula, rather than using the 1990 census count for ten years. There may be items other than total population in the formula as well. The General Accounting Office has estimated that about 10 billion federal dollars a year are allocated based on funding formulas that use intercensal estimates[1]. States have within state fund-allocation programs as well. Many states use intercensal estimates to allocate within-state funding dollars.

Many sample surveys use national, and to some extent state, intercensal estimates as controls. The most notable is the monthly unemployment survey (the Current Population Survey, or CPS). Sample surveys generally have poorer coverage than a census; therefore, in order to improve the accuracy of estimates from a sample survey, the sample survey estimates are often controlled to an independent total (in this case, the intercensal estimate).

Many Federal agencies produce statistics per 1,000 persons (or some other base). Examples are crime statistics, incidence of certain health conditions, etc. The numerator of these statistics can be obtained at various points in time throughout the decade. In the absence of any updated information, calculating these kinds of statistics on a static 1990 denominator would be misleading; therefore, these Federal agencies use intercensal estimates of population as the denominator.

In order to be responsive to the Secretary's request on intercensal estimates, the Census Bureau formed the Committee to address the technical issues related to a potential adjustment of the base for intercensal estimates. The Committee was made up of many people who also served on the Undercount Steering Committee for the July 1991 decision. However, the Committee also

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[1]Federal Formula Programs - Outdated Population Data Used to Allocate Most Funds (GAO/HRD-90-145, September 1991).

included some new members, including some Census Bureau staff very familiar with intercensal estimates. Though the Committee focused on the technical issues surrounding a potential adjustment, early in the Committee's deliberations, the Committee also had to make some key decisions related to the unique nature of the intercensal estimates program. The Committee decided that:

1. For the purpose of survey controls, there would be only one decision point in the decade about whether to adjust intercensal estimates.

2. If there was a decision to adjust, there would have to be a mechanism to make the intercensal estimates additive from the smallest area to the national total.

3. There would not be adjustment for some uses of intercensal estimates, but no adjustment for other uses of the estimates.

4. If there were a decision to adjust, the amount of the adjustment would be calculated on the base population. This adjustment plus an estimate of population change for the time period since the census would be added to the unadjusted base.

After every census, there is a change in the base used to calculate the intercensal estimates. Apart from the question of adjustment, there would be a change from a 1980 census base to a 1990 census base. For the use of estimates as survey control totals, that changeover date was postponed from January 1992 to January 1993. Therefore, 1992 estimates released in January 1993 would reflect the 1990 base. The postponement was made so that the decision on whether to adjust the base for intercensal estimates could be made at the same time. If there is a decision to adjust, then the change to a 1990 base and the change to a 1990 adjusted base would be simultaneous. If the decision is not to adjust, then there will be a change to the 1990 unadjusted base. In that case, even if evidence later in the decade would lead one to support adjustment, the base would not be changed from 1990 unadjusted to 1990 adjusted at a later point in the decade for the purpose of survey controls. Any change in base presents a discontinuity in uses based on intercensal estimates. Federal agency users of intercensal estimates for survey controls were quite clear that they strongly preferred only one such discontinuity during the decade.

On a technical basis, it is conceivable to be able to support adjustment at one level (say states), but not at lower levels. In such a case, state estimates would add to the national estimate, but substate estimates would not add to state estimates. There was agreement from users and from the staff making the estimates that failure to have additivity was not only undesirable, but close to unacceptable. Also, on a technical basis, it is conceivable to be able to support adjustment for one purpose (for example, national survey controls), but not for another (for example, subnational fund allocation). The Committee found this situation undesirable. Finally, it is possible for the Census Bureau to decide not to adjust the base of estimates but for some Federal agencies to do their own adjustment. This topic was discussed among Federal agencies at a meeting at the OMB. There was general agreement that it

would be unacceptable to have variable sets of intercensal estimates used differently by different Federal agencies.

Estimates start with a base population and add estimated population change (births, deaths, and net migration). If estimates are adjusted, an additional term would be added that represents the net adjustment level for each area. This net adjustment level is the difference between the adjusted base population and the unadjusted base population. In the estimation process, the sum of this net adjustment and the estimated population change would be added to the unadjusted population base. Under this procedure, the net adjustment would remain constant throughout the decade.

FURTHER RESEARCH
THE BASIS FOR THE ASSESSMENT

When discussing the issue of whether to adjust the 1990 census, almost all experts agreed that with more time, there would be refinements and changes to the estimated undercount. Most experts, however, assumed these changes would be relatively small. Since the July 1991 decision, the Census Bureau had the time and at the direction of the Secretary of Commerce, continued to examine the estimated undercount. As expected, the Census Bureau has made some refinements and changes. During this analysis, the Census Bureau discovered a significant computer processing error in the system used to determine the undercount estimates that were under consideration in spring 1991. As a result of an error in computer processing, the estimated national undercount rate of 2.1% was overstated by 0.4%. After correcting the computer error, the national level undercount was estimated to be about 1.7%. After making other refinements and corrections, the national undercount is now estimated to be about 1.6%. Attachment 3 shows revised undercount estimates by selected age-sex-race categories. Attachment 4 shows revised undercount estimates by state. Attachment 11 shows revised undercount estimates for cities of 100,000 or more population. Attachment 12 shows revised undercount estimates for counties of 100,000 or more population.

Since PES undercount estimates were based on a sample survey, they are subject to error. There is sampling error to reflect the fact that the information came from some and not all of the population. The estimates are also subject to biases. For example, errors in matching, erroneous responses from respondents, etc. can bias the undercount estimate. Just as for the estimate of undercount, the Census Bureau also refined its estimates of bias. The level of total bias, excluding correlation bias[2], on the revised estimate of undercount is negative 0.73 (-0.73%). Therefore, about 45% (0.73/1.58) of the revised estimated undercount is actually measured bias and not measured undercount. In 7 of the 10 evaluation strata[3], 50% or more of the estimated undercount is bias. When correlation bias is included, these percentages go down. With correlation bias, the revised estimate of total bias is negative 0.35 percent (-0.35%). Including correlation bias, about 22% of the revised estimate of undercount is actually bias and not measured undercount. In general, the Committee was concerned that the estimate of correlation bias could be an underestimate, which meant the total bias estimate of negative 0.35% was an overstatement. There was limited time and methodology to investigate this concern further. The Committee did not feel lack of more information on this concern had an appreciable effect on their overall conclusion.

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[2]Correlation bias is a term that reflects the fact that the DSE of total population based on the PES is an underestimate for the model used by the Census Bureau. The DSE is downwardly biased because of correlation bias which occurs, for example, because there are people missed in both the census and the PES. Correlation bias is described more fully below in the section entitled Third Issue-Part B, p 21.

[3]See Attachment 6 for a description of evaluation post-strata.

When the Committee began discussing the issue of whether to adjust the base for intercensal estimates, it started by reviewing the technical concerns raised about whether to adjust the 1990 census. This analysis produced a list of concerns, which the Committee summarized into five key areas.

1. Could the problems in the smoothing model, including lack of robustness, be resolved?

2. Could the estimated biases in the PES estimate of undercount be removed?

3. Were all components of the bias adequately reflected in the total error model, and was total error being accurately handled in loss function analysis?

4. Could we learn more about whether or not our homogeneity assumption held sufficiently to support adjustment?

5. Could we resolve the inconsistencies between the PES and other estimates of undercount, primarily Demographic Analysis?

There were other issues raised. While it would have been helpful to research these other questions as well, the Committee felt comfortable in confining its research efforts to the five key questions. The Committee felt they could make a reasoned choice about whether to adjust the base for intercensal estimates if they got appropriate information on these five issues.

FIRST ISSUE: COULD PROBLEMS IN THE SMOOTHING MODEL BE RESOLVED?

Summary: The Committee was very comfortable with the new post-stratification scheme which reduced sampling variance enough to avoid the use of smoothing. However, because of the limitations of artificial population analysis[4], there was still some concern with the finding that there was no loss in homogeneity[5] in a smaller post-stratum design that had only about 25% as many post-strata. (See fourth issue.)

For the July 1991 decision on whether to adjust the 1990 census, the sample of about 400,000 people was post-stratified into 1,392 groups. A person could be in one and only one of the 1,392 post-stratum groupings. Some of

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[4]Artificial Population Analysis refers to the study to examine if the persons within each of the 357 post-strata were alike (homogeneous) with regard to their probability of being counted in the census. Artificial Population Analysis is described below in the section entitled Forth Issue, p 25.

[5]To make estimates from the PES, each sample person is assigned to one and only one post-stratum. A necessary assumption is that every person within a post-stratum has approximately the same chance of being counted in the census or the PES. This assumption is called the homogeneity assumption.

those post-stratum groupings were quite small so the estimate of undercount was subject to very high sampling variance. In order to reduce this sampling error, the Census Bureau used a technique called smoothing. Smoothing was a regression prediction model. Based on items correlated with undercount, the undercount for each of the 1,392 post-strata was predicted using the regression model. Then, the final undercount was an average of the predicted undercount and the directly observed undercount.

The smoothing process was successful at reducing the sampling variance. However, there were several issues raised about the entire smoothing process. It would have taken a large, intense, and uncertain research program to have answered all of these concerns. Therefore, the Committee chose a different approach. The Committee agreed to reduce the number of post-strata. By doing so, each new post-stratum would have more sample size than under the 1,392 system, and presumably, enough sample size so that the estimates would be stable (meaning the estimates would not have very large sampling variance); therefore, no smoothing would be required. It was expected that there would be some loss of homogeneity by going to a smaller post-stratum design, since with fewer strata, each stratum now had more people. Therefore, one could expect that it was less likely that everyone within these larger strata had the same capture probability as in smaller strata. The Committee assumed that the loss in homogeneity would be smaller than the problems and potential error from smoothing. As it turned out, the Committee's assumption seemed to be correct.

Based on measures of census performance and general patterns of undercount, a new set of 357 strata were designed. The 357 strata were not a simple regrouping of the 1,392 strata. The 357 strata design included 51 main strata defined by geography, owner-renter, and race/Hispanic cross classified by 7 age groupings cross classified by male-female. Attachment 5 contains a description of the 357 post-stratum design. This 357 design turned out to be a very effective stratification, primarily because we were able to examine additional data before defining the strata. Perhaps the most important piece of information for this examination was the strong relationship of living in owner or renter housing units to undercount. Hence, owner-renter status is very prominent in the 357 design.

We prepared revised PES estimates of undercount based on the 357 design and analyzed sampling variance by post-stratum. The intent was to verify the assumption that the sampling variances under the smaller (357) design would be relatively stable. At the state level, the variances were at an acceptable level[6]. Attachment 10 contains revised estimates of undercount or overcount for the 51 main post-strata that were part of the 357 post-stratum design.

The Committee was also concerned with the potential loss of homogeneity with the smaller post-stratum design. Using artificial population analysis, the Committee examined the homogeneity of the 1,392 design compared to the 357 design. Artificial population analysis is described below in the section called Fourth Issue. Based on the artificial

[6]C.A.P.E. minutes 4-6-92, Attachment 3.

population analysis assuming no bias in the PES, the Committee found the homogeneity for the 1,392 design and the 357 design to be about the same[7]. This result at first seemed counter-intuitive since one would have expected some reduction in homogeneity. However, the result may be explained by the fact that the 357 design is much more effective than the 1,392 design (probably true since the 357 design was based on a careful review of auxiliary data), by limitations of the artificial population analysis, or by a combination of both those factors.

In summary, the Committee was very comfortable with the new stratification. In general, for state-level estimates, the Committee felt satisfied with the 357 design without smoothing versus the 1,392 design including smoothing. However, because of the limitations of artificial population analysis, there was still some concern with the finding of no loss in homogeneity by going to a smaller post-stratum design that had only about 25% as many post-strata.

SECOND ISSUE: CAN ESTIMATED BIASES BE REMOVED FROM PES ESTIMATES?

Summary: One of the first steps in further analysis of the PES was to re-examine the 104 blocks which had the greatest effect on the undercount. Many of the blocks had such a significant effect, they could be considered outliers. As a result of the examination of 104 blocks[8], corrections to the Post Enumeration Survey (PES) undercount estimates and bias removal were conducted. The net result was to reduce the estimated national net undercount by 0.1%. During that analysis, the Census Bureau also found and corrected a computer error that had incorrectly overstated the 2.1% undercount reported in July 1991 by .4%. The July 1991 estimate of undercount was reduced by 0.4% because of the computer error and an additional 0.1% because of modifications and bias removal resulting in a revised July 1992 national PES estimate of undercount of about 1.6%. The Committee obviously was satisfied that the decision to do a review of 104 blocks led to the discovery of the computer processing error. The Committee was also confident that outlier blocks had been more appropriately handled. As for bias removal, the Committee had mixed feelings. They were pleased that the review of only 104 blocks had removed a relatively large amount of bias. But, a significant amount still remained. The Committee could find no reliable or expedient method to remove the balance of the bias from the PES estimates.

The PES estimates of undercount are subject to biases. The Census Bureau had many evaluation programs to try to measure the level of these biases. At the U.S. level for total population, the estimated bias was negative 0.73% (or negative 0.35% if correlation bias is included) on an estimated

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[7]C.A.P.E. minutes 4-6-92 Attachment 5 and C.A.P.E. minutes 3-9-92 Attachment 1.

[8]Small blocks were often combined to form block clusters. This report uses blocks to refer to blocks and block clusters.

undercount of about 1.6%. If it was possible, it would be desirable to remove these biases before any potential adjustment since the PES estimate of undercount including the bias is an overstatement of the undercount the PES actually measured. At the U.S. level for total population, the bias could be removed. The Committee discussed the possibility of removing the bias at sub-national levels. The only alternative was a modeling approach. Considering the very small samples used to estimate the biases and the difficulties of modeling, the Committee was very reluctant to try to remove the bias by modeling. The Committee was concerned that more error would be introduced than the level of error we were trying to remove. A further complication was the concern that our estimate of correlation bias was conservative (see page 15).

As a partial solution to bias removal, the Committee recommended an examination of the blocks that had the potential to contribute the most to the PES estimate of undercount. If the bias could be removed from these blocks, the PES estimates would be improved. Of course, the results from this set of blocks could not be generalized to other blocks, so any solution would only be a partial removal of the bias. 104 blocks were included in the study. The study is referred to by various names since additional components to the study were added over time. This study was originally called OCR (Outlier Cluster Review) because of the intent to review the blocks that had outliers. When the study was expanded to a second purpose (removal of bias), the study was called Selective Cluster Review (SCR).

During the SCR, several types of problems were examined. The treatment of outliers was reexamined and corrected as necessary. Some blocks had unusual results and had very big effects on the estimated undercount, effects far larger than one block should be expected to have. These are called outliers. They are similar to unusual marks by judges in athletic competitions. For the July 1991 estimates of undercount, there was a method to defuse the effect of these outliers. Now, with more time, we were able to reexamine these outliers and to use better methods (when applicable) to dampen their effect.

In addition, during SCR, we looked for errors. An example is failure to search in the proper block. Searching for matching should have been done in the PES sample block as well as the ring of blocks surrounding the sample block. Generally, this was done. Sometimes errors were made and the matchers failed to look into the entire ring. Mistakes like these were corrected.

Matching, even in the proper set of blocks, is error prone. Errors in matching can lead to a bias in the PES estimates. During SCR, expert matchers tried to remove all matching error and therefore any bias in the PES estimate due to matching.

As a result of all aspects of SCR, the estimated national undercount was reduced by one-tenth of one percent (0.1%)[9]. The bias reduction only applied to the 104 blocks and could not be generalized to other blocks. The 104 blocks represent about 2% of the total sample while the 0.1% reduction on an estimated 0.7% total bias represents about a 14% reduction. Even though total bias could not be removed, these numbers show that the effort of redoing these 104 blocks was well worth it. The results of the SCR were also subtracted as appropriate from the total bias so that the resulting total bias only represents residual error for residual blocks (the total minus these 104 blocks).

During the SCR, Census Bureau staff discovered a computer processing error that affected the estimates of undercount released in July 1991. Codes that were attached to cases in clerical processing were incorrectly fed into the computer processing. Errors went in both directions (increasing and decreasing the estimated undercount), but the net result of the error was to reduce the estimated national undercount of 2.1% by 0.4%.

THIRD ISSUE: IS THE TOTAL ERROR MODEL COMPLETE?

Summary: With regard to total error, the Committee was completely satisfied that all components of bias were represented. The Committee was concerned about the accuracy of some of the estimates of bias and the high variance for some estimates of bias. The general conclusion was to use caution in evaluating the results of loss function analysis since the target numbers in that analysis were so dependent on the levels of estimated bias. The Committee felt that correlation bias should be a component of total error. However, there was concern about our method of estimating it and very serious concern about the method of allocating it to states, cities, etc. Since there did not appear to be methods or time to analyze this allocation issue further, the Committee requested that loss function analysis be done with and without correlation bias. There was a choice of various loss functions. Primarily, the Committee concentrated on loss functions that examined proportionate population shares and not population counts. In addition, in general, the Committee considered loss functions based on squared error not absolute error. Using hypothesis tests with 10% significance, loss function analysis excluding correlation bias does not support adjustment. Using hypothesis tests with 10% significance and including correlation bias, all but one of the loss function analyses favors adjustment at the state level when examining aggregate loss. The Committee tended to accept these findings keeping in mind the numerous caveats. As a result of some comments from the Panel of Experts, the Committee was concerned about whether the significance level they used for the hypothesis tests was appropriate.

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[9] "Post Census Rematching for the Outlier Cluster Review," Howard Hogan, undated; C.A.P.E. minutes 6-11-92 Attachment 1,2; C.A.P.E. minutes 4-20-92 Attachment 2.

THIRD ISSUE-PART A: TOTAL ERROR

The third major concern was whether the total error model contained all components of error and whether the components of error were adequately measured. In terms of whether all components of error were considered, two new components were added-- error due to cases done very late in the regular census (called late-late returns) and treatment of out-of-scope cases. The Committee felt completely confident that all components of error had been listed and considered.

The Committee could come to no agreement about the adequacy of the level of error measured for each of these components. There were concerns that matching error was determined by a dependent study and not an independent study. There were concerns that evaluation interviews used to determine the quality of the PES were conducted in February 1991, ten months after the census. There was concern that the estimate of only 13 fabrications in a sample of 150,000 seemed low compared to reasonable expectations. The Committee strongly agreed that the evaluation sample sizes were too small. The sampling error on several of the estimates of bias was extremely high.

In summary, with regard to total error, the Committee was satisfied that all components of error were represented. The Committee was concerned about the accuracy and variance of the estimates of bias, but there was really nothing that could be done. The general conclusion was to use caution in evaluating the results of loss function analysis since the target numbers in that analysis were so dependent on the levels of estimated bias. Attachment 6 contains estimates of the bias.

THIRD ISSUE-PART B: CORRELATION BIAS

The Committee spent a good deal of time discussing one aspect of total bias--correlation bias[10]. The Dual System Estimate (DSE) of total population produced by comparing the PES and the census is a biased estimate. It is biased because of matching error, etc. These components of bias are described immediately above.

The DSE can also be biased by correlation bias which has multiple components. The first is that the DSE assumes that a person's participation in the PES is not affected by his or her participation in the census (the causal independence assumption). Failure of this assumption can cause a bias. Generally lack of independence is not considered to be a big problem since the PES is conducted almost 4 months after the census and because of other controls introduced into the PES system.

The second component of correlation bias occurs because of variable capture probabilities within a post-stratum. The DSE does not require that the census and the PES have the same probability of counting people (called capture probability). But, the DSE does assume that within a post-stratum,

[10]Sometimes, model bias is used synonymously with correlation bias. In this report, correlation bias will be used.

everyone in the PES (or everyone in the census) has approximately the same capture probability. So, for example, a white male renter age 30-49 in rural areas of Louisiana is assumed to be just as likely to be counted as a white male renter age 30-49 in rural Mississippi, etc. Generally, if people within a post-stratum have differing capture probabilities, then the DSE is downwardly biased. That means the DSE underestimates the total population and in most cases would underestimate the undercount.

As a special case of variable capture probabilities, assume within a post-stratum there is a set of people with zero probability of being captured. These are often called the impossible to count or people missed in both the census and the PES. They are another component of correlation bias.

There are no direct estimates of either of these components of correlation bias, but an estimate for the total of both combined is obtained by comparing PES estimates to Demographic Analysis (DA) estimates. To estimate the level of correlation bias, the assumption is that sex ratios as determined by DA are accurate. Then, since in general the DSE estimates of males are lower than the DA estimates of males, there is a calculation of how many males would have to be added to the DSE to make the PES sex ratio equal to the DA sex ratio. These added males are an estimate of the level of correlation bias in the PES.

Actually, after estimating the extent of correlation bias, it is not added to the DSE of total population (just as other estimates of bias are not subtracted). Rather, the estimate of correlation bias is added to the total error model and is used to determine target numbers for loss function analysis.

The Committee was concerned about the combination of the two components of correlation bias, but there did not appear to be any alternative. The Panel of Experts expressed the same sentiment. They agreed that they were uncomfortable with the combination, but there does not seem to be an easy alternative. The Committee also was concerned that the PES measures more females than DA so that this method of estimating correlation bias should have had the effect of estimating a true population (for loss function analysis target numbers) that was bigger than total population in DA. However, the sum of the target populations did not equal the sum of the PES estimate and the level of correlation bias that was estimated to be added, as it should have. There was no time to examine these concerns further. Finally, there was concern that the method used for comparing the DSE with bias to DA understated the estimate of people missed due to correlation bias.

Mostly, however, the Committee was concerned with the method of allocating the correlation bias. Basically, the estimated missing people due to all types of correlation bias (all males) are allocated back to each post stratum proportional to the estimate of the number of males in the fourth cell of the DSE for the post-stratum. Further modeling is used to allocate the total error down to sub post-stratum levels.

The fourth cell in the DSE is an estimate of the number of people missed in both the PES and the census, but it is a biased estimate because of

correlation bias. It is not directly estimated, but an estimate can be obtained by subtraction. Some of the numbers used in the subtraction are sample estimates, therefore, they are subject to sampling variability. The fourth cell is expected to be the product of the true population times one minus the capture probability of the PES times one minus the capture probability for the census. In theory, this number cannot be negative. But, in practice, due to sample variability, matching error, etc., it can be estimated to be negative. When the estimate in the fourth cell is negative, no amount of the estimated people missed due to correlation bias is allocated to that post-stratum.

Both the Committee and the Panel of Experts were very concerned about the negative values in the fourth cell. The Panel of Experts suggested some methods to change the DSE process to avoid negative values. There was also considerable concern about using the fourth cell as the basis for allocation of the estimate of people missed due to correlation bias. In fact, other methods of allocation had been tried by the Census Bureau.

In summary, the Committee felt that correlation bias should be a component of total error. However, there was concern about our method of estimating it and very serious concern about the method of allocating it. Therefore, the Committee requested that loss function analysis be done with and without correlation bias. Each Committee member would then have to make some judgements about how to analyze the results.

THIRD ISSUE-PART C: LOSS FUNCTION ANALYSIS

Estimates of bias in the PES estimates of undercount are useful for interpreting the accuracy of the PES estimates. But, estimates of bias were also a key component in a summary analysis called loss function analysis. If truth were known, the census count and the adjusted base count could be compared to truth and an appropriate choice could be made. That of course is impossible. To approximate that comparison, the Census Bureau performed loss function analysis.

As a first step in loss function analysis, the true population is estimated. This estimate is called the target population. It is estimated by taking the PES estimate of population and modifying that estimate based on the estimates of error in the PES (the components of bias from the total error model). These estimates of bias are also subject to error, so you can't simply subtract bias from the PES estimate and assume that is the true population. A further complication is that estimates of bias are only available for 10 evaluation post-strata and target numbers are needed for every state, every county, every place, etc. A modeling system is used to allocate the bias from the 10 evaluation post-strata to sub-levels of geography. Once target numbers are calculated, there is a comparison to see whether census counts or adjusted counts are closer to the target numbers, which are assumed to be "truth." There is still an issue of what is the appropriate comparison between census, adjusted and target numbers. Should it be a simple difference? If so, how are pluses and minuses handled? Should it be the square of the differences, which avoids the problem of pluses and minuses but overemphasizes states (or other areas of

interest) with big differences. Or should it be some kind of weighted squared difference to avoid the over-effect of big states but to still reflect some of the differences in state size?

The Committee could come to no consensus on these difficult questions. Therefore, the Committee ran a variety of loss functions. These were a combination of:

-Various methods of allocating the bias to target numbers

-With and without correlation bias

-Absolute and squared error as well as variations of those to take account of variation in state (or other area of interest) size.

Even with these various loss functions, there was still another important question. Do you only look at the aggregate loss over all areas of interest (example, all states), or do you look at individual losses? This question was discussed with the Panel of Experts. The Panel felt that a simple count of "winners" and "losers" was inappropriate. One suggestion was to use a Pitman nearness measure. Time prevented that kind of analysis. In the absence of this measure, the Committee continued its original intent to examine aggregate loss. The Panel supported analysis of aggregate loss. In doing aggregate loss analysis, the Committee heeded the advice of the Panel of Experts who strongly recommended that loss function analysis be viewed only as a tool and not an exact decision mechanism.

In examining total loss over a set of areas (like all states), there was a question about whether the difference in aggregate loss between the census and adjusted base counts was a real difference or only due to random error. The Census Bureau had developed a statistical hypothesis test to try to answer that question. The Panel of Experts reviewed this work as well. In particular, the representative from Statistics Canada, who face the same problem, commented on the proposed hypothesis test. That expert warned that in effect we were not doing a standard hypothesis test, but rather we would be making a decision on which set of estimates to use based on the results of the test. If we continued with the standard test, we could be making mistakes about what level of significance to use. The most appropriate level might very well be larger than the 10% level of significance the Committee chose to use. Because of the lateness of the suggestion, time prevented us from completely examining the alternative hypothesis test approach. Hence, the Committee used, with caution, the significance level of standard hypothesis test results.

In summary, using hypothesis tests with 10% significance, loss function analysis excluding correlation bias does not support adjustment. Using hypothesis tests with 10% significance and including correlation bias, all but one of the loss function analyses favors adjustment at the state level

Various types of loss function analyses were used to compare the estimated scaled surrogate variables with the actual scaled surrogate variables. If the loss from the estimate was small you could assume that the post-stratification was good and the homogeneity assumption was holding. If the loss was large, there would be cause for concern. In addition, we could examine the number of places (states, cities, etc.) "improved" by adjustment. We could do this kind of analysis for surrogate variables since we know truth (the actual value of the surrogate variable).

Based on artificial population analysis, a first analysis showed similar homogeneity for the 1,392 design as well as the 357 design as well as for a design with only 2 strata. Further analysis showed two problems. One, the surrogate variables did not vary much by post-stratum. Since the assumption was that undercount did vary by post-stratum, there was concern about whether this set of surrogate variables was a good set. Another concern was that the analysis assumed no bias in the surrogate variable estimates and the PES estimates of undercount are biased. Therefore, there was an attempt to find additional surrogate variables as well as to introduce bias into the artificial population analysis. Artificial population analysis was rerun with various levels of constant bias added. The bias in the PES is not constant, but there was no adequate way to introduce variable bias into the artificial population analysis.

The original five surrogate variables were:

-Allocation Rate (The rate at which questions without answers on the census questionnaire had to be allocated a response)
-Percent of population covered by the mail census procedure
-Percent enumerated by mail (mail return rate)
-Substitution rate (The rate at which an entire person's census characteristics had to be created by a computer algorithm)
-Percent of housing units that were multi-unit

The three additional items were:

-Percent in poverty
-Percent unemployed
-A mobility statistic

For states and most large geographic areas, without any bias, artificial population analysis supported the homogeneity assumption assuming that the surrogate variables act like undercount. Once bias is introduced, however, the artificial population analysis shows less and less homogeneity. When bias is 25% of the estimate, the artificial population analysis indicates that there is serious concern that the homogeneity assumption does not hold. Currently, with correlation bias included, the bias in the PES estimate of undercount is 22%. Without correlation bias, the bias is 45% of the estimate. In summary, the Committee could only support the homogeneity assumption with some concern since the level of bias in the PES was close to the point where artificial population analysis shows the homogeneity assumption fails to hold.

when examining aggregate loss[11]. The Committee tended to accept these findings keeping in mind the numerous caveats mentioned above.

FOURTH ISSUE: DOES THE HOMOGENEITY ASSUMPTION HOLD?

Summary: Just as in July 1991, the results on whether the homogeneity assumption holds are inconclusive. The new research used to examine the homogeneity assumption (called artificial population analysis) indicates that the assumption does not hold when the bias in the estimate gets to be about 25% or higher. Since the bias in the Post Enumeration Survey (PES) estimate as currently measured is 22% to 45%, the Committee was concerned.

An integral part of the PES/DSE system is to assume that everyone within a post-stratum has approximately the same probability of being counted in the PES. This is often referred to as having the same "capture probability." As discussed in the part of the third issue having to do with correlation bias, failure of this assumption leads to a bias in the DSE. It is also important because of the way the sample is selected and used to make estimates for states, cities, etc. Very few political units, including states, have direct estimates from the PES. That is, the state (or city) was not defined as a universe, and then a sample drawn from it to represent it. Rather, the sample was drawn by region, type of area (large urban area, other urban, rural), race, etc. Therefore, a sample case in Tennessee (for example) also is used in the estimate of undercount for Florida, Georgia, etc. This approach assumes homogeneity. Recognizing the importance of this assumption, the Census Bureau designed a study (labeled P-12) to analyze whether the homogeneity assumption held. The results of P-12 were mixed or inconclusive.

Recognizing this, the Committee asked for more extensive research into the issue of homogeneity. The new research was called artificial population analysis. Basically, items felt to be correlated with undercount were selected. They were called surrogate variables. These items were then scaled to the level of the undercount. For example, the mail return rate of census questionnaires was one of these items. The mail return rate was about 65% while undercount was about 2%. The 65% was scaled to 2%. Then an area that had a mail return rate 5% greater than the national average, got a scaled mail return rate 5% above the national average.

We know mail return rates for every area in the country. Using the same process used to estimate DSE's we estimated this scaled mail return rate. In effect, the comparison of the estimated scaled mail return rate to the known scaled mail return rate substitutes for the comparison of estimated undercount with known undercount.

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[11]Summaries of loss function analysis results can be found in the following C.A.P.E. minutes: C.A.P.E. minutes 5-4-92 Attachment 4; C.A.P.E. minutes 6-1-92 Attachments 9-11; C.A.P.E. minutes 6-9-92 Attachment 5; C.A.P.E. minutes 7-6-92 Attachments 2,3.

FIFTH ISSUE: CAN THE INCONSISTENCY OF PES AND OTHER ESTIMATES BE EXPLAINED?

Summary: Even though there were some points of concern, the Committee is much more comfortable with the consistency of the revised Post Enumeration Survey (PES) estimates and Demographic Analysis (DA) than they were with the July 1991 PES estimates and DA. At the state level, the Committee generally felt the revised PES estimates met their face validity expectations with some individual state exceptions.

As part of the July 1991 decision whether to adjust the 1990 census, there were many concerns about the PES estimates compared to other estimates, mainly Demographic Analysis (DA). In particular, there was concern that the PES estimated a higher population than DA and the fact that the PES estimated about a million more woman than DA. In addition, PES estimates were compared to "best professional judgement" estimates, mainly to see if undercount was being measured by the PES in areas where undercount was expected. This check was called face validity. Face validity checks, though not rigorous, indicated some areas of concern in the PES estimates. For these reasons, the Committee requested additional research to try to investigate the apparent differences.

With regard to DA, the revised PES estimates are now much more consistent. Attachment 7 contains a table summarizing the comparisons. The PES estimate of total population was now lower than the DA estimate, a more expected outcome. The estimated undercount from the PES at the national level was 1.6% compared to an estimate of 1.8% from DA. The PES estimate of women remained higher than DA (an unexpected result), but the difference has been reduced from one million to about 400,000 and was within sampling error. As expected, the PES estimates for Blacks (and in particular, young Black males) were much lower than the DA estimates. This is a result of correlation bias. Even though expected, the Committee was concerned about this problem because there was no method to adequately add these people back into PES estimates.

With regard to face validity checks, there also was now more consistency. Almost all of the changes between the revised PES and the July 1991 PES estimates were in the direction expected by the Committee.

Since intercensal estimates of states are of such importance, the Committee asked for an analysis of revised PES state estimates compared with other information on states to see if there was consistency. Basically, there was consistency with a few exceptions. The exceptions were substantiated by an independent analysis done by one of the Panel of Experts. The Committee was concerned about these exceptions, therefore, they could only conclude that, on average, there would be an improvement using adjusted base counts for states.

In summary, even though there were some points of concern, the Committee was much more comfortable with the consistency of the revised PES estimates and DA than they were with the July 1991 PES estimates and DA. At the

state level, the Committee generally felt the revised PES estimates met their face validity expectations with some exceptions.

THE DECISION PROCESS

The decision process that led to the assessment of the Committee contained many parts. By far, the largest part was the year of extensive research and discussion between the Committee and the statistical staff at the Census Bureau. That part of the decision process is summarized in this report and recorded in far more detail in the minutes of the Committee. The decision process culminated with three key discussions. These were a day long meeting with the Panel of Experts, a decision discussion meeting with the Committee, and a decision discussion meeting with the Executive Staff of the Census Bureau. This section of the report summarizes those three meetings.

MEETING WITH PANEL OF EXPERTS:

The Census Bureau wanted to have outside review of the additional research it had done since July 1991. The Census Bureau wanted to include some Panel members who had not been too involved in the July 1991 decision in order to get a fresh look. In addition, the Census Bureau considered the outside expert advice it obtained in conjunction with the July 1991 decision. The Panel of Experts was sent materials in advance. In addition, each member was asked to chose two of five key areas on which to concentrate his or her attention. They were, of course, free to comment on any other issue, and as expected, they did. The meeting with the Panel was held on July 14, 1992. In order to place this summary of the Panel meeting in proper context, it is important to understand that the agenda for the Panel was restricted to major problems and that the Census Bureau specifically requested critical review.

In summary, the Panel made comments on the following key points:

1. The Panel thought the additional research done by the Census Bureau was extremely thorough and useful. The Panel took the time to commend the Census Bureau for this effort. They felt this research took the Census Bureau a long way towards being able to adjust at some time, even if not fully at the present.

2. The Panel thought the Census Bureau should only adjust for the geographic areas for which it was comfortable supporting the decision on technical grounds. Even then, there were bound to be some areas that were adversely affected by an adjustment or no adjustment, even though most were improved. The Panel urged the Census Bureau to examine the exceptions and see if they were "seriously" hurt. If so, the Panel recommended the Census Bureau reconsider an adjustment, even if it was technically defensible on average. For areas below the level for which there is technical backing to support adjustment, the decision about whether to adjust was more of a policy issue. The Panel did point out that errors in estimates of population change from the census year to the year of interest could be large, and perhaps larger than errors from adjustment, particularly for small areas.

3. The Panel cautioned that many of the statistical analyses used by the Census Bureau (Loss Function, Total Error Model, etc.) were just tools and not exact decision mechanisms.

4. The Panel would have felt more comfortable if the bias could be removed from the PES estimates before their use in any potential adjustment. The Census Bureau agreed with the concern of the Panel but knew of no adequate methodology to remove the bias by state, city, etc.

In addition, the Panel expressed some concerns:

1. The Panel was quite concerned about the negative values in the fourth cell. The Panel suggested ways to alter the DSE process in order to avoid the negative values.

2. While the Panel recognized the need to do something about correlation bias, they also recognized the potential problems caused by the inability to estimate the components of the bias separately. The Panel was also concerned about the problems with the proposed allocation scheme.

3. The Panel cautioned against loss function analysis where winners and losers were tallied up. Instead, if the intent is to examine individual losses/gains, the Panel recommended a Pitman nearness measure be used.

4. The Panel cautioned against too much reliance on the significance level in the hypothesis test the Census Bureau was planning to use and urged the Census Bureau to consider the implications of the approach to hypothesis testing being studied by Statistics Canada.

5. The Panel cautioned that artificial population analysis, like the P-12 study, was inconclusive about whether the homogeneity assumption held.

6. Some Panel members expressed concern about the extensive use of synthetic estimation in the adjustment process. (Examples: allocating undercount estimates to areas below which there were direct estimates, allocating bias, etc.)

Attachment 8 contains more detail from the meeting with the Panel of Experts.

C.A.P.E. DECISION DISCUSSION

In July 22, 1992, the Committee met with the Director to discuss each member's opinion about the accuracy of adjusted base counts for use in intercensal estimates. Prior to the main part of the meeting, one of the Committee members made a suggestion based on some analysis he had performed. He recommended the Committee consider a composite (50-50) estimate which would be the simple average of the census count and the adjusted base. The reasoning for the suggestion was that we have two estimates of population, both with error. Despite massive research, it is still inconclusive about which is better overall, for all levels of geography. Therefore, an average of the two might make sense. There is precedent for this kind of averaging in other Census Bureau work. Despite the lateness of the suggestion, the Committee members were asked to comment on the new proposal.

To help in the overall discussion about whether to adjust the base for intercensal estimates, there was a list of key uses and issues of intercensal estimates. Committee members were asked to tie their opinions about potential improved accuracy to the uses of the estimates and geographic level. The list is shown in Attchment 9.

Each Committee member expressed his or her opinion about whether or not the base for intercensal estimates should be adjusted. Though not unanimous, most of the Committee members felt that adjustment of the base should be done at the national and state level. For national and state uses of intercensal estimates, most Committee members felt adjusting the base would make the eventual estimates better on average. There was considerable concern about the states for which it was uncertain whether adjustment would make an improvement. Below the state level, the Committee could not make a recommendation about improvement from adjustment and supported the census counts. In terms of the issue of differential undercount and perception of fairness, the Committee strongly felt that adjustment at the state and national level would satisfy that element. The Committee could come to no agreement on whether an adjustment to the base would improve overall accuracy (accuracy at all levels of geography).

In addition to those summary findings, some other points were raised. These included:

1. No matter what the decision, the Census Bureau needed to examine the existing intercensal estimate challenge system[12]. Regardless of the Census Bureau decision on adjusting the base, a political jurisdiction who feels it was harmed by the Census Bureau decision can and will challenge.

2. Could we adopt the system used in Australia and perhaps Canada? The census is not adjusted, but intercensal estimates are.

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[12]Currently, there is a challenge system in place that allows jurisdictions to question their intercensal estimates. The evidence supplied by the jurisdiction is reviewed by Census Bureau staff. The staff selected are not involved in the intercensal estimate operations. If the challenge is accepted, the intercensal estimate is changed.

3. No matter what the decision on adjustment of the base for intercensal estimates, the reliance on the current DSE system should be examined. Some of the problems with it might never be solved. (See the final section of this report-FUTURE)

The meeting closed with a discussion of the 50-50 composite suggestion. Only a minority of the Committee favored the 50-50 composite as a first choice, although many of the Committee members thought the composite could be a possible acceptable alternative. During the discussion, several pros and cons of the suggestion were listed.

PROS:

1. It would produce estimates that are additive. A procedure following the Committee's general consensus of states and higher would not be additive.

2. It is a move in the right direction. (This can also be viewed as a con since it is only a partial correction, even at the national level.)

3. It dampens the effect of noise (bias, error, etc.) in the PES and census.

4. At the substate level, the composite is probably better than the full adjustment.

5. Even with an adjustment, there would still be a benefit for respondents to take the effort to be counted in the future, because any potential adjustment based on the 50-50 composite method would only be a partial correction.

6. Analysis done by one Committee member showed that hypothesis test results at the state level were much more favorable to the composite estimate than to the full adjustment, even without including correlation bias.

CONS:

1. It is not as good an estimate at the national level as at the adjusted base, but it is probably a better estimate than an estimate with a fully adjusted base for substate levels. Substate improvement is at the expense of state and national estimates.

2. The two estimates (the DSE and the census) are not independent.

3. It was too late to fully examine the technical merits of the composite.

4. It is only half a solution to differential undercount.

5. It looks like a compromise or even like a "cop-out."

6. Why 50-50? 60-40 or some other combination might be better, and there is no way to know.

EXECUTIVE STAFF DECISION DISCUSSION

Following the Committee discussion, the Executive Staff of the Census Bureau met to give their views. Basically, the Executive Staff concentrated on policy concerns since the Committee had discussed the technical issues. The Executive Staff did not make a recommendation on whether or not to adjust the base for intercensal estimates, but rather raised some issues. The following points were raised at the Executive Staff meeting:

1. It is very important to make sure that people understand that the decision on whether to adjust the base for intercensal estimates is different from the decision whether to adjust the full census. Even if there is a decision to adjust the base for intercensal estimates, there is no intention to adjust the 1990 census because research shows insufficient technical justification.

2. The Census Bureau should do what it thinks it can support based on statistical science.

3. The Census Bureau should consider the advice of users, but should not be forced into a decision because of pressure from users.

4. The Census Bureau should consider the effect of the decision on the public and in particular on its respondents.

5. The 50-50 composite suggestion looks arbitrary.

6. The adjustment issue is so complex, there is probably no single intellectually coherent solution. Most likely, none of the available options is fully consistent with the current research. Also, no matter what the decision, some people will not be satisfied.

On balance, the Executive Staff felt very strongly that there should be technical support for the eventual decision. The Executive Staff recognized that many issues, some of them nontechnical, would need to be balanced in making the final choice. Even so, it is very important for the Census Bureau to be confident about the technical support for the decision it chooses. Not only would the Census Bureau have to defend any decision, but the professionalism of the agency can be questioned if the Census Bureau cannot stand behind its decision on statistical grounds.

FUTURE

Regardless of the choice about whether to adjust the base for intercensal estimates, there were several concerns about the future raised during the final discussions. Generally, it was felt that the problem of differential coverage will continue in the future. Therefore, there were strong recommendations that research in the area of differential undercount should continue as input into the design of the year 2000 census. In particular, the following points were made.

1. The Census Bureau should examine alternatives to the Dual System Estimation process used in 1990. Some of the problems of that approach may continue despite best efforts, meaning that a full adjustment based on such a system might never be possible.

2. Even though it might not be statistically efficient, coverage measurement surveys in the future should have samples and estimation systems that produce direct estimates for key political areas (like states).

3. The Committee process was very successful and could be a good model for the future. Examples of the benefits included sufficient time, timely senior staff input, clear goals, etc.

4. Any proposed undercount estimation/adjustment scheme must be simple. It must be simple enough so the technical aspects can be evaluated and it must be simple enough so it can be explained, even to those without extensive statistical knowledge.

5. Methods of incorporating coverage measurement into the census process should be examined.

6. A system that produces one set of counts rather than unadjusted and adjusted counts is definitely preferred.

Attachment 2

LIST OF MEMBERS OF PANEL OF EXPERTS WHO ATTENDED THE MEETING WITH THE CENSUS BUREAU

Mr. Don Royce
Senior Methodologist
Statistics Canada Social Survey
Methods Division

Mr. Wesley Schaible
Associate Commissioner
Office of Research and Evaluation
Bureau of Labor Statistics

Dr. Fritz Scheuren
Director, Statistics of Income
Division
Internal Revenue Service

Dr. Bruce Spencer
Department Head
Statistics Department
Northwestern University

Dr. Theresa A. Sullivan
Chair and Professor for the
Department of Sociology
University of Texas at Austin

Dr. James Trussell
Associate Dean of Woodrow Wilson
School and Director of the
Office of Research
Princeton University

Mr. Joseph Waksberg
Chairman of the Board
WESTAT

Dr. Tommy Wright
Research Staff Member
Oak Ridge National Laboratory

Dr. Donald Ylvisaker
Director for the Division of
Statistics, Mathematics
Department
University of California

Dr. Alan Zaslavsky
Assistant Professor
Statistics Department
Harvard University

Attachment 1: List of

COMMITTEE ON ADJUSTMENT OF POSTCENSAL ESTIMATES (CAPE)

MEMBERS

Dr. Barbara Everitt Bryant	Director
Mr. C. L. Kincannon	Deputy Director
Mr. William Butz	Associate Director
Mr. Charles Jones	Associate Director
Dr. Robert Tortora	Associate Director
Mr. Peter Bounpane	Assistant Director
Ms. Paula Schneider	Chief, Population Division
Mr. John Thompson	Chief, Decennial Statistical Studies Division
Dr. Robert Fay	Senior Mathematical Statistician
Dr. Howard Hogan	Statistical Research Division
Dr. John Long	Population Division
Dr. Mary Mulry	Decennial Statistical Studies Division
Dr. Gregory Robinson	Population Division
Mr. Michael Batutis	Population Division
Mr. David Whitford	Decennial Management Division

ATTACHMENT 3A: PES ESTIMATES OF UNDERCOUNT BY RACE AND SEX
JULY, 1992

Table of PES Estimates for Selected Race/Origin/Sex Groups

		JULY, 1991		JANUARY, 1992		JULY, 1992	
		Original PES		Revised PES		357 PES	
Race/Hispanic/Sex	Census	Estimate	Std. Error	Estimate	Std. Error	Estimate	Std. Error
Total	248709873	253979141	472946.472	252959473	461310.829	252712821	489754.595
Male	121239418	124249093	245445.426	123648997	238663.637	123623143	273518.304
Female	127470455	129730048	246737.086	129310476	241383.831	129089678	254912.175
Black	29986060	31505838	95559.460	31295058	93635.743	31377094	167925.028
Male	14170151	14974382	49052.934	14857391	47952.832	14900868	82912.806
Female	15815909	16531456	52914.183	16437667	51898.230	16476225	96609.126
Non-Black	218723813	222473303	424675.175	221664415	414933.642	221335728	453076.281
Male	107069267	109274711	222153.799	108791606	216160.510	108722274	249791.220
Female	111654546	113198592	220800.163	112872809	216539.374	112613453	239423.186
Asian or Pacific Islander	7273662	7504906	36264.289	7485602	36157.768	7447371	102828.516
Male	3558038	3688436	19879.800	3674532	19946.424	3684895	60817.829
Female	3715624	3816470	18469.115	3811069	18435.209	3762476	57240.421
American Indian	1878285	1976890	21726.014	1970537	21588.870	2051976	26259.820
Male	926056	980874	11312.232	977738	11302.046	1020059	13248.050
Female	952229	996016	10612.782	992799	10467.531	1031917	13252.478
Hispanic	22354059	23590274	103458.969	23471101	102033.476	23521183	180090.423
Male	11388059	12086513	57498.441	12008888	56356.003	12052241	114778.144
Female	10966000	11503761	52275.143	11462214	52082.441	11468942	84750.443

Table of Undercount Rates for Selected Race/Origin/Sex Groups

		Original PES		Revised PES		357 PES	
Race/Hispanic/Sex	Census	UC Rt	SE(UC Rt)	UC Rt	SE(UC Rt)	UC Rt	SE(UC Rt)
Total	248709873	2.075	0.182	1.680	0.179	1.584	0.191
Male	121239418	2.422	0.193	1.949	0.189	1.928	0.217
Female	127470455	1.742	0.187	1.423	0.184	1.254	0.195
Black	29986060	4.824	0.289	4.183	0.287	4.433	0.511
Male	14170151	5.371	0.310	4.626	0.308	4.904	0.529
Female	15815909	4.328	0.306	3.783	0.304	4.008	0.563
Non-Black	218723813	1.685	0.188	1.327	0.185	1.180	0.202
Male	107069267	2.018	0.199	1.583	0.196	1.520	0.226
Female	111654546	1.364	0.192	1.079	0.190	0.852	0.211
Asian or Pacific Islander	7273662	3.081	0.468	2.831	0.469	2.332	1.349
Male	3558038	3.535	0.520	3.170	0.526	3.443	1.594
Female	3715624	2.642	0.471	2.504	0.472	1.245	1.502
American Indian	1878285	4.988	1.044	4.682	1.044	4.520	1.222
Male	926056	5.589	1.089	5.286	1.095	5.183	1.231
Female	952229	4.396	1.019	4.086	1.011	3.864	1.235
Hispanic	22354059	5.240	0.436	4.759	0.414	4.942	0.728
Male	11388059	5.779	0.448	5.170	0.445	5.511	0.900
Female	10966000	4.675	0.433	4.329	0.435	4.385	0.707

Note: Due to the nature of the data used to compute these counts for the 357 poststrata PES design, the American Indian counts both Table 1 and Table 2 above include Eskimos and Aleuts for the 357 PES. The census count used for this group was 1,959,234. census counts used to compute the original PES counts and the revised PES counts are shown in the tables.

ATTACHMENT 3B: REVISED PES ESTIMATES OF UNDERCOUNT BY AGE-RACE-SEX
JULY, 1992

Table 1 PES Estimates for Selected Race/Origin/Sex Groups for the 0 to 17 Age Group
(357 Poststrata PES Design)

JULY, 1992

Race/Origin/Sex Group	Census	357 PES Estimate	Std. Error	Undercount Rate	Standard Error
Total	63604432	65695382	191195.568	3.183	0.282
Male	32584278	33649795	97743.288	3.166	0.281
Female	31020154	32045587	93459.542	3.200	0.282
Black	9584415	10311019	95917.245	7.047	0.845
Male	4849497	5215800	48390.736	7.023	0.863
Female	4734918	5095218	47527.287	7.071	0.867
Non-Black	54020017	55384363	172047.616	2.463	0.303
Male	27734781	28433994	88325.776	2.459	0.303
Female	26285236	26950369	83724.989	2.468	0.303
Asian or Pacific Islander	2083387	2152880	46537.029	3.228	2.092
Male	1063264	1099038	23792.412	3.255	2.094
Female	1020123	1053842	22745.817	3.200	2.089
American Indian, Eskimo, or Aleut	696967	742996	12481.466	6.195	1.576
Male	354875	378205	6315.004	6.169	1.567
Female	342092	364791	6166.491	6.222	1.585
Hispanic	7757500	8164834	77292.661	4.989	0.899
Male	3971164	4179630	39551.088	4.988	0.899
Female	3786336	3985204	37742.086	4.990	0.900

Table 2 PES Estimates for Selected Race/Origin/Sex Groups for the 18 to 29 Age Group
(357 Poststrata PES Design)

JULY, 1992

Race/Origin/Sex Group	Census	357 PES Estimate	Std. Error	Undercount Rate	Standard Error
Total	48050811	49530134	192936.681	2.987	0.378
Male	24312055	25105216	129869.843	3.159	0.501
Female	23738756	24424918	113605.768	2.809	0.452
Black	6419397	6727151	60784.870	4.575	0.862
Male	3110320	3225832	38478.198	3.581	1.150
Female	3309077	3501319	41388.086	5.491	1.117
Non-Black	41631414	42802983	174778.637	2.737	0.397
Male	21201735	21879384	121313.350	3.097	0.537
Female	20429679	20923599	102738.356	2.361	0.479
Asian or Pacific Islander	1581231	1686549	47226.618	6.243	2.625
Male	802067	893983	35821.446	10.282	3.595
Female	779164	792566	31415.861	1.691	3.897
American Indian, Eskimo, or Aleut	414071	441408	7298.043	6.193	1.551
Male	210263	224725	4083.000	6.435	1.700
Female	203808	216683	3782.708	5.942	1.642
Hispanic	5525130	5903999	83906.191	6.417	1.330
Male	2984897	3207779	67903.944	6.948	1.970
Female	2540233	2696220	31412.026	5.785	1.098

ATTACHMENT 3B: REVISED PES ESTIMATES OF UNDERCOUNT BY AGE-RACE-SEX
JULY, 1992

Table 3 PES Estimates for Selected Race/Origin/Sex Groups for the 30 to 49 Age Group
(357 Poststrata PES Design)

Race/Origin/Sex Group	Census	July, 1992 357 PES Estimate	Std. Error	Undercount Rate	Standard Error
Total	73314363	74327349	178380.748	1.363	0.237
Male	36281757	36965692	114336.225	1.850	0.304
Female	37032606	37361657	94874.030	0.881	0.252
Black	8300318	8705762	57437.333	4.657	0.629
Male	3841762	4099633	38014.164	6.290	0.869
Female	4458556	4606129	31219.727	3.204	0.656
Non-Black	65014045	65621588	168451.681	0.926	0.254
Male	32439995	32866059	106016.209	1.296	0.318
Female	32574050	32755528	90532.426	0.554	0.275
Asian or Pacific Islander	2373785	2396349	35297.064	0.942	1.459
Male	1128527	1127567	23875.089	-0.085	2.119
Female	1245258	1268782	19001.048	1.854	1.470
American Indian, Eskimo, or Aleut	543821	560400	5746.845	2.958	0.995
Male	263525	276134	2812.700	4.566	0.972
Female	280296	284266	3232.422	1.397	1.121
Hispanic	5961207	6271153	61500.742	4.942	0.932
Male	3029043	3225477	40130.964	6.090	1.168
Female	2932164	3045676	33430.513	3.727	1.057

Table 4 PES Estimates for Selected Race/Origin/Sex Groups for the 50 and Older Age Group
(357 Poststrata PES Design)

Race/Origin/Sex Group	Census	July, 1992 357 PES Estimate	Std. Error	Undercount Rate	Standard Error
Total	63740267	63159956	164191.819	-0.919	0.262
Male	28061328	27902440	91400.020	-0.569	0.329
Female	35678939	35257516	98575.338	-1.195	0.283
Black	5481930	5433162	34874.194	-0.866	0.624
Male	2368572	2339603	22227.003	-0.380	0.946
Female	3313358	3273559	19516.989	-1.216	0.603
Non-Black	58058337	57526794	159823.396	-0.924	0.280
Male	25692756	25542837	89232.535	-0.587	0.351
Female	32365581	31983957	96067.229	-1.193	0.304
Asian or Pacific Islander	1235259	1211593	20586.691	-1.953	1.732
Male	564180	564307	7192.919	0.023	1.274
Female	671079	647286	18017.833	-3.676	2.886
American Indian, Eskimo, or Aleut	304375	307172	3091.413	0.911	0.997
Male	138523	140996	1832.019	1.754	1.277
Female	165852	166176	1554.022	0.195	0.933
Hispanic	3110222	3181198	45726.253	2.231	1.405
Male	1402955	1439356	27996.289	2.529	1.896
Female	1707267	1741842	32679.612	1.985	1.839

JULY, 1994

State Level Estimates and Estimated Undercount Rates

State	1990 Census	Original PES July 1991 Estimate	UC Rt	SE(UCRt)	357 PES July 1992 Estimate	UC Rt	SE(UCRt)
01 Alabama	4040587	4146133	2.546	0.383	4115119	1.763	0.316
02 Alaska	550043	560727	1.905	0.437	561255	1.998	0.364
04 Arizona	3665228	3790186	3.297	0.466	3754297	2.373	0.455
05 Arkansas	2350725	2402925	2.172	0.417	2392291	1.738	0.337
06 California	29760021	30888075	3.652	0.420	30594537	2.728	0.379
08 Colorado	3294394	3376099	2.420	0.470	3363357	2.050	0.383
09 Connecticut	3287116	3305658	0.561	0.556	3308309	0.641	0.406
10 Delaware	666168	686661	2.984	0.437	678372	1.799	0.377
11 District of Columbia	606900	638747	4.986	0.517	628309	3.407	0.901
12 Florida	12937926	13277708	2.559	0.384	13196855	1.962	0.390
13 Georgia	6478216	6632561	2.327	0.368	6618829	2.124	0.331
15 Hawaii	1108229	1134417	2.480	0.537	1129162	1.854	0.808
16 Idaho	1006749	1035271	2.753	0.501	1029213	2.183	0.434
17 Illinois	11430602	11592305	1.395	0.352	11544433	0.986	0.358
18 Indiana	5544159	5585918	0.748	0.370	5572239	0.504	0.399
19 Iowa	2776755	2807238	1.086	0.455	2788378	0.417	0.404
20 Kansas	2477574	2506427	1.151	0.353	2494762	0.689	0.350
21 Kentucky	3685296	3767824	2.190	0.418	3745662	1.612	0.370
22 Louisiana	4219973	4332297	2.593	0.346	4313516	2.169	0.339
23 Maine	1227928	1240076	0.980	0.611	1237124	0.743	0.562
24 Maryland	4781468	4868990	1.796	0.444	4882324	2.066	0.418
25 Massachusetts	6016425	6039315	0.379	0.548	6045161	0.475	0.485
26 Michigan	9295297	9403964	1.156	0.368	9361331	0.705	0.371
27 Minnesota	4375099	4419186	0.998	0.355	4394680	0.446	0.380
28 Mississippi	2573216	2632412	2.249	0.397	2628899	2.118	0.434
29 Missouri	5117073	5184411	1.299	0.352	5149052	0.621	0.363
30 Montana	799065	822092	2.801	0.514	818305	2.351	0.492
31 Nebraska	1578385	1594994	1.035	0.380	1588698	0.649	0.366
32 Nevada	1201833	1231620	2.419	0.469	1230675	2.344	0.383
33 New Hampshire	1109252	1115972	0.602	0.530	1110610	0.837	0.546
34 New Jersey	7730188	7836174	1.353	0.498	7776411	0.569	0.612
35 New Mexico	1515069	1586489	4.502	0.514	1563123	3.074	0.505
36 New York	17990455	18304414	1.715	0.451	18261955	1.487	0.581
37 North Carolina	6628637	6814693	2.730	0.363	6753175	1.844	0.347
38 North Dakota	638800	647837	1.395	0.463	643042	0.660	0.502
39 Ohio	10847115	10933430	0.790	0.354	10921925	0.685	0.360
40 Oklahoma	3145585	3213646	2.118	0.386	3202730	1.784	0.338
41 Oregon	2842321	2898058	1.923	0.445	2896147	1.859	0.401
42 Pennsylvania	11881643	11956891	0.629	0.477	11916630	0.294	0.483
44 Rhode Island	1003464	1006150	0.267	0.556	1004811	0.134	0.590
45 South Carolina	3486703	3589808	2.872	0.407	3558918	2.029	0.362
46 South Dakota	696004	706954	1.549	0.494	702878	0.978	0.548
47 Tennessee	4877185	5012173	2.693	0.386	4963686	1.743	0.344
48 Texas	16986510	17550747	3.215	0.378	17469248	2.763	0.395
49 Utah	1722850	1757423	1.967	0.537	1753121	1.727	0.497
50 Vermont	562758	570651	1.383	0.709	569091	1.113	0.765
51 Virginia	6187358	6352705	2.603	0.351	6313620	2.000	0.353
53 Washington	4866692	4986607	2.405	0.433	4957987	1.841	0.437
54 West Virginia	1793477	1842267	2.648	0.436	1819004	1.403	0.430
55 Wisconsin	4891769	4923844	0.651	0.369	4921997	0.614	0.397
56 Wyoming	453588	466067	2.678	0.481	463569	2.153	0.416
United States Totals	248709873	253979140	2.075	0.182	252712822	1.584	0.191

UC Rt — Undercount Rate as estimated from the PES.

SE(UCRt) — The sampling error of the estimated undercount rate.

ATTACHMENT 5: THE 357 POSTSTRATUM DESIGN
FOR POSTCENSAL ESTIMATION--JULY, 1992

The following page defines the 51 poststrata groups and seven age sex groups used to poststratify the Post-Enumeration Survey (PES). These were used to develop dual system estimates for use in the postcensal estimation program. Cross classification of the 51 poststrata groups with the seven age sex groups yields 357 poststrata cells for which dual system estimates have been developed.

The following rough definitions are used:

"Urbanized area 250,000+" means that the PES sample block was part of an Urbanized Area the total population size of which was greater than 250,000.

"Other-urban" refers to all PES blocks that were part of an Urbanized Area not greater than 250,000 or were part of an other urban place.

"Non-urban" means all rural areas and other areas not falling into the above categories.

"Owner/Non-Owner" is determined from the tenure variable on the PES questionnaire. All persons in group quarters are non-owners by definition.

"Asian and Pacific Islander" refers to all people who report themselves as being Asian and Pacific Islander. This group is not restricted to the West or Mid Atlantic as it was in the July, 1991 estimates. Asians and Pacific Islanders of Hispanic origin are included here.

"American Indians on Reservations" include American Indians living on reservations and Tribal Trust Lands. All other concepts (Black, Non-black Hispanic, etc.) are defined as in the census.

"North East" states are Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, New Jersey, New York, and Pennsylvania.

"South" states include Delaware, District of Columbia, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Kentucky, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, and Texas.

"Midwest" states are Illinois, Indiana, Michigan, Ohio, Wisconsin, Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota.

"West" states include Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Wyoming, Alaska, California, Hawaii, Oregon, and Washington.

Revised Post-Stratification for Postcensal Estimation

Post-Strata Groups	North East	Mid West	South	West
Non-Hispanic White & Other				
Owner				
Urbanized Areas 250,000 +	1	2	3	4
Other Urban	5	6	7	8
Non-Urban	9	10	11	12
Non-owner				
Urbanized Areas 250,000 +	13	14	15	16
Other Urban	17	18	19	20
Non-Urban	21	22	23	24
Black				
Owner				
Urbanized Areas 250,000 +	25	26	27	28
Other Urban	29			
Non-Urban	30			
Non-owner				
Urbanized Areas 250,000 +	31	32	33	34
Other Urban	35			
Non-Urban	36			
Non-Black Hispanic				
Owner				
Urbanized Areas 250,000 +	37	38	39	40
Other Urban	41			
Non-Urban	42			
Non-owner				
Urbanized Areas 250,000 +	43	44	45	46
Other Urban	47			
Non-Urban	48			
Asian & Pacific Islander				
Owner	49			
Non-owner	50			
American Indians on Reservations	51			

Age-Sex Groups

	Males	Females
0 to 17		a
18 to 29	b	d
30 to 49	c	e
50 and Over	f	g

ATTACHMENT 6:

Total Error of the Net Undercount Rate Assuming No Correlation Bias and Synthetic Estimation of Net Component Errors

JULY, 1992

Evaluation Poststratum	$\hat{U}$*	$\hat{B}(\hat{U})$	St. Dev. $\hat{B}(\hat{U})$	Total St. Dev.	95% Interval
Non-Hispanic White and Other, Owner					
Urban 250k+	-0.50	0.32	0.99	1.06	(-2.95, 1.31)
Other Urban	0.11	0.21	0.25	0.34	(-0.79, 0.59)
Non-Urban	-0.22	0.86	0.87	1.00	(-3.07, 0.92)
Non-Hispanic White and Other, Non-Owner					
Urban 250k+	2.33	-0.06	0.60	0.96	(0.47, 4.32)
Other Urban	2.92	1.70	0.82	1.13	(-1.03, 3.47)
Non-Urban	5.30	0.47	0.74	1.35	(2.13, 7.53)
Black, Non-Black Hispanic, Asian and Pacific Islander, Urban 250k+					
Owner	1.33	0.84	0.44	0.67	(-0.86, 1.82)
Non-Owner	7.13	0.80	0.48	0.94	(4.44, 8.21)
Black, Non-Black Hispanic, Asian and Pacific Islander, Other Urban & Non-Urban					
Owner	2.07	2.38	0.90	1.25	(-2.81, 2.18)
Non-Owner	6.44	3.98	0.94	1.63	(-0.80, 5.72)
National	1.61	0.73	0.30	0.36	(0.17, 1.60)

*Based on PES population only.

Assuming Synthetic Estimation of Net Component Errors

Evaluation Poststratum	$\hat{U}$*	$\hat{B}(\hat{U})$	St. Dev. $\hat{B}(\hat{U})$	Total St. Dev.	95% Interval
Non-Hispanic White and Other, Owner					
Urban 250k+	-0.50	0.31	0.99	1.06	(-2.94, 1.32)
Other Urban	0.11	0.18	0.25	0.34	(-0.76, 0.62)
Non-Urban	-0.22	0.81	0.88	1.00	(-3.03, 0.97)
Non-Hispanic White and Other, Non-Owner					
Urban 250k+	2.33	-0.68	0.76	1.07	(0.87, 5.16)
Other Urban	2.92	1.54	0.84	1.14	(-0.90, 3.65)
Non-Urban	5.30	-0.12	0.90	1.45	(2.52, 8.31)
Black, Non-Black Hispanic, Asian and Pacific Islander, Urban 250k+					
Owner	1.33	0.80	0.45	0.68	(-0.83, [illegible])
Non-Owner	7.13	-1.37	1.30	1.54	(5.42, 11.56)
Black, Non-Black Hispanic, Asian and Pacific Islander, Other Urban & Non-Urban					
Owner	2.07	2.23	0.95	1.28	(-2.71, 2.41)
Non-Owner	6.44	3.55	1.05	1.70	(-0.50, 6.28)
National	1.61	0.35	0.33	0.38	(0.50, 2.03)

*Based on PES population only.

ATTACHMENT 7: COMPARISON OF REVISED PES ESTIMATES VERSUS DA--JULY 1992

Comparison of the Census, Post Enumeration Survey (PES) and Demographic Analysis (DA) Estimates of Population and Percent Net Undercount: 1990

(A positive difference means that the demographic estimate is higher than the PES estimate; a negative difference means that the demographic estimate is lower).

Race, Sex, Age	PES Net Undercount				DA Net Undercount		Difference in DA and PES Percent Net Undercount	
	Original Estimates July 1991		Revised Estimates July 1992					
	Amount (1)	Percent (2)	Amount (3)	Percent (4)	Amount (5)	Percent (6)	Original PES 7=6-2	357 PES 8=6-4
TOTAL	5,269,267	2.07	4,002,947	1.58	4,683,913	1.85	-0.23	0.26
Male	3,009,674	2.42	2,383,724	1.93	3,480,216	2.79	0.37	0.86
Female	2,259,593	1.74	1,619,223	1.25	1,203,697	0.94	-0.81	-0.32
BLACK	1,519,776	4.82	1,391,033	4.43	1,836,272	5.68	0.86	1.25
Male	804,233	5.37	730,717	4.90	1,338,380	8.49	3.12	3.59
Female	715,543	4.33	660,316	4.01	497,892	3.01	-1.32	-1.00
NONBLACK	3,749,491	1.69	2,611,914	1.18	2,847,641	1.29	-0.40	0.11
Male	2,205,441	2.02	1,653,007	1.52	2,141;836	1.97	-0.05	0.45
Female	1,544,050	1.36	958,907	0.85	705,805	0.63	-0.73	-0.22

NOTE: Original PES estimates are the July 15, 1991 estimates based on 1392 poststrata and incorporate smoothing; revised PES estimates are the July 1992 estimates based on 357 poststrata, all PES revisions since July 1991, and no smoothing.

ATTACHMENT 8: THE MEETING WITH THE PANEL OF EXPERTS

hile the Panel came to no consensus about whether the base for intercensal estimates hould be adjusted, the Panel was extremely impressed with the extensive research done by he Census Bureau. The concerns raised by the Panel were not criticisms of the Census ureau's work, but rather were indications of the difficulty and complexity of the overal ssue as well as the fact that some of these problems may never be fully solved. The anel concentrated its discussion on five areas as requested by the Census Bureau. These ere the most difficult problem areas that Census Bureau statisticians had not been able o fully resolve. Not only was the discussion limited to difficult problem areas, but as equested by the Census Bureau, the Panel members were critical and raised concerns. eading just a list of concerns can lead to an unbalanced view of what Panel members felt bout the adjustment issue in general. Therefore, the parameters under which the Panel perated should be kept in mind in order to put the following more detailed discussion of anel concerns in proper perspective.

FIRST AREA: TOTAL ERROR MODEL INCLUDING CORRELATION BIAS

During this discussion the Panel mentioned that it didn't see an easy alternative to the current method of treating correlation bias, but Panel members were uneasy about certain aspects of it. For one, the Panel was quite concerned about the negative fourth cells. In addition, there was concern that we weren't estimating the level of the bias properly. In particular, one Panel member felt we should consider comparing the unbiased PES estimates (taking out the bias) to DA in order to estimate the level of correlation bias. Another panel member expressed serious concern that the Census Bureau assumed all correlation bias was male. This panel member pointed to his research to show that there also are problems of differing capture probabilities in the female population. Currently, the Census Bureau's treatment of correlation bias assumes that doesn't occur. It was also during this discussion that most of the Panel recommended that the Census Bureau try to remov the bias from the PES estimates before making any adjustment. Another panel membe went through the PES/DSE process in some detail with an emphasis on whether or not it was understandable to an average person and whether or not it was creditable. He pointed out several parts of the process that were of concern to him particularly the extensive use of synthetic estimation. He also cautioned that if new research between July 1991 and the present uncovered new findings, then he wouldn't be surprised to see additional research after July 1992 turn up new results and new estimates of undercount. Another Panel member strongly desired that total error be broken out separately by persons of Hispanic ethnicity. This section of the meeting concluded with a discussion of the problem of inconsistent racé classification between systems (example: PES and DA), which the Panel felt was a significant issue that needed further research.

SECOND AREA: LOSS FUNCTION ANALYSIS

This part of the meeting was quite technical, with a review of the various loss functions under consideration. Most of the Panel advised against counting up winners and losers (For example: states that gained or lost in a loss function analysis done on states). Instead one Panel member recommended a Pitman nearness measure which he uses when faced with this kind of problem. Then, there was a discussion of aggregate loss. The Panel pointed out that decisions on aggregate loss may make sense statistically, but that the "losing" political areas might have

a problem. Also, it was during this discussion that the Panel made a recommendation that the results of loss function analysis be used with caution. Loss function analysis is a tool, depends on personal standards of judgement, and is not an exact decision mechanism. It also was during this discussion that the Panel reiterated a theme they raised in the first topic. Panel members were concerned that there is too much confusion about the undercount/adjustment issue by the "person on the street." The Panel recommended that the Census Bureau try to alleviate that in the future. Finally, there was a discussion about the large number of states for which it doesn't matter much whether or not there is an adjustment. Both sides of the case were discussed. If so, why bother to adjust?; or if so, adjust all states in order to correct a problem in a few states and the error in most other states won't be too bad. This discussion ended with another theme heard often. The total error model is a good tool to try alternative assumptions. It is not an exact decision mechanism.

THIRD AREA: HYPOTHESIS TESTS

The Census Bureau had recognized the limitations of loss function analysis. In particular, once you had two losses to compare, was the difference between them a "real" difference, or could it be attributable solely to chance since these were sample estimates. To help answer that question, the Census Bureau planned some statistical hypothesis tests. The Panel was asked to review the Census Bureau plans.

This part of the discussion was led by the expert from Statistics Canada, since Statistics Canada was faced with a similar problem. The discussion was extremely technical. Before getting to the issue of the hypothesis test, the Panel member cautioned that several key questions had to be answered, and they all had an effect on the eventual hypothesis test. These questions included:

What is the quantity of interest? (Total population, population share, etc.)

Which Loss Function would be used?

How accurate are your target numbers?

How do you account for error in estimating the target numbers?

The bulk of the discussion centered about the technical performance of the hypothesis test assuming the above questions had been answered satisfactorily. Basically, the Panel pointed out that we were not simply dealing with a standard hypothesis test. Instead, we planned to use one of the set of estimates based on the results of the hypothesis test. Under those conditions, a model could be developed to examine the true level of risk for the hypothesis test. At present, Statistics Canada had developed such an approach. The Panel member urged the Census Bureau to take this finding into account in the significance level of the Census Bureau's proposed hypothesis test. During this part of the discussion, this panel member warned that if there is a high positive bias in the estimate of undercount, then the hypothesis test can be misleading, and in fact, adjustment can be very problematic when the estimate of undercount has a large bias. Also, it was pointed out that Statistics Canada feels its estimates of undercount at the province level

are adequate for use in adjusting intercensal estimates, but not at sub-province level. Whether or not to adjust below the Province level will be more a policy call than a technical decision. Finally, it was during this part of the meeting that the Panel repeated its recommendation that if estimates of bias are good enough for use in determining target numbers for loss function analysis, then they should be removed from the PES estimates before any potential adjustment.

FOURTH AREA: ARTIFICIAL POPULATION ANALYSIS

Because of the way the PES/DSE system operates, the homogeneity assumption is a key one. In conjunction with the July 1991 decision, the Census Bureau studied homogeneity and recorded the results in study called P-12. Since the homogeneity assumption was so key, the Census Bureau undertook additional work in a study called Artificial Population Analysis. The Panel was asked to examine various aspects of the analysis. The Panel member who did part of the P-12 study led the discussion. The Panel member started with a brief review of study P-12 which he characterized as inconclusive. In reviewing the artificial population analysis, he thought the Census Bureau had taken a major additional step to try to investigate the issue, but he still felt the results were inconclusive. In his opinion, only two of the eight surrogate variables considered by the Census Bureau were associated enough with undercount to be considered. (Percent enumerated by mail and substitution rate.) He wondered if there were better alternative surrogate variables. The Panel also expressed some concern about the constant scaling of the surrogate variables to undercount. Variable scaling might be preferred. Likewise, the Panel was concerned about the constant introduction of bias into the artificial population analysis. Once again, variable bias would be preferred. Even so, the Panel was concerned that artificial population analysis showed failure of the homogeneity assumption when the constant bias was 25% or greater. One panel member did some work on his own. From that study, he concluded that by using substitution rate, adjustment looks better. Using poverty, the results are mixed. And, using unemployment rate, the census looks better. This kind of analysis supports the conclusion that even with all the new research, the results are inconclusive. This panel member felt that a considerable amount of additional work would be needed to get a definitive answer on whether the homogeneity assumption held.

FIFTH AREA: COMPARISON OF PES TO DA

Generally, at the national level, estimates of population from DA are felt to be "better" than estimates from a post-censal survey. Even so, the DA estimates are subject to some error. Before discussing the comparison of the PES and DA, one panel member shared her work on the quality of DA numbers. In addition to the known problems with DA, she pointed out some additional places where the DA estimates could be in error. These included:

1. Over correction for the under-registration of black males. (This error has the effect of overestimating the undercount.)

2. The problem of Mexicans near the border who register the birth in the US, but then return to Mexico to raise the child. (This problem has the effect of overstating the undercount.)

3. Under reporting of infant deaths near the border since the birth certificate can be resold. (This problem overstates the undercount.)

4. Concerns about the consistency and reliability of reporting data on vital statistics forms, especially those done by a third party. (These types of errors might not effect the estimate of total undercount, but would effect the estimates by age-race-sex.)

5. Concern about a change in a person's self perception of race/Hispanic over time. These characteristics could be recorded one way at birth and another at death. (This problem only has an effect on DA estimates of undercount by race/Hispanic.)

Even with these and other problems, there is still general confidence in the DA estimates, particularly at the national level. That is why the Panel was concerned about some inconsistencies between the PES and DA. In particular, one panel member reviewed the Census Bureau work that compared PES estimates by state with DA and other information. She was quite concerned about the states that seemed quite inconsistent. At this point, another panel member indicated that another independent study he had done confirmed the inconsistency in a similar set of states. The Panel discussed the issue and concluded that in an adjustment where there would be overall improvement for states, some states would be adversely affected, even if most were improved and the US average was improved. The Panel strongly recommended that the Census Bureau examine if these exception states were hurt "seriously."

...e meeting closed with a brief discussion of the actual mechanism of the intercensal estimate process. During that discussion, there was a question about the accuracy of intercensal estimates. That question couldn't be answered exactly, but there was some summary information provided. Basically, by comparing the estimate in a census year to the census count, you can estimate the error in the estimates over a 10-year period. The following table summarizes the Census Bureau findings.

AREA	LEVEL OF ERROR OVER 10 YEARS[1]
States	1.5 - 2.5%
Places over 50,000	4.0%
Places 5,000 to 50,000	7.0 - 8.0%
Places under 5,000	16.0 - 20.0%

[1]Level of error as measured in previous decades. These error estimates exclude any estimated undercoverage in the census.

ATTACHMENT 9: USES OF INTERCENSAL ESTIMATES AND ISSUES CONSIDERED BY C.A.P.E

Uses of Intercensal Estimates:

1. Survey controls
2. Denominators for per capita Federal statistics
3. Funding programs
   a. State populations either for direct funding or as the first tier in a funding program
   b. Substate areas of 100,000 population or larger
   c. Substate areas below 100,000 population

Other Concerns:

1. National population estimates
2. Differential undercount and the perception of fairness
3. Overall accuracy

ATTACHMENT 10: ESTIMATED UNDERCOUNT/OVERCOUNT FOR 51 POST-STRATA, JULY 1992

Post-Strata Groups	Percent Undercount				Standard Errors			
	North East	South	Mid West	West	NE	S	MW	W
Non-Hispanic White & Other								
Owner								
Urbanized Areas 250,000 +	-2.13	0.68	-0.26	-0.34	1.08	0.71	0.39	0.65
Other Urban	-1.08	0.52	-0.10	0.62	0.49	0.42	0.40	0.58
Non-Urban	-0.54	0.18	-0.71	0.29	0.70	0.69	1.18	0.69
Non-owner								
Urbanized Areas 250,000 +	1.16	2.56	2.33	3.18	1.39	1.48	1.61	1.62
Other Urban	3.41	3.20	1.23	4.49	1.51	1.74	1.09	1.34
Non-Urban	6.52	6.23	2.85	6.08	4.20	1.71	1.51	1.81
Black								
Owner								
Urbanized Areas 250,000 +	1.63	2.16	0.81	6.10	1.91	0.90	0.87	1.91
Other Urban		1.34				0.98		
Non-Urban		3.52				1.90		
Non-owner								
Urbanized Areas 250,000 +	8.37	6.27	5.99	9.96	1.61	1.90	1.68	2.72
Other Urban		4.15				1.18		
Non-Urban		4.62				5.33		
Non-Black Hispanic								
Owner								
Urbanized Areas 250,000 +	0.67	2.53	-4.33	2.89	4.45	0.90	2.58	0.87
Other Urban		0.94				1.64		
Non-Urban		2.73				2.69		
Non-owner								
Urbanized Areas 250,000 +	6.72	9.34	6.64	5.91	3.51	2.59	3.26	1.84
Other Urban		6.60				2.74		
Non-Urban		15.80				5.01		
Asian & Pacific Islander								
Owner		-1.45				1.50		
Non-owner		6.96				2.52		
American Indians on Reservations		12.22				4.73		

Negative numbers in table signify an estimated overcount.

Attachment 11: Place Level Estimates and Estimated Undercount Rates (Places with 100,000 or More Population)

State/Place/Place Name		1990 Census	Original PES July 1991 Estimate	UC Rt	SE(UCRt)	357 PES July 1992 Estimate	UC Rt	SE(UCRt)
01	0185 Birmingham city	265968	278776	4.594	0.504	273918	2.902	0.750
01	0935 Huntsville city	159789	165498	3.450	0.557	162535	1.689	0.587
01	1165 Mobile city	196278	203932	3.753	0.522	201181	2.437	0.619
01	1180 Montgomery city	187106	194786	3.943	0.516	190738	1.904	0.521
02	0140 Anchorage city	226338	231258	2.119	0.471	232174	2.514	0.518
04	0140 Glendale city	148134	151575	2.270	0.443	150725	1.725	0.571
04	0215 Mesa city	288091	294297	2.770	0.583	292643	1.556	0.638
04	0260 Phoenix city	983403	1013566	2.976	0.549	1003800	2.032	0.515
04	0305 Scottsdale city	130069	132778	2.040	0.589	131178	0.846	0.612
04	0340 Tempe city	141865	147232	3.645	0.588	145453	2.467	0.791
04	0380 Tucson city	405390	419413	3.344	0.577	415971	2.544	0.542
05	1195 Little Rock city	175795	181658	3.228	0.496	179875	2.268	0.610
06	0070 Anaheim city	266406	277711	4.071	0.530	273740	2.679	0.534
06	0180 Bakersfield city	174820	179483	2.706	0.574	179398	2.552	0.511
06	0245 Berkeley city	102724	107538	4.477	0.487	106630	3.664	0.712
06	0525 Chula Vista city	135163	140021	3.470	0.584	138715	2.561	0.475
06	0595 Concord city	111348	113121	1.567	0.622	113137	1.582	0.580
06	0880 El Monte city	106209	112288	5.414	0.745	110792	4.137	1.014
06	0935 Escondido city	108635	112428	3.374	0.533	111040	2.166	0.549
06	1080 Fremont city	173339	177040	2.091	0.584	176094	1.565	0.522
06	1090 Fresno city	354202	369030	4.018	0.497	366527	3.363	0.555
06	1095 Fullerton city	114144	116779	2.256	0.583	116725	2.211	0.514
06	1110 Garden Grove city	143050	146505	2.358	0.572	146412	2.296	0.515
06	1130 Glendale city	180038	183360	1.812	0.584	184515	2.426	0.579
06	1225 Hayward city	111498	115752	3.675	0.566	114720	2.809	0.503
06	1300 Huntington Beach city	181519	183976	1.336	0.632	184639	1.690	0.635
06	1340 Inglewood city	109602	123350	11.146	0.953	116991	6.316	1.290
06	1347 Irvine city	110330	111773	1.291	0.631	112191	1.659	0.665
06	1610 Long Beach city	429433	450964	4.774	0.466	445925	3.698	0.594
06	1630 Los Angeles city	3485398	3671205	5.061	0.514	3624206	3.830	0.651
06	1790 Modesto city	164730	168273	2.106	0.601	168849	2.440	0.500
06	1849 Moreno Valley city	118779	126583	6.165	0.563	121925	2.580	[illegible]
06	1970 Oakland city	372242	392769	5.226	0.540	391553	4.932	[illegible]
06	1990 Oceanside city	128398	132708	3.248	0.586	131711	2.513	0.510
06	2005 Ontario city	133179	141449	5.860	0.577	137458	3.113	0.551
06	2015 Orange city	110658	113020	2.090	0.590	112738	1.845	0.495
06	2050 Oxnard city	142216	148120	3.984	0.581	147164	3.342	0.643
06	2125 Pasadena city	131591	137947	4.608	0.460	136431	3.548	0.582
06	2230 Pomona city	131723	138469	4.872	0.536	137116	3.933	0.693
06	2278 Rancho Cucamonga city	101409	106455	4.919	0.548	103309	1.839	0.485
06	2370 Riverside city	226505	233085	2.823	0.562	232608	2.624	0.492
06	2420 Sacramento city	369365	384466	3.928	0.477	380736	2.987	0.538
06	2435 Salinas city	108777	113243	3.944	0.595	112783	3.484	0.993
06	2450 San Bernardino city	164164	170413	3.667	0.524	170249	3.574	0.571
06	2475 San Diego city	1110549	1156224	3.950	0.476	1143032	2.842	0.527
06	2485 San Francisco city	723959	756182	4.261	0.504	745573	2.899	0.62[illegible]
06	2510 San Jose city	782248	814783	3.993	0.520	801296	2.377	0.47[illegible]
06	2570 Santa Ana city	293742	309907	5.216	0.648	305815	3.948	0.87
06	2585 Santa Clarita city	110642	112528	1.676	0.647	111997	1.210	0.55
06	2615 Santa Rosa city	113313	115042	1.503	0.668	115898	2.231	0.53
06	2702 Simi Valley city	100217	104425	4.030	0.566	102006	1.754	0.44
06	2805 Stockton city	210943	218902	3.636	0.568	218358	3.396	0.60
06	2835 Sunnyvale city	117229	119490	1.892	0.578	119999	2.308	0.61
06	2897 Thousand Oaks city	104352	108398	3.733	0.565	105407	1.001	0.55
06	2910 Torrance city	133107	134632	1.133	0.601	135125	1.494	0.56
06	3000 Vallejo city	109199	113359	3.670	0.550	112178	2.656	0.54
08	0095 Aurora city	222103	227295	2.284	0.673	227110	2.205	0.58
08	0240 Colorado Springs city	281140	289844	3.003	0.572	287033	2.053	0.65
08	0520 Denver city	467610	482714	3.129	0.579	480862	2.756	0.41
08	0760 Lakewood city	126481	128314	1.429	0.680	128094	1.259	-0.6[illegible]
09	001010 Bridgeport town	141686	143879	1.524	0.857	145431	2.709	1.8[illegible]
09	001090 Stamford town	108056	108286	0.212	0.770	109430	1.254	0.4[illegible]
09	003070 Hartford town	139739	143285	2.475	0.957	144308	4.490	1.2

UC RT — Undercount Rate as estimated from the PES.

SE(UCRt) — The sampling error of the estimated undercount rate.

09	009075	New Haven town	130474	132416	1.467	0.844	135057	3.393	0.84
09	009120	Waterbury town	108961	109092	0.120	0.759	110722	1.591	0.53
	0005	Washington city	606900	638747	4.986	0.517	628309	3.407	0.90
	0645	Fort Lauderdale city	149377	153932	2.959	0.490	152687	2.168	0.66
12	0860	Hialeah city	188004	196416	4.283	0.935	197448	4.785	1.62
12	0915	Hollywood city	121697	125104	2.723	0.509	123463	1.431	0.56
12	1003	Jacksonville city (remainder)	635230	658739	3.569	0.462	649437	2.188	0.54
12	1370	Miami city	358548	376424	4.749	0.703	377379	4.990	1.52
12	1600	Orlando city	164693	170303	3.294	0.462	169260	2.698	0.70
12	1900	St. Petersburg city	238629	245561	2.823	0.472	242169	1.454	0.55
12	2070	Tallahassee city	124773	129647	3.759	0.526	127834	2.395	0.81
12	2075	Tampa city	280015	291356	3.893	0.449	287445	2.585	0.62
13	0150	Atlanta city	394017	415204	5.103	0.540	407923	3.409	0.91
13	0660	Columbus city (remainder)	178681	184860	3.343	0.505	182489	2.087	0.55
13	1725	Macon city	106612	110227	3.280	0.542	109027	2.215	0.58
13	2540	Savannah city	137560	142220	3.277	0.531	140538	2.119	0.56
15	0110	Honolulu CDP	365272	382505	4.505	0.803	372146	1.847	0.98
16	0090	Boise City city	125738	127612	1.469	0.702	128336	2.024	0.54
17	1051	Chicago city	2783726	2857364	2.577	0.582	2852041	2.395	0.76
17	4590	Peoria city	113504	116740	2.772	0.681	114753	1.089	0.41
17	4965	Rockford city	139426	143232	2.657	0.681	140598	0.834	0.42
17	5480	Springfield city	105227	107885	2.462	0.700	105921	0.655	0.45
18	0775	Evansville city	126272	129192	2.260	0.712	126950	0.534	0.47
18	0825	Fort Wayne city	173072	177949	2.741	0.690	174511	0.824	0.42
18	0905	Gary city	116644	122166	4.518	0.866	119611	2.479	0.71
18	1145	Indianapolis	731327	737483	0.835	0.612	741712	1.400	0.52
18	2375	South Bend city	105511	108564	2.812	0.681	106417	0.851	0.37
19	0670	Cedar Rapids city	108751	110887	1.926	0.648	109199	0.410	0.43
19	1130	Des Moines city	193187	197761	2.313	0.631	194878	0.919	0.50
20	1430	Kansas City city	149767	153306	2.309	0.483	151947	1.435	0.69
20	2194	Overland Park city	111790	112871	0.958	0.491	112485	0.618	0.48
20	2795	Topeka city	119883	123028	2.556	0.602	120748	0.716	0.43
20	3040	Wichita city	304011	308747	1.534	0.480	307807	1.233	0.51
21	1140	Lexington-Fayette	225366	233157	3.342	0.602	229930	1.985	0.70
21	1230	Louisville city	269063	279912	3.876	0.499	274816	2.094	0.61
	0095	Baton Rouge city	219531	227504	3.505	0.479	226061	2.889	0.70
	0956	New Orleans city	496938	514558	3.424	0.486	513936	3.307	0.87
	1240	Shreveport city	198525	205361	3.329	0.482	203753	2.566	0.63
24	0025	Baltimore city	736014	772082	4.672	0.511	759127	3.045	0.80
25	013090	Springfield city	156983	158023	0.658	0.785	159597	1.638	0.85
25	017130	Lowell city	103439	103118	-0.311	0.770	105772	2.206	0.66
25	025085	Boston city	574283	579743	0.942	0.806	590705	2.780	0.78
25	027380	Worcester city	169759	169075	-0.405	0.753	171148	0.812	0.81
26	0080	Ann Arbor city	109592	112804	2.847	0.727	111442	1.660	0.52
26	0640	Detroit city	1027974	1064760	3.455	0.622	1056180	2.671	0.75
26	0920	Flint city	140761	146209	3.726	0.703	143923	2.197	0.58
26	1085	Grand Rapids city	189126	194874	2.950	0.666	191834	1.412	0.50
26	1485	Lansing city	127321	131473	3.158	0.684	129434	1.625	0.55
26	1545	Livonia city	100850	101462	0.603	0.527	100700	-0.149	0.34
26	2585	Sterling Heights city	117810	118625	0.687	0.514	117955	0.123	0.41
26	2790	Warren city	144864	145814	0.652	0.535	145018	0.106	0.35
27	2585	Minneapolis city	368383	374945	1.755	0.469	374537	1.643	0.64
27	3425	St. Paul city	272235	275845	1.309	0.485	275962	1.351	0.54
28	0815	Jackson city	196437	205662	4.388	0.515	202591	2.939	0.7
29	2125	Independence city	112301	113335	0.912	0.487	112970	0.592	0.4
29	2220	Kansas City city	435146	444859	2.183	0.472	441627	1.468	0.5
29	3875	St. Louis city	396685	408263	2.836	0.518	405175	2.096	0.6
29	4075	Springfield city	140494	143438	2.053	0.650	141440	0.669	0.5
31	1425	Lincoln city	191972	196234	2.172	0.660	193565	0.720	0.4
31	1825	Omaha city	335795	340507	1.384	0.476	339436	1.073	0.4
32	0045	Las Vegas city	258295	266308	3.009	0.562	264680	2.412	0.5
32	0090	Reno city	133850	136305	1.801	0.650	137829	2.887	0.6
34	1715	Elizabeth city	110002	111988	1.773	0.740	113626	3.189	1.2
34	2290	Jersey City city	228537	236712	3.454	0.681	236914	3.534	0.9
34	2895	Newark city	275221	285923	3.743	0.775	289965	5.085	1.1
34	3115	Paterson city	140891	146967	4.134	0.752	146865	4.068	1.3
35	0015	Albuquerque city	384736	397206	3.139	0.583	393462	2.218	0.4
36	0030	Albany city	101082	103456	2.295	0.692	103108	1.965	0.8
36	0450	Buffalo city	328123	333145	1.508	0.592	334286	1.844	0.7
	2505	New York city	7322564	7552196	3.041	0.588	7547146	3.232	0.9
	3100	Rochester city	231636	239832	3.417	0.720	237133	2.318	0.7
36	3565	Syracuse city	163860	167479	2.161	0.683	166653	1.676	0.7

36	4075	Yonkers city	188082	192435	2.262	0.664	190656	1.350	0.852	
37	0480	Charlotte city	395934	412646	4.008	0.467	405932	2.463	0.635	
37	0750	Durham city	136611	141713	3.600	0.536	139962	2.394	0.712	
37	1065	Greensboro city	183521	189851	3.334	0.518	187128	1.928	0.646	
37	2020	Raleigh city	207951	215573	3.536	0.520	213485	2.592	0.728	
37	2785	Winston-Salem city	143485	148215	3.191	0.513	146388	1.983	0.619	
39	0035	Akron city	223019	229527	2.835	0.683	226256	1.431	[illegible]	
39	0865	Cincinnati city	364040	369165	1.388	0.631	372392	2.243	[illegible]	
39	0900	Cleveland city	505616	512581	1.359	0.637	516598	2.124	[illegible]	
39	0960	Columbus city	632910	639303	1.000	0.605	645256	1.913	0.630	
39	1110	Dayton city	182044	186260	3.302	0.670	185861	2.054	0.624	
39	4265	Toledo city	332943	335164	0.663	0.600	337317	1.297	0.497	
40	1815	Oklahoma City city	444719	454958	2.251	0.516	454630	2.180	0.548	
40	2445	Tulsa city	367302	375358	2.146	0.539	374856	2.015	0.597	
41	0360	Eugene city	112669	114413	1.524	0.702	115726	2.661	0.685	
41	0905	Portland city	437319	450413	2.907	0.538	445566	1.851	0.659	
41	1005	Salem city	107786	109189	1.285	0.652	110240	2.227	0.546	
42	0165	Allentown city	105090	105902	0.767	0.627	105216	0.120	0.831	
42	3685	Erie city	108718	110075	1.233	0.662	109866	1.045	0.534	
42	7180	Philadelphia city	1585577	1606249	1.287	0.609	1608942	1.452	0.742	
42	7234	Pittsburgh city	369879	374002	1.102	0.583	373752	1.036	0.728	
44	007045	Providence city	160728	161519	0.490	0.777	164304	2.176	0.829	
46	1225	Sioux Falls city	100814	102712	1.848	0.658	101208	0.389	0.496	
47	0245	Chattanooga city	152466	157807	3.385	0.528	155875	2.187	0.637	
47	0760	Knoxville city	165121	170454	3.129	0.587	168582	2.053	0.698	
47	0940	Memphis city	610337	640019	4.636	0.498	628329	2.864	0.709	
47	1016	Nashville-Davidson (remainder)	488374	509302	4.109	0.519	499383	2.205	0.625	
48	0015	Abilene city	106454	109869	2.926	0.515	108885	2.049	0.646	
48	0100	Amarillo City	157615	162215	2.836	0.532	160530	1.816	0.577	
48	0175	Arlington city	261721	272160	3.836	0.510	269098	2.742	0.608	
48	0210	Austin city	465622	480242	3.044	0.501	483156	3.629	0.752	
48	0320	Beaumont city	114323	118161	3.248	0.474	116654	1.998	0.500	
48	0980	Corpus-Christi city	257483	264458	2.722	0.551	267127	3.622	0.798	
48	1085	Dallas city	1006877	1057658	4.801	0.508	1043947	3.551	0.727	
48	1340	El Paso city	515342	531606	3.059	0.637	538250	4.256	0.964	
48	1500	Fort Worth city	447619	467853	4.325	0.490	461686	3.047	0.606	
48	1580	Garland city	180650	185940	2.845	0.494	185336	2.528	0.539	
48	1975	Houston city	1630553	1715433	4.959	0.542	1697301	3.933	0.777	
48	2060	Irving city	155037	162091	4.352	0.530	160622	3.477	0.762	
48	2400	Laredo city	122899	127296	3.454	0.793	126611	2.932	1.262	
48	2545	Lubbock city	186206	192375	3.207	0.512	190661	2.334	[illegible]	
48	2795	Mesquite city	101484	104448	2.838	0.503	103803	2.234	[illegible]	
48	3200	Pasadena city	119363	123270	3.170	0.588	123539	3.380	0.721	
48	3310	Plano city	128713	132377	2.768	0.519	131188	1.887	0.540	
48	3745	San Antonio city	935933	964071	2.919	0.561	974099	3.918	0.857	
48	4415	Waco city	103590	107015	3.201	0.476	106382	2.624	0.728	
49	0870	Salt Lake City city	159936	162897	1.818	0.664	163014	1.888	0.721	
51	0025	Alexandria city	111183	112748	1.388	0.541	114451	2.856	0.771	
51	0242	Chesapeake city	151976	153512	1.001	0.556	155185	2.068	0.509	
51	0590	Hampton city	133793	139284	3.942	0.459	137415	2.636	0.617	
51	0860	Newport News city	170045	178053	4.498	0.468	175121	2.899	0.689	
51	0875	Norfolk city	261229	273457	4.472	0.444	269011	2.893	0.733	
51	0990	Portsmouth city	103907	108477	4.213	0.474	106837	2.742	0.695	
51	1035	Richmond city	203056	209959	3.288	0.549	208987	2.838	0.817	
51	1280	Virginia Beach city	393069	408213	3.710	0.487	402092	2.244	0.551	
53	1140	Seattle city	516259	534576	3.427	0.506	528151	2.252	0.671	
53	1220	Spokane city	177196	179308	1.178	0.711	179391	1.223	0.73	
53	1280	Tacoma city	176664	180714	2.241	0.625	180831	2.304	0.62	
55	1475	Madison city	191262	196296	2.565	0.734	193499	1.156	0.50	
55	1645	Milwaukee city	628088	635953	1.234	0.601	642860	2.298	0.68	

Attachment 12: County Level Estimates and Estimated Undercount Rates (Counties with 100,000 or More Population)

State/County/County Name		1990 Census	Original PES July 1991 Estimate	UC Rt	SE(UCRt)	357 PES July 1992 Estimate	UC Rt	SE(UCRt)
01	015 Calhoun County	116034	119037	2.523	0.466	117856	1.546	0.424
01	073 Jefferson County	651525	673700	3.292	0.423	665329	2.075	0.517
01	089 Madison County	238912	246704	3.158	0.456	242937	1.657	0.478
01	097 Mobile County	376643	390685	3.582	0.417	387137	2.194	0.479
01	101 Montgomery County	209085	217215	3.743	0.481	213105	1.886	0.480
01	103 Morgan County	100043	102781	2.664	0.459	101438	1.375	0.407
01	125 Tuscaloosa County	150522	155432	3.159	0.424	153449	1.908	0.508
02	020 Anchorage Borough	226338	231238	2.119	0.671	232174	2.514	0.518
04	013 Maricopa County	2122101	2180538	2.680	0.496	2160697	1.786	0.512
04	019 Pima County	666880	686848	2.907	0.486	681920	2.206	0.464
04	021 Pinal County	116379	121955	4.572	0.377	120033	3.045	0.584
04	025 Yavapai County	107714	110720	2.715	0.575	109685	1.797	0.442
04	027 Yuma County	106895	111958	4.522	0.570	109960	2.787	0.572
05	119 Pulaski County	349660	360243	2.938	0.432	357441	2.177	0.517
05	143 Washington County	113409	116428	2.593	0.474	115578	1.877	0.615
06	001 Alameda County	1279182	1323971	3.383	0.455	1317233	2.889	0.521
06	007 Butte County	182120	187906	3.079	0.548	186831	2.522	0.554
06	013 Contra Costa County	803732	825024	2.581	0.603	817943	1.737	0.400
06	017 El Dorado County	125995	126797	0.633	0.696	128413	1.883	0.451
06	019 Fresno County	667490	692890	3.666	0.457	691987	3.540	0.501
06	023 Humboldt County	119118	122156	2.487	0.582	122610	2.689	0.488
06	025 Imperial County	109303	116024	5.793	0.705	113220	3.460	0.866
06	029 Kern County	543477	566235	4.019	0.473	558755	2.734	0.375
06	031 Kings County	101469	105597	3.909	0.504	105099	3.454	0.581
06	037 Los Angeles County	8863164	9291988	4.615	0.448	9168889	3.334	0.548
06	041 Marin County	230096	232036	0.836	0.651	232947	1.224	0.523
06	047 Merced County	178403	186707	4.448	0.470	185406	3.777	0.628
06	053 Monterey County	355660	370124	3.908	0.461	367580	3.243	0.644
06	055 Napa County	110765	113411	2.333	0.503	113298	2.236	0.447
06	059 Orange County	2410556	2469336	2.380	0.519	2461373	2.065	0.493
06	061 Placer County	172796	174772	1.131	0.575	175303	1.430	0.374
06	065 Riverside County	1170413	1220764	4.125	0.487	1198964	2.381	0.343
06	067 Sacramento County	1041219	1069918	2.682	0.491	1065198	2.251	0.524
06	071 San Bernardino County	1418380	1490697	4.851	0.501	1455550	2.554	0.355
06	073 San Diego County	2498016	2576888	3.061	0.442	2560392	2.436	0.486
06	075 San Francisco County	723959	756182	4.261	0.504	745573	2.899	0.626
06	077 San Joaquin County	480628	498718	3.627	0.453	495154	2.934	0.381
06	079 San Luis Obispo County	217162	222991	2.614	0.513	222841	2.549	0.500
06	081 San Mateo County	649623	664468	2.234	0.571	661709	1.826	0.457
06	083 Santa Barbara County	369608	383034	3.505	0.473	381039	3.000	0.645
06	085 Santa Clara County	1497577	1541197	2.817	0.453	1531196	2.196	0.475
06	087 Santa Cruz County	229734	238267	3.581	0.503	236007	2.658	0.531
06	089 Shasta County	147036	150573	2.349	0.528	150145	2.070	0.447
06	095 Solano County	340421	353913	3.812	0.450	348512	2.322	0.324
06	097 Sonoma County	388222	399078	2.720	0.504	397377	2.304	0.422
06	099 Stanislaus County	370522	382542	3.092	0.487	380499	2.673	0.475
06	107 Tulare County	311921	324294	3.815	0.482	323520	3.585	0.681
06	111 Ventura County	669016	694637	3.688	0.468	683672	2.144	0.357
06	115 Yolo County	141092	145883	3.284	0.456	145975	3.343	0.565
08	001 Adams County	265038	271716	2.458	0.654	269856	1.786	0.496
08	005 Arapahoe County	391511	398166	1.671	0.693	397542	1.517	0.588
08	013 Boulder County	225339	229447	1.790	0.591	230754	2.347	0.533
08	031 Denver County	467610	482714	3.129	0.579	480862	2.756	0.498
08	041 El Paso County	397016	407043	2.455	0.493	405212	2.023	0.558
08	059 Jefferson County	438430	444327	1.327	0.706	442890	1.007	0.577
08	069 Larimer County	186136	189346	1.695	0.596	190549	2.326	0.527
08	101 Pueblo County	123051	125454	2.072	0.590	125754	2.149	0.540
08	123 Weld County	131821	134887	2.273	0.534	135793	2.925	0.518
09	001 Fairfield County	827645	831105	0.416	0.593	832682	0.605	0.384
09	003 Hartford County	851783	857182	0.630	0.589	857897	0.713	0.483
09	005 Litchfield County	174092	175581	0.848	0.538	175080	0.565	0.523
09	007 Middlesex County	143196	143812	0.428	0.529	143825	0.437	0.526
09	009 New Haven County	804219	807947	0.461	0.583	807987	0.466	0.514
09	011 New London County	254957	255796	0.328	0.554	257535	1.001	0.470

UC RT — Undercount Rate as estimated from the PES.

SE(UCRt) — The sampling error of the estimated undercount rate.

09	013 Tolland County	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
09	015 Windham County	102525	104554	1.941	0.823	103793	1.222	[illegible]	[illegible]
10	001 Kent County	110993	114068	2.696	0.443	112995	1.772	0.39[illegible]	
10	003 New Castle County	441946	456338	3.154	0.510	450294	1.854	0.516	
10	005 Sussex County	113229	116255	2.603	0.501	115083	1.611	0.452	
11	001 District of Columbia	606900	638747	4.986	0.517	628309	3.407	0.901	
12	001 Alachua County	181596	188223	3.521	0.429	186051	2.394	0.635	
12	005 Bay County	126994	130912	2.993	0.477	129096	1.629	0.536	
12	009 Brevard County	398978	410499	2.807	0.446	404953	1.476	[illegible]	
12	011 Broward County	1255488	1291812	2.812	0.453	1277394	1.715	[illegible]	
12	015 Charlotte County	110975	112871	1.680	0.526	111898	0.825	[illegible]	
12	019 Clay County	105986	106804	0.766	0.595	107762	1.648	0.376	
12	021 Collier County	152099	156294	2.684	0.526	154958	1.845	0.464	
12	025 Dade County	1937094	1997643	3.031	0.591	2011300	3.690	0.945	
12	031 Duval County	672971	697735	3.549	0.463	687821	2.159	0.549	
12	033 Escambia County	262798	271007	3.029	0.466	268329	2.061	0.495	
12	053 Hernando County	101115	100975	-0.139	0.612	102051	0.918	0.319	
12	057 Hillsborough County	834054	851877	2.092	0.448	853411	2.268	0.478	
12	069 Lake County	152104	155095	1.929	0.481	154003	1.233	0.341	
12	071 Lee County	335113	343538	2.452	0.465	339589	1.318	0.466	
12	073 Leon County	192493	199708	3.613	0.437	196621	2.100	0.615	
12	081 Manatee County	211707	216819	2.358	0.508	214609	1.352	0.513	
12	083 Marion County	194833	199845	2.508	0.487	197743	1.472	0.354	
12	085 Martin County	100900	103232	2.259	0.592	102120	1.195	0.406	
12	091 Okaloosa County	143776	148410	3.122	0.505	146346	1.756	0.593	
12	095 Orange County	677491	700574	3.295	0.458	693622	2.326	0.530	
12	097 Osceola County	107728	111188	3.112	0.564	109720	1.816	0.479	
12	099 Palm Beach County	863518	886676	2.612	0.484	876764	1.511	0.493	
12	101 Pasco County	281131	281049	-0.029	0.614	283694	0.904	0.395	
12	103 Pinellas County	851659	861306	1.120	0.448	860438	1.020	0.555	
12	105 Polk County	405382	416923	2.768	0.470	411918	1.587	0.405	
12	111 St. Lucie County	150171	154362	2.715	0.479	152554	1.562	0.474	
12	115 Sarasota County	277776	283554	2.038	0.550	279921	0.766	0.505	
12	117 Seminole County	287529	297007	3.191	0.569	292736	1.779	0.505	
12	127 Volusia County	370712	380601	2.598	0.512	375737	1.338	0.463	
13	021 Bibb County	149967	154963	3.224	0.453	153035	2.005	0.475	
13	051 Chatham County	216935	224122	3.207	0.435	221102	1.885	0.506	
13	063 Clayton County	182052	184137	1.132	0.562	186841	2.563	0.581	
13	067 Cobb County	447745	453535	1.277	0.544	456480	1.914	0.547	
13	089 DeKalb County	545837	553706	1.421	0.533	561155	2.730	0.608	
13	121 Fulton County	648951	671488	3.356	0.442	668495	2.953	0.734	
13	135 Gwinnett County	352910	356619	1.040	0.611	359473	1.826	[illegible]	
13	215 Muscogee County	179278	185474	3.341	0.505	183097	2.086	[illegible]	
13	245 Richmond County	189719	195914	3.162	0.443	194873	2.643	[illegible]	
15	001 Hawaii County	120317	121720	1.153	0.717	122654	1.905	0.75[illegible]	
15	003 Honolulu County	836231	861245	2.904	0.570	852074	1.859	0.83[illegible]	
15	009 Maui County	100374	101591	1.198	0.714	102187	1.774	0.74[illegible]	
16	001 Ada County	205775	208426	1.272	0.594	209575	1.813	0.46[illegible]	
17	019 Champaign County	173025	177031	2.263	0.553	175375	1.340	0.41[illegible]	
17	031 Cook County	5105067	5212195	2.055	0.423	5186429	1.569	0.57	
17	043 DuPage County	781666	789453	0.986	0.499	784956	0.419	0.39	
17	089 Kane County	317471	324570	2.187	0.524	320253	0.869	0.41	
17	097 Lake County	516418	524672	1.573	0.558	519640	0.624	0.33	
17	099 La Salle County	106913	106411	-0.472	0.538	107150	0.222	0.41	
17	111 McHenry County	183241	184777	0.831	0.510	183780	0.293	0.3[illegible]	
17	113 McLean County	129180	131827	2.008	0.582	130128	0.729	0.4[illegible]	
17	115 Macon County	117206	119550	1.961	0.570	117856	0.551	0.3[illegible]	
17	119 Madison County	249238	251156	0.764	0.432	250446	0.483	0.3[illegible]	
17	143 Peoria County	182827	186534	1.987	0.534	186180	0.735	0.3[illegible]	
17	161 Rock Island County	148723	151424	1.784	0.534	149787	0.711	0.4[illegible]	
17	163 St. Clair County	262852	266701	1.443	0.423	266421	1.340	0.4[illegible]	
17	167 Sangamon County	178386	181578	1.758	0.542	179149	0.426	0.3[illegible]	
17	179 Tazewell County	123692	124872	0.943	0.561	123942	0.202	0.4[illegible]	
17	197 Will County	357313	363530	1.710	0.554	359200	0.525	0.2[illegible]	
17	201 Winnebago County	252913	257702	1.858	0.528	254302	0.546	0.3[illegible]	
18	003 Allen County	300836	306760	1.931	0.534	302274	0.476	0.3[illegible]	
18	035 Delaware County	119659	121730	1.701	0.537	120341	0.566	0.4[illegible]	
18	039 Elkhart County	156198	158664	1.554	0.530	156797	0.382	0.4[illegible]	
18	057 Hamilton County	108936	109674	0.673	0.513	109211	0.252	0.3[illegible]	
18	089 Lake County	475594	487249	2.392	0.552	480522	0.984	0.4[illegible]	
18	091 La Porte County	107066	107036	-0.028	0.462	107368	0.281	0.4[illegible]	
18	095 Madison County	130669	132535	1.408	0.514	131090	0.321	0.4[illegible]	

18	097 Marion County	797159	803890	0.837	0.577	808143	1.359	0.5
18	105 Monroe County	108978	111084	1.896	0.552	110094	1.013	0.4
18	127 Porter County	128932	130035	0.848	0.659	129287	0.274	0.3
18	141 St. Joseph County	247052	251786	1.880	0.535	248403	0.544	0.3
18	157 Tippecanoe County	130598	133031	1.829	0.550	132098	1.135	0.4
18	163 Vanderburgh County	165058	168249	1.897	0.596	165711	0.394	0.4
18	167 Vigo County	106107	107712	1.490	0.517	106607	0.469	0.3
19	013 Black Hawk County	123798	126453	2.100	0.553	124529	0.587	0.3
19	113 Linn County	168767	171900	1.823	0.541	169329	0.332	0.3
19	153 Polk County	327140	334027	2.062	0.537	329530	0.725	0.4
19	163 Scott County	150979	154206	2.093	0.533	152246	0.832	0.4
20	091 Johnson County	355054	358386	0.930	0.435	357029	0.553	0.4
20	173 Sedgwick County	403462	409349	1.389	0.407	407780	1.010	0.4
20	177 Shawnee County	160976	164773	2.304	0.525	161845	0.537	0.3
20	209 Wyandotte County	161993	165474	2.222	0.456	164206	1.348	0.4
21	067 Fayette County	225366	233157	3.342	0.602	229930	1.985	0.7
21	111 Jefferson County	664937	685007	2.930	0.439	676776	1.749	0.5
21	117 Kenton County	142031	145523	2.400	0.593	144235	1.528	0.5
22	017 Caddo Parish	248253	256120	3.072	0.428	254356	2.400	0.5
22	019 Calcasieu Parish	168134	172829	2.717	0.405	170974	1.661	0.4
22	033 East Baton Rouge Parish	380105	392277	3.103	0.395	390145	2.574	0.5
22	051 Jefferson Parish	448306	458980	2.326	0.470	457937	2.103	0.5
22	055 Lafayette Parish	164762	169813	2.974	0.409	168125	2.000	0.4
22	071 Orleans Parish	496938	514558	3.424	0.486	513936	3.307	0.8
22	073 Ouachita Parish	142191	146297	2.807	0.400	144953	1.905	0.4
22	079 Rapides Parish	131556	135085	2.612	0.389	133995	1.820	0.3
22	103 St. Tammany Parish	144508	147804	2.230	0.451	146874	1.611	0.3
23	001 Androscoggin County	105259	106912	-0.331	0.585	106120	0.812	0.5
23	005 Cumberland County	243135	243615	0.197	0.539	245266	0.861	0.5
23	011 Kennebec County	115904	117501	1.359	0.693	116582	0.581	0.5
23	019 Penobscot County	146601	147574	0.659	0.563	147738	0.770	0.5
23	031 York County	164587	166105	0.914	0.552	165635	0.633	0.5
24	003 Anne Arundel County	427239	431624	4.016	0.537	434447	1.659	0.4
24	005 Baltimore County	692134	696225	0.588	0.567	702812	1.519	0.5
24	013 Carroll County	123372	124098	0.585	0.606	124911	1.232	0.4
24	017 Charles County	101154	102192	1.016	0.571	102794	1.595	0.4
24	021 Frederick County	150208	152604	1.570	0.494	152690	1.626	0.4
24	025 Harford County	182132	183499	0.745	0.583	185018	1.560	0.
24	027 Howard County	187328	189033	0.902	0.582	190409	1.618	0.
24	031 Montgomery County	757027	764514	0.979	0.543	771160	1.833	0.
24	033 Prince George's County	729266	740060	1.458	0.579	751587	2.970	0.
24	043 Washington County	121393	124802	2.732	0.464	123257	1.496	0.
24	510 Baltimore city	736014	772082	4.672	0.511	759127	3.045	0.
25	001 Barnstable County	186605	189889	1.729	0.855	187904	0.691	0.
25	003 Berkshire County	139352	139722	0.265	0.520	140508	0.823	0.
25	005 Bristol County	506325	505255	-0.212	0.554	509637	0.650	0.
25	009 Essex County	670080	670474	0.059	0.579	671451	0.204	0.
25	013 Hampden County	456310	457899	0.347	0.585	458054	0.381	0.
25	015 Hampshire County	146568	147943	0.929	0.563	147848	0.866	0.
25	017 Middlesex County	1398468	1402907	0.316	0.600	1399207	0.053	0.
25	021 Norfolk County	616087	618087	0.324	0.653	611139	-0.810	0.
25	023 Plymouth County	435276	436386	0.254	0.580	436400	0.258	0.
25	025 Suffolk County	663906	670095	0.924	0.744	680618	2.484	0.
25	027 Worcester County	709705	711256	0.218	0.537	713339	0.509	0.
26	017 Bay County	111723	113132	1.245	0.537	111895	0.153	0.
26	021 Berrien County	161378	163661	1.395	0.598	162674	0.796	0.
26	025 Calhoun County	135982	138148	1.568	0.517	136672	0.505	0.
26	049 Genesee County	430459	438800	1.901	0.538	434600	0.953	0.
26	065 Ingham County	281912	288505	2.285	0.534	286089	1.460	0.
26	075 Jackson County	149756	151535	1.173	0.526	150189	0.288	0.
26	077 Kalamazoo County	223411	227212	1.673	0.520	224957	0.687	0.
26	081 Kent County	500631	509273	1.697	0.526	504353	0.738	0.
26	093 Livingston County	115645	116408	0.656	0.511	115499	-0.126	0.
26	099 Macomb County	717400	722597	0.719	0.522	718766	0.190	0.
26	115 Monroe County	133600	134642	0.774	0.511	133783	0.137	0.
26	121 Muskegon County	158983	161494	1.555	0.535	159784	0.501	0
26	125 Oakland County	1083592	1094932	1.036	0.481	1088374	0.439	0
26	139 Ottawa County	187768	189955	1.151	0.605	188460	0.367	0
26	145 Saginaw County	211946	216195	1.947	0.537	213567	0.759	0
26	147 St. Clair County	145607	147341	1.177	0.448	145854	0.169	0
26	161 Washtenaw County	282937	288679	1.989	0.516	286038	1.084	0
26	163 Wayne County	2111687	2160354	2.253	0.426	2144482	1.529	0

27	003 Anoka County	243641	245862	0.903	0.517	244251	0.258	0.37[illegible]
27	037 Dakota County	275227	278036	1.011	0.512	276471	0.450	0.389
27	053 Hennepin County	1032431	1044852	1.189	0.381	1041265	0.848	0.467
27	109 Olmsted County	106470	108411	1.790	0.553	106753	0.265	0.411
27	123 Ramsey County	485765	491319	1.130	0.382	490387	0.943	0.479
27	137 St. Louis County	198213	201605	1.683	0.576	198462	0.126	0.430
27	145 Stearns County	118791	121193	1.982	0.639	119274	0.405	0.560
27	163 Washington County	145896	147156	0.856	0.506	146053	0.108	[illegible]
28	047 Harrison County	165365	170273	2.882	0.422	168426	1.818	[illegible]
28	049 Hinds County	254441	264818	3.919	0.446	261731	2.785	[illegible]
28	059 Jackson County	115243	118271	2.560	0.460	117089	1.576	0.407
29	019 Boone County	112379	115311	2.543	0.550	113620	1.092	0.444
29	047 Clay County	153411	154746	0.863	0.396	154298	0.575	0.414
29	077 Greene County	207949	211970	1.897	0.545	208941	0.475	0.429
29	095 Jackson County	633232	645060	1.834	0.378	640624	1.154	0.466
29	099 Jefferson County	171380	172865	0.859	0.510	171632	0.147	0.504
29	183 St. Charles County	212907	215015	0.980	0.431	213851	0.442	0.380
29	189 St. Louis County	993529	1010023	1.633	0.458	999753	0.623	0.370
29	510 St. Louis city	396685	408263	2.836	0.518	405175	2.096	0.682
30	111 Yellowstone County	113419	114710	1.125	0.605	115539	1.835	0.450
31	055 Douglas County	416444	421918	1.297	0.419	420353	0.930	0.453
31	109 Lancaster County	213641	218226	2.101	0.611	215022	0.642	0.420
31	153 Sarpy County	102583	104050	1.410	0.492	103780	1.154	0.483
32	003 Clark County	741459	759866	2.422	0.518	758692	2.271	0.521
32	031 Washoe County	254667	258890	1.634	0.556	261007	2.429	0.510
33	011 Hillsborough County	336073	335652	-0.125	0.578	338911	0.838	0.500
33	013 Merrimack County	120005	121598	1.310	0.636	120910	0.748	0.539
33	015 Rockingham County	245845	246967	0.454	0.586	247556	0.691	0.546
33	017 Strafford County	104233	104021	-0.204	0.583	105081	0.807	0.557
34	001 Atlantic County	224327	227837	1.561	0.546	226943	1.153	0.374
34	003 Bergen County	825380	829281	0.470	0.580	820928	-0.542	0.786
34	005 Burlington County	395046	401239	1.539	0.645	394939	-0.032	0.568
34	007 Camden County	502824	510058	1.418	0.621	503429	0.120	0.719
34	011 Cumberland County	138053	140210	1.538	0.530	139656	1.148	0.379
34	013 Essex County	778206	802268	2.999	0.560	799678	2.685	0.782
34	015 Gloucester County	230082	233020	1.261	0.699	229106	-0.426	0.624
34	017 Hudson County	553099	568477	2.705	0.577	569258	2.839	1.107
34	019 Hunterdon County	107776	107861	0.079	0.603	108451	0.623	0.745
34	021 Mercer County	325824	331440	1.694	0.544	328647	0.859	0.554
34	023 Middlesex County	671780	677682	0.871	0.548	672992	0.180	0.712
34	025 Monmouth County	553124	556412	0.591	0.574	550805	-0.421	[illegible]
34	027 Morris County	421353	425501	0.975	0.717	419138	-0.529	[illegible]
34	029 Ocean County	433203	433516	0.072	0.599	429899	-0.769	[illegible]
34	031 Passaic County	453060	461845	1.902	0.541	459194	1.336	0.858
34	035 Somerset County	240279	241669	0.575	0.578	239512	-0.320	0.617
34	037 Sussex County	130943	132073	0.856	0.729	131218	0.210	0.536
34	039 Union County	493819	503004	1.826	0.588	497433	0.727	0.778
35	001 Bernalillo County	480577	497633	3.427	0.318	491854	2.293	0.457
35	013 Dona Ana County	135510	141574	4.283	0.545	139939	3.165	0.665
36	001 Albany County	292594	295111	0.853	0.530	293849	0.427	0.654
36	005 Bronx County	1203789	1245874	3.378	0.730	1265768	4.897	1.41
36	007 Broome County	212160	212548	0.183	0.541	213689	0.716	0.45
36	013 Chautauqua County	141895	141997	0.072	0.525	143047	0.805	0.53
36	027 Dutchess County	259442	261192	0.662	0.543	261808	0.896	0.45
36	029 Erie County	968532	976594	0.826	0.588	969213	0.070	0.65
36	045 Jefferson County	110943	112132	1.060	0.562	112635	1.503	0.71
36	047 Kings County	2300664	2379096	3.329	0.592	2389150	3.704	0.90
36	055 Monroe County	713968	722929	1.240	0.536	716126	0.301	0.64
36	059 Nassau County	1287348	1296128	0.677	0.571	1277449	-0.775	0.82
36	061 New York County	1487536	1537991	3.281	0.596	1541441	3.497	0.94
36	063 Niagara County	220756	221792	0.467	0.537	220729	-0.012	0.51
36	065 Oneida County	250836	251805	0.385	0.510	252906	0.819	0.44
36	067 Onondaga County	468973	472839	0.818	0.532	469750	0.165	0.45
36	071 Orange County	307647	309752	0.680	0.564	310882	1.040	0.45
36	075 Oswego County	121771	121870	0.081	0.623	122882	0.904	0.61
36	081 Queens County	1951598	2004192	2.624	0.624	1992006	2.029	0.81
36	083 Rensselaer County	154429	154995	0.365	0.535	155072	0.415	0.5
36	085 Richmond County	378977	384265	1.371	0.533	378782	-0.052	0.7
36	087 Rockland County	265475	269627	1.560	0.688	264771	-0.266	0.7
36	089 St. Lawrence County	111974	112733	0.673	0.594	113179	1.044	0.4
36	091 Saratoga County	181276	181488	0.117	0.615	181850	0.316	0.5
36	093 Schenectady County	149285	149852	0.378	0.524	148589	-0.468	0.7

36	103	Suffolk County	1321864	1330743	0.667	0.576	1313346	-0.649	0.72
36	111	Ulster County	165304	167147	1.103	0.612	167385	1.244	0.73
36	119	Westchester County	874866	890648	1.772	0.641	879705	0.550	0.68
[illegible]	001	Alamance County	108213	111418	2.877	0.439	109811	1.455	0.40
[illegible]	021	Buncombe County	174821	179768	2.752	0.465	177162	1.321	0.41
37	035	Catawba County	118412	122063	2.991	0.498	120094	1.401	0.42
37	051	Cumberland County	274566	284189	3.386	0.419	280604	2.152	0.51
37	057	Davidson County	126677	130509	2.936	0.580	128544	1.453	0.45
37	063	Durham County	181835	188378	3.473	0.462	185785	2.126	0.57
37	067	Forsyth County	265878	274462	3.128	0.430	270363	1.659	0.44
37	071	Gaston County	175093	177824	1.536	0.464	177837	1.543	0.45
37	081	Guilford County	347420	358847	3.184	0.443	353615	1.752	0.56
37	119	Mecklenburg County	511433	528981	3.317	0.424	523306	2.269	0.55
37	129	New Hanover County	120284	124111	3.084	0.438	122381	1.714	0.54
37	133	Onslow County	149838	154392	2.950	0.374	153141	2.157	0.41
37	147	Pitt County	107924	110732	2.536	0.423	110516	2.345	0.55
37	151	Randolph County	106546	109790	2.955	0.595	108009	1.354	0.43
37	155	Robeson County	105179	108097	2.699	0.452	107475	2.136	0.53
37	159	Rowan County	110605	111420	0.732	0.524	112305	1.514	0.3
37	183	Wake County	423380	438428	3.432	0.434	432630	2.138	0.49
37	191	Wayne County	104666	107153	2.321	0.401	106769	1.969	0.39
38	017	Cass County	102874	105012	2.036	0.571	103452	0.559	0.4
39	003	Allen County	109755	111410	1.486	0.510	110262	0.460	0.4
39	017	Butler County	291479	295537	1.373	0.535	292902	0.486	0.3
39	023	Clark County	147548	149800	1.503	0.519	148179	0.426	0.4
39	025	Clermont County	150187	151277	0.721	0.514	150784	0.396	0.5
39	029	Columbiana County	108276	107346	-0.679	0.584	108375	0.091	0.5
39	035	Cuyahoga County	1412160	1429431	1.210	0.431	1427932	1.106	0.4
39	045	Fairfield County	103461	103995	0.516	0.427	103594	0.129	0.5
39	049	Franklin County	961437	970249	0.908	0.463	975539	1.446	0.5
39	057	Greene County	136731	138166	1.039	0.632	137700	0.704	0.3
39	061	Hamilton County	866228	876347	1.155	0.424	874795	1.205	0.4
39	085	Lake County	215499	216985	0.685	0.519	216122	0.288	0.3
39	089	Licking County	128300	129042	0.575	0.432	128558	0.201	0.5
39	093	Lorain County	271126	275982	1.760	0.520	272668	0.565	0.3
39	095	Lucas County	462361	465553	0.686	0.477	467096	1.014	0.4
[illegible]	099	Mahoning County	264806	268995	1.557	0.528	266443	0.614	0.3
[illegible]	103	Medina County	122354	123157	0.652	0.514	122484	0.106	0.4
[illegible]	113	Montgomery County	573809	583903	1.729	0.528	580267	1.113	0.4
39	133	Portage County	142585	144241	1.148	0.573	143615	0.717	0.5
39	139	Richland County	126137	127829	1.324	0.520	126535	0.314	0.4
39	151	Stark County	367585	372544	1.331	0.525	368829	0.337	0.3
39	153	Summit County	514990	523958	1.712	0.520	518979	0.769	0.4
39	155	Trumbull County	227613	230339	1.097	0.560	228736	0.403	0.3
39	165	Warren County	113909	114657	0.452	0.498	114158	0.218	0.3
39	169	Wayne County	101641	100828	-0.628	0.605	101745	0.279	0.6
39	173	Wood County	113269	113881	0.537	0.446	113812	0.565	0.4
40	027	Cleveland County	174253	178292	2.265	0.446	177845	2.020	0.5
40	031	Comanche County	111486	114833	2.915	0.418	113736	1.996	0.5
40	109	Oklahoma County	599611	613697	2.295	0.419	612788	2.150	0.5
40	143	Tulsa County	503341	514637	2.195	0.453	512955	1.874	0.5
41	005	Clackamas County	278850	279977	0.403	0.724	281892	1.079	0.4
41	029	Jackson County	146389	150125	2.489	0.537	149287	1.941	0.4
41	039	Lane County	282912	289415	2.247	0.551	289266	2.197	0.4
41	047	Marion County	228483	234494	2.563	0.508	233587	2.185	0.4
41	051	Multnomah County	583887	598049	2.368	0.489	593788	1.668	0.4
41	067	Washington County	311554	314044	0.793	0.688	315806	1.346	0.4
42	003	Allegheny County	1336449	1346520	0.748	0.600	1331707	-0.356	0.7
42	007	Beaver County	186093	186376	0.152	0.593	185256	-0.452	0.4
42	011	Berks County	336523	337434	0.270	0.536	338569	0.604	0.4
42	013	Blair County	130542	130430	-0.086	0.532	131077	0.408	0.4
42	017	Bucks County	541174	545735	0.836	0.726	537873	-0.614	0.4
42	019	Butler County	152913	153223	0.790	0.660	152898	0.579	0.4
42	021	Cambria County	163029	162949	-0.049	0.556	163876	0.517	0.4
42	027	Centre County	123786	124397	0.491	0.570	125635	1.472	0.1
42	029	Chester County	374394	380542	1.090	0.704	377088	0.184	0.1
42	041	Cumberland County	195257	195365	0.055	0.575	195256	-0.001	0.1
42	043	Dauphin County	237813	241035	1.337	0.552	239154	0.561	0.
42	045	Delaware County	547651	554003	1.147	0.694	545044	-0.475	0.
42	049	Erie County	275572	276888	0.475	0.529	277235	0.600	0.
[illegible]	051	Fayette County	145351	145958	0.416	0.742	146681	0.907	0.
[illegible]	055	Franklin County	121082	122079	0.817	0.632	122180	0.899	0.

42	069	Lackawanna County	219039	218814	-0.103	0.532	217294	-0.803	0.73[illegible]
42	071	Lancaster County	422822	423976	0.272	0.564	426528	0.869	0.523
42	075	Lebanon County	113744	113779	0.031	0.543	114518	0.676	0.589
42	077	Lehigh County	291130	291961	0.285	0.515	289980	-0.396	0.66[illegible]
42	079	Luzerne County	328149	327768	-0.116	0.546	326439	-0.524	0.593
42	081	Lycoming County	118710	118822	0.094	0.538	119511	0.670	0.493
42	085	Mercer County	121003	121190	0.154	0.552	121627	0.513	[illegible]
42	091	Montgomery County	678111	683019	0.719	0.697	673620	-0.667	[illegible]
42	095	Northampton County	247105	247686	0.235	0.527	246917	-0.076	[illegible]
42	101	Philadelphia County	1585577	1606249	1.287	0.609	1608942	1.452	0.742
42	107	Schuylkill County	152585	153416	0.542	0.631	152989	0.264	0.525
42	125	Washington County	204584	205463	0.428	0.738	204548	-0.018	0.506
42	129	Westmoreland County	370321	371539	0.328	0.750	369009	-0.356	0.551
42	133	York County	339574	340569	0.292	0.572	341321	0.512	0.472
44	003	Kent County	161135	161498	0.225	0.654	159355	-1.117	0.776
44	007	Providence County	596270	597016	0.125	0.580	597960	0.283	0.697
44	009	Washington County	110006	110452	0.404	0.638	110982	0.880	0.633
45	003	Aiken County	120940	124770	3.070	0.542	123291	1.907	0.403
45	007	Anderson County	145196	149574	2.927	0.502	147268	1.407	0.375
45	015	Berkeley County	128776	133468	3.515	0.555	132081	2.502	0.472
45	019	Charleston County	295039	304829	3.212	0.437	302751	2.547	0.580
45	041	Florence County	114344	118062	3.149	0.453	116765	2.056	0.654
45	045	Greenville County	320167	330290	3.065	0.494	325537	1.650	0.467
45	051	Horry County	144053	147841	2.562	0.452	146650	1.771	0.455
45	063	Lexington County	167611	173083	3.162	0.583	170341	1.602	0.375
45	079	Richland County	285720	295225	3.220	0.421	293299	2.584	0.566
45	083	Spartanburg County	226800	233790	2.990	0.489	230616	1.654	0.374
45	085	Sumter County	102637	105121	2.363	0.403	105017	2.267	0.500
45	091	York County	131497	133960	1.839	0.454	133717	1.660	0.609
46	099	Minnehaha County	123809	126103	1.819	0.578	124220	0.331	0.442
47	037	Davidson County	510784	532433	4.066	0.521	522044	2.157	0.617
47	065	Hamilton County	285536	293917	2.852	0.442	290664	1.764	0.512
47	093	Knox County	335749	345081	2.704	0.466	341481	1.679	0.582
47	125	Montgomery County	100498	104034	3.399	0.463	102468	1.923	0.518
47	149	Rutherford County	118570	122462	3.178	0.466	120716	1.778	0.511
47	157	Shelby County	826330	861616	4.095	0.432	847848	2.538	0.589
47	163	Sullivan County	143596	146794	2.179	0.489	145270	1.152	0.437
47	165	Sumner County	103281	105733	2.319	0.586	104756	1.408	0.343
48	027	Bell County	191088	197377	3.186	0.387	195808	2.410	0.563
48	029	Bexar County	1185394	1220995	2.916	0.498	1230141	3.638	[illegible]
48	039	Brazoria County	191707	196965	2.670	0.484	195577	1.979	[illegible]
48	041	Brazos County	121862	126396	3.587	0.520	125880	3.192	[illegible]
48	061	Cameron County	260120	269905	3.625	0.754	268659	3.178	0.903
48	085	Collin County	264036	271624	2.794	0.479	269169	1.900	0.613
48	113	Dallas County	1852810	1929504	3.975	0.408	1912100	3.101	0.62[illegible]
48	121	Denton County	273525	282791	3.277	0.444	279483	2.132	0.69[illegible]
48	135	Ector County	118934	122783	3.135	0.461	121298	1.949	0.58[illegible]
48	141	El Paso County	591610	611278	3.218	0.611	617397	4.177	0.89[illegible]
48	157	Fort Bend County	225421	233251	3.357	0.459	230752	2.310	0.33[illegible]
48	167	Galveston County	217399	223599	2.773	0.388	221787	1.979	0.48[illegible]
48	183	Gregg County	104948	107799	2.645	0.417	106936	1.860	0.52[illegible]
48	201	Harris County	2818199	2939388	4.123	0.421	2915587	3.340	0.63
48	215	Hidalgo County	383545	399356	3.959	0.883	399991	4.112	0.84
48	245	Jefferson County	239397	246592	2.918	0.488	243776	1.796	0.44
48	303	Lubbock County	222636	229852	3.139	0.466	228182	2.430	0.59
48	309	McLennan County	189123	194533	2.781	0.393	193347	2.185	0.54
48	329	Midland County	106611	109988	3.070	0.466	108645	1.872	0.49
48	339	Montgomery County	182201	186761	2.442	0.500	185687	1.877	0.44
48	355	Nueces County	291145	299681	2.848	0.533	301959	3.581	0.71
48	423	Smith County	151309	155316	2.580	0.390	154321	1.952	0.39
48	439	Tarrant County	1170103	1212831	3.523	0.405	1200703	2.549	0.54
48	441	Taylor County	119655	123143	2.833	0.479	122112	2.012	0.57
48	453	Travis County	576407	594107	2.979	0.447	596444	3.360	0.6[illegible]
48	479	Webb County	133259	138180	3.576	0.771	137203	2.889	1.2[illegible]
48	485	Wichita County	122378	125621	2.582	0.460	126508	1.711	0.5[illegible]
48	491	Williamson County	139551	143640	2.847	0.503	142643	2.182	0.3[illegible]
49	011	Davis County	187941	190520	1.354	0.734	190068	1.119	0.7[illegible]
49	035	Salt Lake County	725956	736793	1.471	0.433	735135	1.249	0.4[illegible]
49	049	Utah County	263590	268891	1.971	0.628	271102	2.771	0.6[illegible]
49	057	Weber County	158330	160566	1.393	0.381	160318	1.240	0.5[illegible]
50	007	Chittenden County	131761	132031	0.205	0.387	132975	0.913	0.5[illegible]
51	013	Arlington County	170936	178147	4.048	0.491	175566	2.637	0.7[illegible]

51	041 Chesterfield County	209274	216590	3.378	0.584	212658	1.591	0.432
51	059 Fairfax County	818584	826402	0.946	0.575	833668	1.809	0.501
	087 Henrico County	217881	224759	3.060	0.546	221878	1.801	0.506
	153 Prince William County	215686	218414	1.249	0.585	220359	2.121	0.425
	510 Alexandria city	111183	112768	1.388	0.541	114451	2.856	0.771
51	550 Chesapeake city	151976	153512	1.001	0.556	155185	2.068	0.509
51	650 Hampton city	133793	139284	3.942	0.459	137415	2.636	0.617
51	700 Newport News city	170045	178053	4.498	0.468	175121	2.899	0.689
51	710 Norfolk city	261229	273457	4.472	0.444	269011	2.893	0.733
51	740 Portsmouth city	103907	108477	4.213	0.474	106837	2.742	0.695
51	760 Richmond city	203056	209959	3.288	0.549	208987	2.838	0.817
51	810 Virginia Beach city	393069	408213	3.710	0.487	402092	2.244	0.558
53	005 Benton County	112560	115161	2.259	0.556	115073	2.184	0.445
53	011 Clark County	238053	245741	3.129	0.555	241186	1.299	0.533
53	033 King County	1507319	1536441	1.895	0.519	1531673	1.590	0.612
53	035 Kitsap County	189731	196029	3.213	0.531	193702	2.050	0.425
53	053 Pierce County	586203	607187	3.456	0.502	597344	1.865	0.541
53	061 Snohomish County	465642	470715	1.078	0.625	471683	1.281	0.537
53	063 Spokane County	361364	370081	2.355	0.539	365976	1.260	0.577
53	067 Thurston County	161238	166421	3.114	0.542	164464	1.962	0.425
53	073 Whatcom County	127780	131437	2.782	0.532	130903	2.386	0.487
53	077 Yakima County	188823	196444	3.880	0.499	195170	3.252	0.557
54	039 Kanawha County	207619	213488	2.749	0.492	210468	1.354	0.443
55	009 Brown County	194594	197594	1.518	0.540	195417	0.421	0.428
55	025 Dane County	367085	373810	1.799	0.541	370065	0.805	0.441
55	059 Kenosha County	128181	130580	1.837	0.548	128869	0.534	0.392
55	073 Marathon County	115400	116699	1.113	0.555	115646	0.213	0.516
55	079 Milwaukee County	959275	969329	1.037	0.459	975296	1.643	0.598
55	087 Outagamie County	140510	142519	1.410	0.543	141059	0.390	0.428
55	101 Racine County	175034	178398	1.886	0.522	176209	0.667	0.366
55	105 Rock County	139510	141935	1.709	0.558	140129	0.441	0.395
55	117 Sheboygan County	103877	105288	1.340	0.537	104218	0.327	0.445
55	133 Waukesha County	304715	306312	0.521	0.454	305387	0.220	0.361
55	139 Winnebago County	140320	142464	1.505	0.549	140855	0.380	0.418

Mr. MILLER. Thank you all very much for being here today. We appreciate the expertise that all three of you bring.

Let me start with a couple of questions. Let me just go on record; all of you—and correct me if I'm wrong—believe that sampling was a failure in 1990? If they use sampling and adjustment, that would have been worse than the full enumeration that was used; is that correct?

Mr. DARGA. Yes.

Mr. COFFEY. Yes.

Mr. STARK. Yes; statistics means never having to say you're certain. [Laughter.]

I'm almost certain. [Laughter.]

Mr. MILLER. From what you know about the 2000 plan, what is your belief that it will be a success—that we'll have a miraculous census?

Mr. STARK. I don't see anything in the proposal for 2000 that would alleviate what I see the primary problems of what was done in 1990.

Using a larger sample size, in some sense, to stretch this rifle analogy further, is like having a more accurate rifle. If you don't sight it in, you might be able to hit the same spot every time, but that's not going to be the bull's eye. The problem is the bias. What increasing the sample size might do is decrease the scatter, but that doesn't make your shot land closer to the bull's eye, necessarily.

Mr. COFFEY. Bias problems, generally, are quite resistant to changes in sample size. Typically, when you're taught about bias in your first course in statistics, it's that constant term that sits out there after you divide by "n," as you may know. As I indicated in some of my comments toward the end of the oral statement, and also in my written statement, my best guess is that some of these bias problems are actually going to increase.

I am even more concerned that some of the auxiliary information that has always been available for you to, at least, catch some of the errors you've created and possibly fix them, is going to be submerged in just a sea of noise of lots of new kinds.

Mr. DARGA. See, I'm also very concerned about the plans for sampling in the next census. In 1990, it would have resulted in disastrous inaccuracies at the local level and major inaccuracies even at the national level, and I'm concerned about the same problem in the year 2000.

It's not just due to small problems in execution, if the Census Bureau tries a little bit harder they can do a better job, but it's due to the impossibility of accomplishing the task by that particular method.

Mr. MILLER. The people that are opposed to sampling have been referred to as Luddites, in that they oppose modern approaches to using new technology and such. How would each of you respond to that idea, that it was actually even Mr. Sawyer's comment? And is there kind of a myth out there that it is no longer possible to count everybody, and we should just give up and use modern techniques. How do you respond to that?

Mr. STARK. Well, accepting the premise that sampling is a new idea—[laughter]—not every new idea is good, and no good idea

solves every problem, and this is a bit like taking a yardstick that's 2 inches too short and trying to do a job that you need a micrometer to do. The bias is large, the instrument is crude. What we need is not a low-tech solution; we need a better count.

Mr. MILLER. How about the fact that many of your colleagues—certainly not all of them—[laughter]—in the statistical community, academic community, believe the only solution is sampling. How do you address that issue?

Mr. STARK. I take it you're referring, for example, to the National Academy of Sciences reports.

Mr. MILLER. Maybe that one or the American Statistical Association.

Mr. STARK. Well, when I try to come to a scientific conclusion, I've been trained to place more weight on the evidence than on the letterhead that the evidence is on. I read the National Academy reports; I found the evidence quite weak. There are no data on which the conclusions are based. There is no mathematical theory on which the conclusions are based. The recommendation of sampling in National Academy reports seems to be based on loose analogies, to very idealized circumstances under which sampling would be a good idea.

Mr. MILLER. Does anyone else wish to comment about, as far as the perception is out there, that everybody is a Luddite if they don't believe in sampling or that because of the American Statistical Association statisticians professionally think this is the only solution?

Mr. COFFEY. I've probably seen more bad samples than everybody else sitting at the table. [Laughter.]

Lots of them came across my desk every day at OMB. Sampling is not the solution to every problem, and frequently, the kind of difficulty we had was moving an agency toward an effective sampling strategy and away from a poor one.

There really are no analogs to the task that the Census Bureau does in performing the enumeration. You can't draw analogs, analogies, with other kinds of statistical work. It is a unique task in the whole world. It's the largest data collection that anybody does. You really have to think through each problem on its merits; look for the solutions to that problem; and avoid the trap of trying to draw simple analogies with other kinds of problems that aren't really comparable.

Mr. MILLER. Thank you.

Mr. DARGA. I see the question is not really being in favor of sampling or being opposed to sampling, but evaluating a particular methodology for using sampling to address a particular problem. I can't say that I am opposed to sampling. That would be kind of like a carpenter saying that he's opposed to hammers. That doesn't mean that sampling should be used for every purpose in any manner. Now the particular methodology that's been proposed for using sampling in the census is a very seriously flawed methodology.

Thank you.

Mr. MILLER. Thank you all very much.

Mrs. MALONEY. Thank you. I'd like to ask each of you, despite the fact that the Census Bureau made improving the count among minorities a major goal of the 1990 census, the 4.4 percent differen-

tial in the 1990 undercount between blacks and non-blacks was the highest ever recorded. Experts have repeatedly said that spending more money on traditional methods will not reduce this differential. If not through statistics, how do you propose to reduce this differential Dr. Stark?

Mr. STARK. I think—I'm obviously not an expert on policy—but I think the way to get more accurate counts would be to get a higher response rate, and that is a policy issue. What can be done to encourage a higher fraction of people, especially people for whom the undercount appears to be differential, to respond? One issue—one question is where the 4.4 percent number is coming from, because there are uncertainties in the demographic estimates and there are also, obviously, uncertainties in the sampling-based estimates. So, how one gets at ground truth is really rather touchy, and how one comes up with this figure is really rather difficult.

I deeply believe that the capture—recapture survey-based methods like the PES or the ICM add more error than they fix, and I don't believe that they're the solution. I don't necessarily have a better idea on the statistical side. I think the way to improve things is to count better.

Mrs. MALONEY. Would you like to respond, Dr. Coffey, or Mr. Darga? I mean, the undercount is undisputed, and it's growing. So, if you don't use statistics, what do you do to correct it?

Mr. COFFEY. I'd have to reserve judgment on both those scores. The undercount in 1990 is 2.1 percent, or 1.8 percent, or 1.6 percent, or 1.2 percent, or 0.9 percent, or 0.6 of a percent. Frankly, I have——

Mrs. MALONEY. But it's there.

Mr. COFFEY [continuing]. Difficulty choosing. [Laughter.]

There may be something there. [Laughter.]

I would certainly expect that with the kind of evidence you see, there is something there having a factor of three difference between the lowest and the highest. It does not leave me with a sense of comfort that I can draw conclusions, certainly not the same conclusions, if I'd believe 2.1 as if I'd believe 0.6. Think about the 0.6; if a substantial portion of the real undercount is unobserved, you are then looking at the attributes. You're measuring the attributes of a modest fraction of the uncounted population. To the extent that those are consistent with the kinds of analysis that you get out of demographic analysis. You probably have some reason for thinking that's something you should believe.

On the other hand, if you look at what the committee did—and these were very sharp people—it reached the point where they are starting to question some of the possible errors in demographic analysis—looking for sources of error to bring it down closer to the lower figure.

The one thing that I came away with from reading that report was that I am not at all sure what the level is. I am not at all sure which people—I have less confidence in the policies aimed at capturing identified portions of the undercount in the absence of sure analysis of what the attributes of this uncounted population are. Basically, if somebody came along and said, you know, "I've got a strategy for going after 10 different subgroups." I'd say that's a better strategy than going after four, because I can't be sure which

groups are really out there. I don't like the idea of trying to find two in a policy that may be based on inaccurate information. To the extent that you can go after or implement policies that will improve response generally, that will, or can, go after groups that you think may be—on whatever evidence——

Mrs. MALONEY. We have roughly a 60-year history of higher undercounts for African-Americans. Are you suggesting that we do nothing?

Mr. COFFEY. No, not at all. I've——

Mrs. MALONEY. And it's not just the undercount, it's the overcount. The Census Bureau says 10 million undercounted, 6 million overcounted; that's a 16 million error. Are you suggesting we do nothing? It's undisputed that there is a large undercount for African-Americans. What do you suggest we do about it?

Mr. COFFEY. Well, the methodology that was being used in the PES, precisely, leads you to that conclusion. It does dispute the size of the undercount in demographic analysis.

Mrs. MALONEY. Well, for 60 years they've been——

Mr. COFFEY. I believe——

Mrs. MALONEY [continuing]. Talking about it, reporting on it.

Mr. COFFEY. I believe demographic analysis, like most of the experts, is more reliable which makes me fall down on the side of, well, this other newer methodology probably isn't working as well.

Mrs. MALONEY. Well, let's hear from the demographer.

Mr. DARGA. OK. [Laughter.]

Mrs. MALONEY. Again, we have an undercount. What do you suggest we do about it?

Mr. DARGA. Well, there are two things that we could do about it. The first is to do the best possible census that we can. And the second, since we obviously don't know how to do a valid adjustment for undercount in the census—the Census Bureau also, in addition to conducting the census, prepares population estimates and population projections.

It may be possible, at least at some levels of geography, to do a valid estimate of population undercount through the Estimates Program. Not to do an adjustment to the census, and not at the smallest local level where an adjustment would destroy the value of the census, and the validity of the data—but to do an estimate only at those levels of geography where the estimate makes sense.

Mrs. MALONEY. Well, I have a series of more questions, but my time is up. At this point, I send out a second round, or not?

Mr. MILLER. I'm not sure we'll have time for a second round, but we'll certainly be able to submit questions and ask you to respond, if you would, because we do have a third panel. I think we'll have time to complete it.

We'll go in the order that everyone arrived, so we'll go with Mr. Snowbarger next.

Mr. SNOWBARGER. First of all, Mr. Darga, it's my understanding from your paper, that one of the ratios that we know is the ratio of male-to-female children. That's one of the most stable demographic statistics that we have, and I think that's 51 percent boys to 49 percent girls. You mentioned that the adjusted census counts are far from the norm, and that doesn't quite make sense to me. Could you explain that in further detail?

Mr. DARGA. OK. When I was reviewing the undercount adjustments, one of the things I noticed was that there were a number of areas of the country, and subgroups of the population, for which the adjustment for boys under the age of 10 was very different from the adjustment for girls under the age of 10. On page 12 of my paper, I list 18 segments of the population for which the discrepancy was over 10 percentage points. In demography, a fraction of a percentage point is often a big deal, but here, we're talking about a 10 percentage point difference in the size of these populations that would result from the undercount adjustment.

So, I saw that this was an opportunity to evaluate whether the adjustment was valid or not. If these areas of the country really did have such terrible differential undercounts between boys and girls, we should be able to look at the census data for these areas, and we'll see that they don't follow this 51 to 49 ratio that we find everywhere else in the country.

On page 14 of my paper, I have a table that shows 51 percent boys for every race and for every region, with very small variation among metropolitan areas. And then, if you look at these areas for which the Post Enumeration Survey suggested huge differential undercounts for boys and girls, we find 51 percent, 52 percent, 51, 51, 51, 51, 51, 51, 51. There was no differential undercount of boys and girls in these regions. These regions are right in line with every place else in the country. And yet, the Post Enumeration Survey didn't suggest 51, 51, 51. It suggested 49, 55, 56, 48, 53, 49, 48, 54, 48—wild variation in the data after you adjust it.

Mr. SNOWBARGER. Does this go to the bias that we've been talking about? Is that a potential answer to that? I'm going to give all of you a little bit more time to explain this in layman's terms, what bias is all about and, hopefully, you can be a little bit more specific about the bias that you saw in the 1990 Post Enumeration Survey. Dr. Stark.

Mr. STARK. Just heuristically, bias means that if you measure things repeated times, your measurements tend to be all off in the same direction. It's like using a ruler that's too short, using a watch that runs fast, something like that. Yes, there's going to be some fluctuation in how long it takes you to get to work when you measure it on your watch, but you're always going to think it takes longer than it really does if your watch runs fast.

There are a number of sources of bias in these adjustments to the census. Many of them involve the models that are the premise for this Dual System Estimator that's been mentioned before, the idea that you catch people one time with the census, you catch them again with the survey. You look at the overlap; you look at the number that was missed, one compared to the other; and you infer how many neither of them saw. That's the fourth cell that Dr. Coffey was talking about.

In order to infer what's going on in that fourth cell, you have to assume a very special relationship between what's going on in the three cells that you do see and the fourth cell that you don't see. We know that that relationship doesn't really hold, and as a result of that, you get bias in the estimates.

Now the Census Department, the CAPE report, and other people have tried to look at the bias that results from that relationship

not holding, as well as bias from other things. One of the issues—a very difficult issue, and a very critical one, is what do you do with the unresolved cases? You've tried to match up the census with the Post Enumeration Survey—I'm sorry, I'm using your time here—you do followup on some cases, and there's some cases where you simply don't know whether there's a match or not. It turns out that, depending on what you do with the cases that you were unable to resolve, you can turn the adjustment, the estimate of undercount, from an undercount of 9 million people to an overcount of 1 million people, depending on what you do with these people whom you just don't know what's going on for. Now there's a model that's used to infer how you want to classify those people whom you can't classify. And the result depends crucially on what you do there.

Mr. SNOWBARGER. Mr. Chairman, I know my time has expired. Could we allow the other two to, maybe, quickly answer the same question?

Mr. MILLER. If they're short answers because we are running out of time.

Mr. DARGA. You asked if it's due to bias. It's due to a combination of sampling error and measurement error or bias. Sampling error is where, the experience of the area selected for the sample isn't totally representative of what's happening in the broader area, and measurement error is where you don't even get an accurate measurement of what's happening within your sample. So, it's a combination of sampling error and non-sampling measurement error.

Mr. SNOWBARGER. Thank you, Mr. Chairman.

Mr. MILLER. Thank you. Mr. Davis.

Mr. DAVIS of Virginia. Let me just say from my perspective, if you're concerned about overcounts in one group or another, the one thing you don't want to do is replace one set of inaccuracies with another set of inaccuracies, and I think that's our concern here. We do know that there are ways to focus on a better count, and that there are some very tangible things that we can do to bring it up if we'll give it the appropriate focus.

I've got a few questions for Mr. Darga. I wonder if you could explain, in laymen's terms, the problems that the Bureau faces in matching census data to the PES data. You mentioned in your opening statement that the Census Bureau listed six serious sources of error that caused sample results to be unreliable. I wonder if you could list those again?

Mr. DARGA. OK. They were survey-matching error, fabrication of interviews, ambiguity or misreporting of usual residence, geo-coding errors, unreliable interviews, and unresolvable cases.

Mr. DAVIS of Virginia. What about matching errors? Can you explain what——

Mr. DARGA. OK.

Mr. DAVIS of Virginia [continuing]. They are?

Mr. DARGA. OK. Well, the Census Bureau first does the census, then they do the Post Enumeration Survey. Then, to find out who was missed in the census, they match the results of those two surveys person by person. And if you make a mistake in matching, if you really do have the same person in both surveys, but you fail

to match them—you don't realize that you have them in both surveys—then you're identifying undercount where there is no undercount.

And it turns out that matching is an extremely difficult thing to do. Now, perhaps if we had a Social Security number in the census we'd be able to match accurately. But what we have is a name provided sometimes by a householder, and sometimes by proxy interviews with neighbors or landlords. It was particularly a problem in the Post Enumeration Survey when data was obtained from neighbors and landlords. So, it's very difficult to just look at the data and find out if it matches, and the Census Bureau demonstrated that in their evaluation of the Post Enumeration Survey.

Their method was to first have the match done by a computer, which took care of 75 percent of the cases—and we know that computers don't make mistakes, so we can assume that this 75 percent was 100 percent correct. But then, the remainder went to two independent teams. And the really disconcerting thing is that these two teams, using exactly the same data, and exactly the same guidelines, couldn't agree on who matched and who didn't. Of those classified as matched by the first team, 5.7 percent were classified as not matched by the second team. And another 4.5 percent were classified as unresolved, so that's 10 percent.

Now, if you realize that we are trying to measure an undercount of only 1.8 percent of the population, according to demographic analysis, having the data be so hard to match that you can't even agree on the match status of 10 percent of the cases that come before you, demonstrates that——

Mr. DAVIS of Virginia. You can be much more inaccurate——

Mr. DARGA. Right.

Mr. DAVIS of Virginia. [continuing]. From the sample then you would with just a regular count.

Mr. DARGA. That fact alone. The discrepancy between these two teams of matchers, by itself, invalidates any adjustment based on the Post Enumeration Survey.

Mr. DAVIS. So, some of the challenges involved in matching records between the actual enumerations and the sample census?

Mr. DARGA. OK, let's see. On page 9 of my paper, I have a whole page that lists some of those problems. Things like similarity of names, or the use of aliases in either the census or the Post Enumeration Survey, can make it difficult to match people. People who move are an extremely serious problem. Mr. Sawyer indicated that, we are a mobile society; people have multiple residences. That makes it hard to do a census, but it makes it impossible to do a Post Enumeration Survey and then match it with near 100 percent accuracy against the census. Those trends in our society are even more problematic for the adjustment methodology than they are for the census itself.

We heard discussion, also, of proxy interviews; 4.3 percent of the cases in the Post Enumeration Survey were proxy interviews—interviews with neighbors, or landlords, or other people in the neighborhood. For a census, you at least have a mail-out/mail-back methodology so that people on the go can at least turn in their census form. A Post Enumeration Survey is entirely interviewer-based, so it has a high level of proxy data. And when you try to match

the data that you gave in the census with the data that your neighbor gave in the Post Enumeration Survey, it's not going to be easy to see. Is Mindy the same person as Mandy? Is this 23-year old the same person as that 28-year old? It's extremely, extremely difficult to do a match with 100 percent accuracy.

Mr. DAVIS of Virginia. I think we get the picture now. OK, thank you. I think my time's up.

Mr. MILLER. Thank you very much. Mr. Shadegg.

Mr. SHADEGG. Thank you, Mr. Chairman. Let me begin with what I understand to be at least my articulation of a laymen's understanding of part of the problems with the Post Enumeration Survey and the projection of its results on populations that you didn't actually count. Any of you can comment on this description and tell me if it's accurate or inaccurate.

As I understand it, there are two problems. One, you make an assumption of a relationship between the people you are surveying and the people you are projecting that survey onto, and that assumption may or may not be accurate. There are inaccuracies in and of itself. Second, you base that assumption or that projection, based on that assumption, on the actual count of the first population, and there may be errors in it. So, you really have two compounding errors when you try to project from a known to an unknown. Is that right? Is that a fair description?

Mr. STARK. At least two.

Mr. COFFEY. Wouldn't—if there were only two? [Laughter.]

Mr. SHADEGG. There are at least two that I've been able to absorb. [Laughter.]

Mr. Darga, let me focus on a point you raised, because it's a point of grave concern to me. You said that at some levels of geography, you might be able to use a sampling method to try to make an approximation of numbers. But, the problem is that when you try to do sampling at the very small geographical areas which are the focus of the census, that is when we get down to, for example, redistricting or reapportionment or to allocation of Government resources based on the boundary line between several small towns. At that level, small geographical errors, is a particular problem with trying to use sampling methods to project accurate numbers.

Mr. DARGA. I don't know of a way to use sampling to estimate undercount, even at the national level.

Mr. SHADEGG. OK.

Mr. DARGA. I think that an estimate of undercount at the national level would be better based on demographic analysis.

Mr. SHADEGG. So even at that level for undercount, you think it's not wise?

Mr. DARGA. Right. Given the fact that a majority of the people identified as undercounted by the Post Enumeration Survey really aren't undercounted. Given that fact, we really need to reassess a lot of what we think we know about undercount.

Mr. SHADEGG. That's a message I've gotten here pretty consistently today.

Dr. Coffey, in your opinion, what was the single biggest problem with the 1990 survey, itself?

Mr. COFFEY. I was not—I had no firsthand experience with this. But looking at the report, itself, I would have to agree with my col-

league here that a lot of the difficult problems involve the dependence of that methodology on—a very sensitive dependence—on matching correctly. There appeared to be a number of issues raised by the expert panel which really seem to revolve around whether or not you were able to do a good match, whether you were properly—and it is critical for this four cell approach, that your matching determinations tells you which cells its in. If you get that wrong, the whole thing begins to come apart. So, I suspect that that might have been the largest problem with that particular approach.

Mr. SHADEGG. Of the various problems that you've identified, are any of them solved by the proposed method for 2000? Or, do you believe they are susceptible of solution?

Mr. COFFEY. As I said in my prepared statement, I don't think increasing the sample size is good truncating followup so that you get a much larger uncounted group are not going to be any good to solve the real problem that was identified in that 1992 evaluation. It may look a little better, but the core of bias from the tough cases will still be there and, in some respects, some of the problems are going to scale right up with the larger——

Mr. MILLER. Speak into the microphone if you would, please.

Mr. COFFEY. Some of the problems are going to scale right up with the larger tasks that you've created under the 2000 plan. The matching problem—you're now going to have a lot more matching to do. One, you're going to have a much larger sample. You're going to have more cases where, what happens if you try to match someone who happened to have been in that 10 percent that you decided not to enumerate? How do draw an inference there?

There are going to be much larger problems. And some of these are going to actually inflate the absolute level of bias over what the expert panel and the census committee found after the 1992 evaluation.

Mr. SHADEGG. One of the straightforward difficulties that I've had with the proposed sampling—and I've had constituents ask me about it at home—is, well, if we are going to do an, quote, unquote, "actual count," an actual enumeration of either 88 percent or 90 percent of the total population, and then we're going to sample, to decide the remaining 10 to 12 percent, "Well, how do we know that we got the 88 percent of the total or 90 percent of the total if we don't know what the total is?" Do any of you have an answer or response to that particular dilemma?

Mr. STARK. You don't know.

Mr. DARGA. Well, as I understand it, the source of that information is vacancy reports from letter carriers. [Laughter.]

Mr. SHADEGG. Great. [Laughter.]

Mr. DARGA. In the Census Bureau's preliminary testing, they found roughly, a 40 percent, disagreement between what the letter carriers reported as vacancy and what their own enumerators checking the letter carriers found reports. So, I'm very concerned that the information being used for that may not be accurate.

Mr. MILLER. Thank you.

Mr. SHADEGG. Can either of you other gentleman give me any assurance on that issue? Or do you share my concern?

Mr. STARK. I share your concern.

Mr. COFFEY. Yes.

Mr. SHADEGG. Thank you, Mr. Chairman.

Mr. MILLER. Thank you. Let me thank the three witnesses here today: Dr. Stark, coming from Berkeley, CA; Mr. Darga, coming from Lansing, MI; and Dr. Coffey, coming from——

Mr. COFFEY. Nearby Fairfax County, VA. [Laughter.]

Mr. MILLER. Fairfax County, VA—[laughter]—but with 30 years of experience within the statistical work in the Government.

We thank you very much, and you've provided a lot of help and insight into the problems we are facing. Thank you very much for being here.

[Followup questions and responses follow:]

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INDEPENDENT

May 15, 1998

Mr. Jerry L. Coffey, Ph.D.
9119 Tetterton Ave.
Vienna, VA 22182

Dear Mr. Coffey,

Thank you for testifying before the Government Reform and Oversight Subcommittee on the Census on May 5, 1998. Because of time constraints, I was left with a number of questions unanswered. Therefore, I request that you answer the following questions:

1. In your testimony you indicated some reservations about the "ground rules" of the CAPE Committee's evaluation. What were these reservations?

2. You stated that the 1.58% revised estimate of the 1990 undercount released by the Census Bureau still contained bias and that using the Census Bureau estimate of measured bias and their assumptions concerning the offsetting "correlation bias" from the CAPE report, their estimate not of bias was 1.2% of undercount. How does this compare to the similar figure attributed to the 1980 Census?

3. From your experience as a professional statistician, to what extent are errors experienced in an actual enumeration likely to appear in a sample as well?

4. In response to a question, you indicated that you had seen a lot of "bad" sampling. Can you elaborate? How do you determine when sampling is appropriate or effective?

5. In response to a question you implied a relationship between errors in measuring undercount and strategies for reducing the differential undercount. How does the former affect the latter?

My questions and answers will be part of the permanent record of the May 5, 1998 hearing. Again thank you for you insight into this important process.

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INDEPENDENT

Sincerely,

Dan Miller
Chairman
Subcommittee on the Census

cc: The Honorable Carolyn B. Maloney

Responses to Chairman Miller --

1. In your testimony you indicated some reservations about the "ground rules" of the CAPE evaluation. What were these reservations?

A. I have two reservations, both concerning the standards of accuracy being applied.

First, there is the emphasis on "state-level" accuracy. It is true that accuracy of the state totals alone would permit the Census Bureau to provide information that discharges its obligation for supporting apportionment (assigning a number of seats to each state). But this disregards (irresponsibly in my opinion) the need for accurate substate data with which to actually construct congressional districts. Important rights are at stake in the accuracy of this process and there is no other data base that will serve.

Second, even the standard of state-level accuracy is treated as an "average" standard. The CAPE expert panel found that adjusted totals looked all right on the average, with some exceptions. In other words the biases (most of the problem) were judged to be acceptable in most cases. This disregards the concept of individual fairness (discussed at length in my response to Maloney #2). Given what is at stake, one must question whether individual states or voters would (or should have to) live with this kind of judgment.

2. You stated that the 1.58% revised estimate of the 1990 undercount released by the Census Bureau still contained bias and that using the Census Bureau estimate of measured bias and their assumptions concerning the offsetting "correlation bias" from the CAPE report, their estimate not (sic) of bias was 1.2% undercount. How does this compare to the similar figure attributed to the 1980 Census?

A. I believe the phrase I used was "net of bias." The published estimate of 1.58% is the sum of measured undercount (the target group) and measured bias (DSE error that exaggerates the undercount). To get at the "best estimate" of overall undercount that can be inferred from the CAPE analysis, the "measured bias" must be subtracted out and the unmeasured undercount (the missing piece represented by the estimated correlation bias) must be added back in. The result is 1.58 - 0.73 + 0.38 = 1.23 or about 1.2%. Each of these terms has been revised (and they are still being revised) so this estimate is certainly not precise to hundredths of a percent, in fact, even the tenths position is soft. Thus the actual similarity between this 1.2% (plus or minus something) and the 1.2% (also plus or minus something) estimated for the 1980 Census is surely coincidence. I attended one of the near riots that followed release of the 1980 figures (with the huge "closure error") -- acceptance of the 1990 figures was relatively sedate by comparison. Attempts to draw fine comparisons based on numbers ten years apart from evolving methodologies in the face of unmeasured uncertainties is, at best, naive.

In terms of quality control, closure error (see Maloney question # 21), and the DSE measured undercount (0.85%), 1990 appears better than 1980. But if one selects other measures, 1980 looks better. When one considers the size of the uncertainties and the fact that the variance

(error) of the difference between two (independent) estimates is the SUM of variances (errors) in the two components, one would be hard pressed to find any significant difference in overall quality between 1980 and 1990.

3. From your experience as a professional statistician, to what extent are errors experienced in an actual enumeration likely to appear in a sample as well?

A. The errors that occur in an enumeration are what statisticians call "nonsampling errors." The introduction of sampling per se has no effect on these errors from sources other than sampling, it adds a new source of error (sampling error) to those sources that already exist. If no other changes are made, then the total error (consisting of both sampling and nonsampling error) increases. There is, however, an exception to this rule -- when the sample is small enough to permit use of improved enumeration methods that directly reduce these other errors.

The ASA Blue Ribbon Panel on the Census discussed this in its technical attachment to the 1996 Report --

> "The achievement of greater accuracy depends on how much more accurate the refined enumeration procedure is than the standard procedure and how much greater is its cost These factors need to be evaluated for each specific case to determine the comparative accuracy of census and sample results. It should also be noted that more refined enumeration methods can sometimes only be employed with smaller-scale, (i.e., sample), studies. Reasons for this include the need for highly trained enumerators who are available only in limited numbers and the use of burdensome questionnaires that can be employed only with a small sample."

The samples proposed for following up nonresponse are very large (not much smaller than the total nonresponding population that would be treated in full follow-up). This requires the same enumeration procedures (with the same contribution of nonsampling error) in the sample as would apply to the full follow-up alternative. If refinements that would reduce nonsampling error (the kind described by the Blue Ribbon Panel) were feasible on this large scale, then the cost of extending such refinements to full follow-up would be modest. (see also Maloney #24)

4. In response to a question, you indicated that you had seen a lot of "bad" sampling. Can you elaborate? How do you determine when sampling is appropriate or effective?

A. Probably the most blatant case was the use of sampling in furtherance of tax fraud. It is an interesting story, but (fortunately) relatively rare. A much more widespread abuse is the use of methods that produce wide error bands so that preferred interpretations are not excluded as inconsistent with the data. Another variation on this theme is the use of methods that are not robust so that different combinations of assumptions can be tested by the policy shop until some preferred result is produced. Statisticians know these risks better than most, but too often they salve their conscience with "caveats" and let the advocates do the damage.

Some of the red flags are:

1) "new" methods that have not been evaluated,
2) the choice of methods with large variance or bias when tighter methods would make the implicit assumptions more visible, and
3) use of non-robust methods (that are sensitive to assumptions) when more robust alternatives are available.

OMB frequently requires a SUCCESSFUL evaluation before approving such methods, but this doesn't always work.

5. In response to a question you implied a relationship between errors in measuring undercount and strategies for reducing the differential undercount. How does the former affect the latter?

A. This is discussed in detail in my response to Maloney #6 and #19.

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May 13, 1998

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Dear Mr. Darga,

Thank you for testifying before the Government Reform and Oversight Subcommittee on the Census on May 5, 1998. Because of time constraints, I was left with a number of questions unanswered. Therefore, I request that you answer the following questions:

1. Can you tell us about a statistical or scientific activity that you've worked on that either worked perfectly the first time you tried it, or that didn't work as well as you had hoped the first time so you abandoned the idea altogether without making an effort to improve or redesign it?

2. Despite the fact that the Census Bureau made improving the count among minorities a major goal of the 1990 Census, the 4.4 percent differential in the 1990 undercount between Blacks and non-Blacks was the highest ever recorded. Experts have repeatedly said that spending more money on traditional methods will not reduce this differential. If not through statistics, how do you propose to reduce this differential?

3. You have mentioned your concerns about block level accuracy. Can you discuss you thoughts on the accuracy of census numbers at the state level if Dual System Estimation is used in 2000? Do you have any evidence that suggests that the census counts will be more accurate at the state level in 2000 if DSE is not used?

4. Secretary Mosbacher, in testimony before both the House and the Senate, said that the Post Enumeration Survey would make the majority of the states more accurate. Is that statement correct? If so, why is his testimony so at odds with your testimony?

5. The 1990 census cost 20 percent more per household in real dollars than the 1980 census. The 1980 census cost twice as much per household in real dollars as the 1970 census. That is an increase in real dollar cost per household of 250 percent with no improvement in the differential undercount. Does that suggest to you that spending more on traditional methods will reduce the differential undercount?

6. Demographic analysis showed higher undercounts of African Americans than the undercounts demonstrated by the Post Enumeration Survey. That suggests that the Post Enumeration Survey understates, not overstates, the undercount, especially for minorities. In other words, isn't it likely that the 1990 census missed more African-Americans that would have been added back into the census by the Post Enumeration Survey?

7. You have talked a lot about bias in the Post Enumeration Survey but have not talked much about the bias in the census. The differential undercount measured by demographic analysis shows that bias in the census is quite real. If there is no Integrated Coverage Measurement, is it not the case that this bias in the census will continue?

8. Do you believe that it is acceptable for the census to consistently miss certain segments of the population -- Africans Americans, Latinos, Asian Americans, poor people in rural and urban communities -- at greater rates than the White population? If that is not acceptable, what do you propose be done to reduce the differential undercount? Can you offer any evidence that you proposal(s) will reduce the differential undercount?

9. It has been stated that one of the faults of the 1990 PES was correlation bias. Can you explain correlation bias? I understand that it is the likelihood that the people missed in the census may be the same people missed in the PES. Said another way, both the census and the survey miss the same people, for example, young Black males. How does correlation bias affect the accuracy count of those traditionally undercounted, Blacks, Hispanics, Asians, Native Americans, renters?

10. Wouldn't the only risk of correlation bias be minimization of the undercount rather than an overestimation the undercount?

11. In testimony before the Senate Committee on Governmental Affairs approximately one year ago, Dr. Lawrence Brown, Professor of Statistics at the University of Pennsylvania, stated that, "Statistical sampling methods can be used in an effective and objective way to assist the census process." Do you agree with Dr. Brown's statement? If you disagree, please explain why.

12. Dr. Lawrence Brown also testified before Senator Thompson that the Sampling for Nonresponse Follow-up plan "is an objective procedure all the way around

[and] has a very good chance of working as desired." Do you agree with that statement? If you disagree, please explain why.

13. In addition, Dr. Brown testified that the Census Bureau's 2000 census plan had been "drastically simplified and improved. ...[these changes] make it possible to now believe that the Integrated Coverage Measurement might work as well as desired to correct the undercount." Do you agree with that statement? If you disagree, please explain why.

14. With regard to concerns that the Integrated Coverage Measurement process could be manipulated to achieve a particular outcome in terms of the population counts, Dr. Brown testified that, "if all of this planning is done in advance, it is very, very hard for me to see how one could direct these subjective decisions towards any desired goal." Do you agree with Dr. Brown that if the procedures and protocols for the Integrated Coverage Measurement are set forth in advance and subject to expert and public scrutiny, that it is very unlikely that the sampling and statistical estimation process will be subject to manipulation, possibly for political advantage? If you disagree, please explain why.

15. Dr. Brown also testified that even after the non-response follow-up phase of the census is complete, there "would still [be] the undercount problem of those people who just refuse to be counted or are very difficult to count." Do you agree with that statement? If you disagree, please explain why.

16. With regard to the post-enumeration survey in the 1990 census, Dr. Brown testified that many of the difficulties with the procedure "can be traced to the fact that the PES sample was much too small to support the kind of objective, reliable analyses that are desired." Do you agree with that? If you disagree, please explain why.

17. The size of the sample in the Integrated Coverage Management (ICM) is 750,000 households. Is that a proper size for such an endeavor?

18. The results of the PES in 1990 showed that census was less accurate than its predecessor. That result was confirmed by demographic analysis, which has been performed on every census since 1940. We certainly know that the 1990 census was much more expensive than the 1980 census. Do you agree with the conclusion that 1990 was less also less accurate than 1980?

19. Please explain the difference between net over- or undercount in the 1990 census count and actual over- and undercounts (mistakes) made int he 1990 count. I know that a net undercount of 1.6% sounds relatively small but for census purposes, aren't those 26 million mistakes a concern?

20. I understand that improvement in the average does not necessarily mean that there will be improvement in every case. In 1990, there was criticism about the strata being broken down by region. If statistical methods are used in 2000, with strata broken down by state in 2000, can we expect more states with improved accuracy than there were in 1990?

21. Representative Sawyer pointed out that the longer the Census Bureau is in the field, the higher the error rate in the information collected. I believe that information came from one of the many GAO studies he and his Republican colleagues commissioned. You have stated your concern about the Census Bureau not be in the field for enough days in the 2000 plan. Can you explain the difference in opinion?

22. In order to address the problem of declining public response, the GAO suggested exploring a radically streamlined questionnaire in future censuses. Would you give us your thoughts on how effective this approach might be in increasing response, and also its effect on perhaps diminishing the usefulness of census data?

23. In its 1992 capping report on the 1990 census, the GAO concluded that "the results and experiences of the 1990 census demonstrate that the American public has grown too diverse and dynamic to be accurately counted solely by the tradition 'headcount' approach and that fundamental changes must be implemented for a successful census in 2000." Do you agree with that conclusion? If you disagree, please explain why.

24. After the 1990 census, GAO concluded that "the amount of error in the census increases precipitously as time and effort are extended to count the last few percentages of the population....This increase in the rate of error shows that extended reliance on field follow-up activities represents a losing trade-off between augmenting the count and adding more errors." In the last months of the follow-up efforts in 1990, GAO estimated that the error rates approached 30 percent, and that this problem was probably exacerbated by the use of close-out procedures. This appears to be a problem inherent to the methodology of the 1990 census. Don't you agree?

    Do you have any information on the error rates for information gathered using close-out procedures?

    Even if sampling is not perfect, isn't its error rate well below the levels for the last percentages of the population using more traditional follow-up procedures?

    If this is the case, then doesn't that logically lead to GAO's and the Commerce Department's Inspector General's conclusion that sampling at least a portion of the nonresponding households would increase the accuracy and decrease the cost of conducting the census?

25. GAO also concluded after the 1990 census that a high level of public cooperation is key to obtaining an accurate census at reasonable cost. Unfortunately the mail response rate has fallen with every census since 1970, and was only approximately 65 percent in 1990. The reasons for this decline are in many instances outside of the Census Bureaus control, for example the increase in commercial mail and telephone solicitations and in nontraditional household arrangements. For these reasons, the Bureau is planning a public education campaign for the 2000 census, surpassing any previous attempts. Given the response in 1990, do you believe this is money well-spent?

    Do you believe that this public education campaign can succeed in arresting the decline in response rates?

    Even if it does, wouldn't some use of sampling be warranted to solve the problems associated with reaching the last few percentages of nonresponding households?

My questions and your answers will be part of the permanent record of the May 5, 1998, hearing. Again, thank you for your impute into this most important process.

Sincerely,

Carolyn B. Maloney
Ranking Minority Member
Subcommittee on the Census

cc: The Honorable Dan Miller

STATE OF MICHIGAN

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June 19, 1998

Honorable Carolyn B. Maloney
Ranking Minority Member
Subcommittee on the Census
U.S. House of Representatives

Dear Representative Maloney:

Thank you for the twenty-five questions which you included in your memo to me on May 13, 1998. These questions raise a wide range of important issues, and I hope that the following responses will lead to a dialog which advances the debate on the techniques proposed for use in the next census.

1. **Can you tell us about a statistical or scientific activity that you've worked on that either worked perfectly the first time you tried it, or that didn't work as well as you had hoped the first time so you abandoned the idea altogether without making an effort to improve or redesign it?**

   Very early in my career, I had an experience with this dilemma which I believe can shed a great deal of light on the process of computing adjustments for census undercount.

   In the first government agency I worked for, I was once asked to do a quick analysis to show the cost of excess hospital capacity in Michigan. I had a pretty good idea what to expect based on the published literature on the subject, but my first calculations showed just the opposite of what I expected.

   Naturally, the question I asked myself was *"What did I do wrong?"* When I reviewed my computer program with this question in mind, I found a simple computational error that explained a large part of the problem. The figures still didn't point in the expected direction, but at least they didn't point so strongly in the "wrong" direction.

I couldn't find any more mistakes in my program, so the next question I asked myself was *"How can I improve the analysis?"* Since I had been taking a very simple approach to a very complex question, it didn't take long to find that I had left out some important factors which biased the results in the "wrong" direction. When I repeated the calculations with allowances for those factors, I got the results that I expected.

Unquestionably, the changes which I made were improvements. I had produced an analysis that was consistent with my expectations about what was true and with the published literature on the subject. But that experience left me with two important questions:

(1.) *What would have happened if my initial results had been consistent with my expectations?* Would I even have found my computational error if I hadn't had to ask myself "What did I do wrong?"

(2.) *What would have happened if my expectations and the initial results had been the opposite of what actually happened?* What if I had expected excess hospital capacity to *decrease* hospital expenditures instead of increasing them, and what if my first calculations had shown an increase? Would I have been able to find some legitimate factors that were left out of the initial analysis which biased the results in this new direction? Would I have "improved" the analysis in the opposite direction if I had the opposite expectations?

I had encountered a dilemma which faces all researchers, whether they are aware of it or not:

> On the one hand, it is probably impossible to produce good research on a complicated problem without finding and correcting mistakes and modifying methods based on new insights that are gained in the course of the analysis. And a principal way to find those mistakes and gain those new insights is by finding things that are contrary to expectations and figuring out either what went wrong or how the data and the analysis can be improved.
>
> On the other hand, when the corrections and refinements are driven by expectations of what the results should be, the research will tend to conform to those expectations regardless of whether those expectations are correct and regardless of whether the data and methodology are sound.

I believe that this personal experience and this dilemma shed a lot of light on the process of measuring undercount through a post-enumeration survey. In one respect, the analysis of the post-enumeration survey is exactly the opposite of the analysis described above: instead of being too simple, it is incredibly complex. Yet it illustrates the dilemma of expectation-driven analysis even better than my personal experience: Matching survey responses with census responses is so difficult and it involves so many errors of so many types that it sets up an impossible dilemma for the Census Bureau. On the one hand, it is necessary to monitor the quality of processes to ensure that they are producing plausible results, to check outliers and disparities, to look for problems, and to correct problems when they are found. On the other hand, those necessary measures tend to make the results conform to expectations, irrespective of the correctness of the expectations or the soundness of the underlying data and methodology.

Some of the corrections that were made had a very large impact on the final adjustments for undercount. For example, when certain blocks seemed to have too much undercount, records were sent for re-matching and they came back with different results: re-matching just 104 out of 5,290 block clusters resulted in a decrease of 250,000 in the estimated net national undercount. When other blocks had obvious problems due to geocoding errors, they were "downweighted" so they would have less impact: downweighting just 2 block clusters reduced their impact on the national net undercount from nearly 1 million persons to only about 150,000 persons. A computer programming error was found which contributed over 1 million persons to the net national undercount. Without these three corrections, the final estimate of net undercount would have been about 40% higher than it was, and it would not have been plausible even at the broadest national level. On the one hand, it would be difficult to argue that these corrections should not have been made. On the other hand, it is clear that there were enough remaining errors that any of the adjustment factors could still have been "corrected" significantly in either direction. [For further discussion of the difficulties of matching surveys and the high level of error in the undercount analysis, please see page 9 of the first paper[1] and pages 3 through 13 of the second paper[2] which I submitted to the Subcommittee on 5/5/98.]

One of the paradoxes of the PES analysis is that it produced a seemingly plausible picture of undercount at the broadest national level despite its many obvious flaws. However, once the potential role of expectations in refining the data is understood, this is not surprising at all. Given enough time, resources, and methodological flexibility, the adjustment factors could probably be

corrected until they produced virtually any pattern of undercount that is deemed plausible.

2. **Despite the fact that the Census Bureau made improving the count among minorities a major goal of the 1990 Census, the 4.4 percent differential in the 1990 undercount between Blacks and non-Blacks was the highest ever recorded. Experts have repeatedly said that spending more money on traditional methods will not reduce this differential. If not through statistics, how do you propose to reduce this differential?**

First, I would like to comment on the observation that the differential undercount in 1990 was the highest ever recorded. It is true that the difference between the estimated undercount for blacks and the estimated undercount for other races increased from 4.3 percentage points in 1970 to 4.4 percentage points in 1990. However, it would be a mistake to suppose that the undercount has been getting worse in each census. In fact, according to the Census Bureau's "demographic analysis" method, the undercount for blacks in 1990 was the second lowest ever recorded. Likewise, the 1990 undercount for whites was the second lowest ever recorded and the overall undercount was the second lowest ever recorded. The lowest undercounts ever recorded were in 1980.

Thus, the last two censuses have been our most accurate in history with respect to undercount. Although there is certainly room for improvement, it is evident that the Census Bureau's efforts to improve the count have met with considerable success. The widespread discouragement and negativism with regard to so-called "traditional methods" is unwarranted.

(A chart showing the estimated undercount rates for each census since 1940 appears in Figure 1 of my first paper.[1] See also the answer to Question 5 below.)

My suggestions for reducing undercount and reducing the undercount differential fall into two general categories: (1.) improving the census enumeration, and (2.) *estimating* the amount of undercount for those demographic groups and levels of geography for which reliable estimates can be made instead of *adjusting* for undercount.

1. *Improving the census enumeration.* Most of the following suggestions for improving the count are not original, and they can be considered

"traditional methods," like those that have made the last two censuses the most successful in our history:

(a.) The Master Address File (MAF) is a key to the success of the census. The Local Review Program and other efforts to improve the MAF should receive all the resources and attention that they need to succeed.

(b.) Another key to the success of the census is the number and quality of enumerators. One reason for the success of the 1980 Census may have been the large number of recent college graduates who were unemployed and available to work for the Census Bureau. With the aging of the Baby Boom generation, such a pool of labor was not available for the 1990 Census. Due to a relatively small number of young people and the possibility of a continued sound economy, recruitment of skilled temporary workers for Census 2000 may be very difficult. Meeting this challenge needs to be a high priority.

(c.) Yet another key to the success of the census is adequate time in which to conduct follow-up. If Integrated Coverage Measurement is not implemented, some of the time currently allotted to the coverage survey could be used for regular census operations.

(d.) Since many households have more than five members, the standard census form should have room for information on more than five people.

(e.) An effort should be made to ensure that every household receives all the census forms that it needs *before* Census Day.

The proposed use of pre-census reminder cards is a promising innovation. The Bureau could consider the possibility of including return-cards that households can use to request foreign-language forms, extra forms for additional household members, and any other special forms and assistance that the household might need.

(f.) Some households include members who may want to keep their census information confidential from other members of the household (or from whom the rest of the household may want to keep their census information confidential). There could be provisions for them to receive and submit separate census forms.

(g.) The traditional "substitution" process for non-respondents and partial respondents could be modified so that the mix of respondents in the "deck" from which substitutions are made reflects the characteristics of non-respondents and partial respondents, rather than reflecting the characteristics of the population as a whole. This should reduce the undercount differential.

Many other good ideas for improving the enumeration have been suggested by other analysts, and many have already been adopted by the Census Bureau.

2. *Estimating undercount instead of adjusting for undercount.* Even after every effort to achieve the best possible count, there will be some segments of the population that have not been fully counted. This problem can be addressed more appropriately through *estimates* of undercount than through *adjustments* for undercount. The advantages of approaching undercount in this manner include the following:

(a.) An estimate of undercount would not have to be released until it is completed and evaluated. An adjustment for undercount would have to be finalized very quickly to meet the statutory deadlines for completion of the census.

(b.) An estimate of undercount could be revised as more is learned about patterns of undercount in the census. An adjustment for undercount could not be changed even after it is found to be faulty, since it would be the official census count and since it would be reflected in hundreds of census products that would not be feasible to replace.

(c.) An estimate of undercount could use all relevant sources of valid information. The proposed method of adjusting for undercount is limited to one source of information—a post-enumeration survey—which misses many of the same people who are missed by the census and identifies many people as missed by the census who were not missed at all.

(d.) An estimate of undercount could be developed for only those levels of geography for which it is reliable. For example, if a methodology works well at the state and national levels but not at the local level, undercount estimates would not have to be made at the local level. In

contrast, the proposed adjustment for undercount would be applied all the way down to the block level.

[See also the answer to Question 8 below.]

3. **You have mentioned your concerns about block level accuracy. Can you discuss your thoughts on the accuracy of census numbers at the state level if Dual System estimation is used in 2000? Do you have any evidence that suggests that the census counts will be more accurate at the state level in 2000 if DSE is not used?**

The central flaws of the proposed method of adjusting for undercount, which are explained in the papers that I submitted to the Subcommittee on 5/5/98,[1,2] are (a.) that it misses many of the same people who are missed by the census, and (b.) that many—in fact, most—of the people that it identifies as missed by the census were not missed at all. Thus, any differences it suggests between states are not so much differences in the amount of undercount as they are differences in the amount of error that the Census Bureau makes in trying to measure undercount.

Several of the sources of bias noted in my testimony are of particular relevance at the state level. For example:

- The exclusion of homeless people from the post-enumeration survey results in a bias against states whose homeless people are more likely to be staying with households during the April census than during the subsequent post-enumeration survey.

- Differences in weather and climate can affect the level of fabrication in the post-enumeration survey, which in turn can have a very serious impact on the apparent undercount rate.

- Because differences in weather and climate influence the likelihood that people will be at home when an enumerator visits, they can affect the proportion of successful PES interviews in different states. A high rate of unsuccessful interviews or proxy interviews in the PES can seriously increase the level of error in measuring undercount.

- When people migrate from one state to another on a seasonal basis, the post-enumeration survey can assign them to a different state from the one

they reported as their "usual" state of residence when they filled out their census form.

[See also the answer to questions 4 and 20 below.]

4. **Secretary Mosbacher, in testimony before both the House and the Senate, said that the Post-Enumeration Survey would make the majority of the states more accurate. Is that statement correct? If so, why is his testimony so at odds with your testimony?**

In the "Notice of Final Decision" regarding adjustment of the 1990 Census, Secretary Mosbacher wrote:

> Based on the measurements so far completed, the Census Bureau estimated that the proportional share of about 29 states would be made more accurate and about 21 states would be made less accurate by adjustment... When the Census Bureau made allowances for plausible estimates of factors not yet measured, these comparisons shifted toward favoring the accuracy of the census enumeration. Using this test, 28 or 29 states were estimated to be made less accurate if the adjustment were to be used... While we know that some will fare better and some will fare worse under an adjustment, we don't really know how much better or how much worse. If the scientists cannot agree on these issues, how can we expect the losing cities and states as well as the American public to accept this change? [*Congressional Record*, 7/22/91, page 33583]

This statement by Secretary Mosbacher is not at odds with my testimony. The figures cited, which involve comparing the adjusted counts to calculations based on assumptions about actual undercount in each state, are consistent with everything I have said about high levels of error in the Post-Enumeration Survey. An adjustment methodology that seemed to be less accurate than the census for 21 or 28 or 29 states in 1990 can hardly be considered a sound basis for fine-tuning the results of the next census.

[See also the answers to Question 3 above and Question 20 below.]

5. **The 1990 census cost 20 percent more per household in real dollars than the 1980 census. The 1980 census cost twice as much per household in real dollars as the 1970 census. That is an increase in real dollar cost per household of 250 percent with no improvement in the differential undercount. Does that suggest to you that spending more on traditional methods will reduce the differential undercount?**

In addressing this question, it is important to remember that the 1980 and 1990 censuses were the most successful in history with respect to minimizing undercount. Based on the Census Bureau's "demographic analysis" method, the 1.8% estimated undercount in 1990 compares favorably to the estimated undercounts for 1940 (5.4%) through 1970 (2.7%). Likewise, the estimated undercount for blacks in 1990 (5.7%) compares favorably to the estimated undercounts for blacks for 1940 (8.4%) through 1970 (6.5%). The estimated 1990 undercounts for blacks, for other races, and for the population as a whole are the second best ever recorded; the only census with better results was the 1980 Census. (See Figure 1 of my first paper.[1])

My assessment of these figures is that the Census Bureau has made a lot of progress through the so-called "traditional methods." Since a number of promising improvements have been incorporated in the plans for Census 2000 and further improvements remain to be explored, it appears that the "traditional methods" hold promise for further progress. [See also the answer to Question 2 above.]

6. **Demographic analysis showed higher undercounts of African Americans than the undercounts demonstrated by the Post Enumeration Survey. That suggests that the Post Enumeration Survey understates, not overstates, the undercount, especially for minorities. In other words, isn't it likely that the 1990 census missed more African-Americans than would have been added back into the census by the Post Enumeration Survey?**

As you note, there are substantial discrepancies between the undercounts suggested by the post-enumeration survey and those suggested by demographic analysis. These discrepancies can be seen in Figure 2 of my first paper[1]: Relative to the results of demographic analysis, the undercount adjustments that were proposed for the 1990 census were 36% too low for black males but 43% too high for black females at the national level. The adjustments for other males were about right at the national level, but the adjustments for other females were 133% too high. Subsequent to correction of several errors, the adjustments proposed in September 1992 were 42% too low for black males and 33% too high for black females at the national level. The adjustments for other males were 25% too low, and the adjustments for other females were 50% too high. The situation was even worse at the regional level, where the proposed adjustments presented an inconsistent mosaic of high and low adjustments for different age, race, and sex categories.

The birth data and other data used in demographic analysis provide a very solid basis for estimating the relative number of males and females that were missed by the census. The discrepancies between the PES and demographic analysis therefore demonstrate quite clearly that the undercount adjustments derived from the PES are implausible and unreliable. However, one obviously cannot go beyond that to characterize them as consistently overstating or understating the undercount of minorities.

7. **You have talked a lot about bias in the Post Enumeration Survey but have not talked much about the bias in the census. The differential undercount measured by demographic analysis shows that bias in the census is quite real. If there is no Integrated Coverage Measurement, is it not the case that this bias in the census will continue?**

The various techniques for conducting a more accurate enumeration—including those listed in my response to Question 2 above, those discussed in reports by the National Academy of Sciences, those proposed by the Census Bureau, and others as well—can be expected to promote a modest improvement in undercount rates. As explained in my response to Question 2 above, I believe that the remaining undercount is best addressed through population estimates rather than through census adjustments.

8. **Do you believe that it is acceptable for the census to consistently miss certain segments of the population—African Americans, Latinos, Asian Americans, poor people in rural and urban communities—at greater rates than the white population? If that is not acceptable, what do you propose be done to reduce the differential undercount? Can you offer any evidence that your proposal(s) will reduce the differential undercount?**

Although the Census Bureau tries very hard to count everybody and makes special efforts to count minorities and persons in poor communities, there are still some people who are missed. Regardless of whether they are missed because their living arrangements make them hard to count or because they intentionally avoid the census, it is desirable to know how many people each community really has and what their characteristics are.

However, the methodology that has been proposed for adjusting the census is not acceptable: it reflects survey matching error more than it reflects undercount, it would greatly reduce the value of sub-national census data, it would invalidate comparisons over time, and it would not be demographically credible even at the national level.

I do not know of any methodology that can produce acceptable adjustments for undercount. Such a methodology would have to meet several difficult criteria. Some of the criteria that come to mind are:

(a.) It would have to reflect undercount, and not some other phenomenon that is distributed differently from undercount.

(b.) It would have to be simple enough to be completed and verified within the tight statutory time frame for producing the census count.

(c.) It would have to be sound enough to be recognized as valid and to need no major corrections or revisions after the census count is published.

(d.) The level of sampling error and other errors would need to be small enough that they wouldn't affect analysis of local census data more seriously than undercount itself.

(e.) Variations in error over time would need to be small enough that they would not invalidate comparisons of detailed census data over time.

The proposed adjustment methodology does not meet any of these criteria, and I know of no alternative adjustment methodology that meets them all.

As indicated in the answer to Question 2 above, the problem of undercount can be addressed by (a.) conducting a more complete count, and (b.) developing *estimates* of undercount instead of *adjustments* for undercount. A properly designed estimate could meet the first and last criteria, and the remaining criteria would be inapplicable or relaxed. An estimate would be subject to review and revision, it would not have to be subject to a tight statutory time frame, and it would not have to be applied to small units of geography unless it was found to be valid for small units of geography.

9. **It has been stated that one of the faults of the 1990 PES was correlation bias. Can you explain correlation bias? I understand that it is the likelihood that the people missed in the census may be the same people missed in the PES. Said another way, both the census and the survey miss the same people, for example, young Black males. How does correlation bias affect the accuracy count of those traditionally undercounted, Blacks, Hispanics, Native Americans, renters?**

Your understanding of correlation bias is correct. Correlation bias should lead to a very substantial underestimate of the undercount for those groups which tend to be missed by both surveys.

10. Wouldn't the only risk of correlation bias be minimization of the undercount rather than overestimation of the undercount?

That is only one of the risks. Another problem is that some communities might have more correlation bias than others. This is one of several factors that can cause the adjusted counts to be less indicative of a community's share of the nation's population than the original counts.

Another problem with correlation bias is that analysts who dismiss it as innocuous sometimes seem to forget that it is there. Correlation bias should result in adjustments for undercount that are much too low. However, the undercount adjustments derived from the 1990 Post-Enumeration Survey were *not* much too low: they were much to high for some segments of the population, much to low for others, and about on target for the national population as a whole. Analysts who forget about correlation bias and focus only on the seemingly plausible picture of undercount for the national population as a whole can make the mistake of thinking that the PES provides reasonably accurate information about undercount. However, for analysts who do *not* forget about correlation bias, the fact that the adjustments derived from the PES are not consistently too low is a clear sign that there is something seriously wrong with them.

11. In testimony before the Senate Committee on Governmental Affairs approximately one year ago, Dr. Lawrence Brown, Professor of Statistics at the University of Pennsylvania, stated that "Statistical sampling methods can be used in an effective and objective way to assist the census process." Do you agree with Dr. Brown's statement? If you disagree, please explain why.

While I do not disagree with this statement, I would add that statistical sampling methods can be used in ways that are effective and ways that are ineffective, in ways that are objective and ways that are biased, and in ways that assist and ways that detract from the census process. Like any tools, statistical sampling methods work better for some purposes than for others, and they can be used in both appropriate and inappropriate ways.

12. Dr. Lawrence Brown also testified before Senator Thompson that the Sampling for Non-Response Follow-up plan "is an objective procedure all the way around and has a very good chance of working as desired." Do you agree with that statement? If you disagree, please explain why.

My testimony and analysis have focused exclusively on the issue of undercount adjustment, and I have not comprehensively reviewed the methodology proposed for handling non-response. Nevertheless, the following observations should be helpful for understanding some of its shortcomings.

An underlying premise of sampling for non-response is that each census statistic will be based mostly on actual responses, and that it will therefore not be seriously affected by minor errors in estimating the characteristics of the remaining 10% or so of the population from a sample.

One critical statistic for which this premise does not hold is the vacancy rate. Obviously, most vacant households will not respond to the census. It is my understanding that most of them are to be excluded from follow-up based on reports by letter carriers that they are vacant. (The plan calls for a sample of these housing units to be followed-up, however, in order to adjust for inaccuracies in the letter carriers' vacancy reports.) Any vacant units that the letter carriers do not report as vacant are to be followed up on a sample basis along with other non-responding households. Unfortunately, neither the letter carrier reports nor the proposed samples will produce reliable vacancy data. The letter carrier reports tend to be inaccurate, their errors cannot be corrected very well through the proposed sample, and the routine sampling of non-responding housing units will be subject to error as well.

In its preliminary testing, the Census Bureau found that 42% of the housing units that letter carriers identified as vacant were actually occupied, and that half of the units pre-identified as vacant were not identified as such by the letter carriers. If this result is at all indicative of the level of error to be expected in the letter carrier reports, they provide a very poor basis for determining vacancy status.

These deficiencies of the letter carrier reports cannot be corrected adequately even through the 30% sample recently proposed. Variations in the accuracy of letter carrier reports from neighborhood to neighborhood and from carrier to carrier will present a serious dilemma: If the correction factors are derived from broad geographic areas, they will not be applicable to neighborhoods where vacancy status is particularly easy or particularly hard to determine, nor

to neighborhoods where the letter carrier has particularly high or particularly low levels of skill and conscientiousness in determining vacancy status. But if they are derived from small geographic areas, they will tend to be dominated by sampling error. Whichever way the Census Bureau chooses to resolve this dilemma, the correction factors will be unreliable for small units of geography. The poor overall quality of the letter carrier reports, in turn, will cause those unreliable correction factors to have a very large impact on the vacancy rates.

A similar dilemma arises in connection with vacant units in the "regular" sample of non-responding households. The number of vacant units missed by the letter carriers can be expected to vary widely from neighborhood to neighborhood: Data derived from broad geographic areas will therefore not be indicative of local conditions, but data derived from small geographic areas will tend to be dominated by sampling error. Finding even one vacant housing unit in the sample can cause several housing units to be considered vacant, which can substantially change the vacancy picture for a census block or a small community. Any error—whether sampling error or non-sampling error—will therefore tend to have a serious impact. And since we are talking about measuring a (usually) small proportion of households through a small sample drawn from a small population, relatively high levels of error can be expected.

These problems would be much less serious if 90% of the data on vacancy were based on actual enumerations and only 10% of the data were subject to substantial error. However, that will not be the case due to the fact that most vacant housing units do not respond to the census. Unlike most other census statistics, the numerator of the vacancy rate is to be *almost entirely* based on very imprecise data.

A problem with faulty vacancy rates is far more critical than it may seem at first glance. In addition to being an important statistic in its own right, the vacancy rate plays a crucial role in determining the census count itself. If the estimated vacancy rate for a unit of government is 2 percentage points too low, then people will be imputed as living in vacant housing units and we can expect the population count to be a little more than 2 percentage points too high. If the estimated vacancy rate is 2 percentage points too high, then housing units that are occupied will be assumed to be vacant and we can expect the population count to be a little more than 2 percentage points too low.

Errors of this magnitude and greater would be quite likely for many units of government, particularly where there is a substantial amount of seasonal or

vacation housing. For example, 49% of the units of government in Michigan had vacancy rates of 10% or more in 1990, 31% had vacancy rates of 25% or more, and 14% had vacancy rates of 50% or more. The proportion of housing units in these areas whose vacancy status would be determined by very imprecise methods would therefore be quite substantial, and the resulting census "counts" could easily be off by *several percentage points*.

As a demographer involved in the production of intercensal population estimates, I am very much aware of the weaknesses and limitations of those estimates and of the need for periodically benchmarking them to new census counts. I am therefore alarmed by the prospect that the proposed methodology might produce census "counts" for many units of government that are less reliable than their intercensal population estimates based on the 1990 Census, and that future population estimates for these areas might have no accurate basis at all.

Another potential problem with sampling for non-response is the possibility of distortions in local population data caused by replicating cases encountered in the sample. For example, if the methodology turns one household with a grandmother caring for grandchildren into several local households with grandmothers caring for grandchildren, or one household with twelve children into several local households with twelve children apiece, then the local census data will be seriously distorted. Thus, it would not be appropriate to replicate the findings from the sample within a small geographic area. (It may be appropriate, however, to use large-area samples as a basis for assigning weights to local census responses in order to influence the composition of the "deck" used for imputing the characteristics of non-responding households. See item 1(g.) under Question 2 above.) [Problematic aspects of sampling for non-response are discussed further in Question 24 (c.) below.]

13. **In addition, Dr. Brown testified that the Census Bureau's 2000 Census plan had been "drastically simplified and improved. ...[these changes] make it possible to now believe that the Integrated Coverage Measurement might work as well as desired to correct the undercount." Do you agree with that statement. If you disagree, please explain why.**

I strongly disagree with this statement. The two papers which I submitted as testimony to the Subcommittee on 5/5/98 are entirely directed toward explaining my position on this question.[1,2]

14. With regard to concerns that the Integrated Coverage Measurement process could be manipulated to achieve a particular outcome in terms of the population counts, Dr. Brown testified that, "if all of this planning is done in advance, it is very, very hard for me to see how one could direct these subjective decisions towards any desired goal." Do you agree with Dr. Brown that if the procedures and protocols for the Integrated Coverage Measurement are set forth in advance and subject to expert and public scrutiny, that it is very unlikely that the sampling and statistical estimation process will be subject to manipulation, possibly for political advantage? If you disagree, please explain why.

Subjective decisions can bias the results in ways that are not necessarily even intentional, conscious, or politically motivated. The most frequent and most likely way for this to happen is for personnel at various levels of the ICM effort—particularly interviewers, matchers, and the managers and statisticians responsible for implementing the methodology—to be influenced in their subjective decisions by their expectations about undercount. For example, when the match status of a particular record is not clear, it is possible for the classification to be influenced by whether the matcher expects people in that demographic category to have a high level of undercount. When a PES interviewer fabricates data on a hot or rainy day for people who never seem to be at home, the characteristics assigned to those people will naturally reflect the expectations of that interviewer. When a decision is made about whether to send a group of records back for re-matching or to downweight a group of records as outliers, that decision can influenced by whether the initial findings for those records were consistent with expectations about undercount and by whether the overall level of apparent undercount is higher or lower than expected.

15. Dr. Brown also testified that even after the non-response follow-up phase of the census is complete, there "would still [be] the undercount problem of those people who just refuse to be counted or are very difficult to count." Do you agree with that statement? If you disagree, please explain why.

I agree with that statement. A substantial portion of this problem is already handled through the Census Bureau's traditional "imputation" or "substitution" process for non-respondents and partial respondents. The importance of this element of the census process is frequently overlooked and, as explained in the answers to questions 2 and 12, this process can be improved. The remainder of the problem, as explained in the answers to questions 2 and 8, can be better

solved through an *estimate* of undercount rather than an *adjustment* for undercount.

16. **With regard to the post-enumeration survey in the 1990 census, Dr. Brown testified that many of the difficulties with the procedure "can be traced to the fact that the PES sample was much too small to support the kind of objective, reliable analyses that are desired." Do you agree with that? If you disagree, please explain why.**

One of the interesting things about measuring undercount through a post-enumeration survey is that the process has several fatal flaws, any one of which is sufficient by itself to explain why it produces such unacceptable results. One such flaw is sampling error due to a sample size that was insufficient to support the detailed stratification which the undercount adjustments require. This was such a big problem that there is no implausible aspect of the 1990 adjustments for which it is not a sufficient explanation.

It would be a fallacy, however, to conclude that sampling error is therefore the only explanation or even the chief explanation for the many implausible aspects of the 1990 adjustment factors. There are several other documented problems which are also sufficient by themselves to explain them. For example, the documented level of uncertainty and error in matching is sufficient to explain any of these implausible results. The level of fabrication in typical surveys, which was generally confirmed by the various studies of fabrication in the PES, is comparable in size to undercount and sufficient to explain any of these implausible results. Likewise, any of the implausible results can be explained by the fact that such an attempt to measure a small component of the population is extremely sensitive to tiny errors in the insurmountable task of classifying the remainder of the population. (See pages 6 through 9 of my first paper.[1]) It would be foolish to presume that solving only one of these problems would be sufficient to "fix" the proposed process for measuring undercount. There would be more than enough problems remaining to invalidate the results.

17. **The size of the sample in the Integrated Coverage Management (ICM) is 750,000 households. Is that a proper size for such an endeavor?**

It is more than sufficient for the post-enumeration survey's traditional role of evaluating census questions and procedures. However, no increase in sample size would be sufficient to produce valid adjustments for undercount through a post-enumeration survey, since sample size is not the only problem or even the

chief problem. As explained in the answer to Question 16 above and in the papers which I submitted to the Subcommittee as testimony on 5/5/98,[1,2] the attempt to measure undercount through a post-enumeration survey has several fatal flaws that are not caused by insufficient sample size. These flaws account for much of the estimated undercount and, since they involve non-sampling error, they obviously will not be reduced by enlarging the sample. In fact, an increased sample size, coupled with a very tight time schedule and questionable staffing levels, is likely to increase the problems of fabrication, proxy interviews, and matching error which plagued the 1990 PES.

18. The results of the PES in 1990 showed that census was less accurate than its predecessor. That result was confirmed by demographic analysis, which has been performed on every census since 1940. We certainly know that the 1990 census was much more expensive than the 1980 census. Do you agree with the conclusion that 1990 was also less accurate than 1980?

I have not studied this issue in detail. However, as explained in the answer to questions 2 and 5 above, it is appropriate to say that the Census Bureau's "demographic analysis" method indicated that the 1980 Census was the most accurate in history and that the 1990 Census was only the second most accurate in history with respect to undercount.

19. Please explain the difference between net over- or undercount in the 1990 census count and actual over- and undercounts (mistakes) made in the 1990 count. I know that a net undercount of 1.6% sounds relatively small but for census purposes, aren't those 26 million mistakes a concern?

There are three sets of terms that need to be explained: (a.) *actual* gross overcount and undercount, (b.) gross *measured* overcount and undercount, and (c.) net measured overcount and undercount.

(a.) "Actual gross overcount" is the number of people *actually* counted twice by the census or counted in error. For example, people who were born after April 1 or who died before April 1 are sometimes counted by the census even though they should not be. College students who are counted at their parents' home instead of at the school where they lived are considered part of the "overcount" of their parents' community and part of the "undercount" of their college community. Overcount is usually referred to as "erroneous enumeration." Similarly, "actual gross undercount" is the number of people *actually* missed by the census.

(b.) "Gross measured overcount" and "gross measured undercount" are appropriate terms for the number of people identified as erroneous enumerations by the Post-Enumeration Survey and the number of people identified as undercounted by the Post-Enumeration Survey. The "26 million mistakes" to which the question refers represent gross measured overcount and gross measured undercount. These numbers are much higher than *actual* gross overcount and *actual* gross undercount for several reasons:

- Much of the measured undercount and overcount is due to measurement errors in the post-enumeration survey rather than actual undercount and overcount in the census. This is the central point developed in my papers. [See pages 6 through 9 of my first paper[1] and pages 3 through 13 of my second paper.[2]]

- All of the people who are added to the census count through the substitution process and all of the people whose census responses are too incomplete to be used for matching are considered to be erroneous enumerations. The corresponding people who are found in those housing units by the Post-Enumeration Survey are considered to be part of the gross undercount. While this is appropriate in the context of the PES analysis, it does tend to make the gross measured overcount and gross measured undercount misleadingly high.

- People who seem to be counted in the wrong location by the census are counted as part of the undercount in one place and part of the overcount in another. This is appropriate in the context of the PES analysis, but it tends to make the total number of errors appear misleadingly high.

- Matching errors in the PES analysis typically involve a census record which should be matched with a PES record but which fails to match for any one of a number of reasons. In most such cases, the census record becomes part of the gross measured overcount and the PES record becomes part of the gross measured undercount. Again, this is appropriate in the context of the overall PES analysis, but it does tend to make the gross measured overcount and gross measured undercount misleadingly high.

  [It should be noted that matching error does not always result in offsetting errors in gross overcount and gross undercount. For

example, if the person described by the unmatched census record really does exist, it might be difficult to prove that they don't exist and they therefore might not become part of the measured overcount. This is one of the ways that matching error introduces bias into the undercount adjustments.]

- Looking at the PES in a broader sense, it can be expected that the number of people erroneously identified as overcounted or undercounted will naturally tend to exceed the number of people erroneously identified as counted correctly. This is because only a very small proportion of the population is actually overcounted or undercounted: in other words, there are very few people at risk of being *erroneously* identified as counted correctly. However, the vast majority of people are counted correctly by the census, and they are therefore at risk of being erroneously identified as overcounted or undercounted. This results in a large upward bias in the gross measured overcount and the gross measured undercount. [This issue is discussed in more detail on pages 6 through 9 of my first paper.[1] On page 9 of that paper, there is a list of eighteen problems which make it very difficult to match people correctly between two surveys so that they can be classified accurately as overcounted, undercounted, or correctly counted.]

(c.) "Net measured undercount" can be simply computed by subtracting gross measured overcount from gross measured undercount. (If an area has more measured overcount than measured undercount, its "net measured overcount" can be calculated by subtracting its net measured undercount from its net measured overcount.)

Thus, the frequently cited figure of "26 million mistakes" is greatly inflated, and it does not reflect the actual level of accuracy in the 1990 Census.

20. I understand that improvement in the average does not necessarily mean that there will be improvement in every case. In 1990, there was criticism about the strata being broken down by region. If statistical methods are used in 2000, with strata broken down by state in 2000, can we expect more states with improved accuracy than there were in 1990?

Since the undercount adjustments reflect error in measuring undercount more than they reflect undercount itself, any prediction of how the numbers will fall

out in any particular census is very uncertain. With that caveat, my expectations are as follows:

(a.) Estimating the adjustments for each state individually will negate most of the advantage otherwise gained from a larger sample size in terms of sampling error.

(b.) The factors which introduced geographic bias into the 1990 undercount adjustments will tend to affect individual states in the same way that they affected regions in 1990. [See answer to Question 3 above.]

(c.) Since state boundaries are as artificial as regional boundaries in terms of having a logical relationship with undercount rates, I see no reason at this time to expect an increase in accuracy resulting from this change in stratification.

[See also the answers to questions 3 and 4 above.]

21. **Representative Sawyer pointed out that the longer the Census Bureau is in the field, the higher the error rate in the information collected. I believe that information came from one of the many GAO studies he and his Republican colleagues commissioned. You have stated your concern about the Census Bureau not being in the field for enough days in the 2000 plan. Can you explain the difference in opinion.**

There is no contradiction between the findings which you cite and the concern about trying to process more interviews with inadequate staff in a shorter period of time. In fact, the findings reinforce the concern.

The higher error rates during the final weeks of follow-up do not result simply from "being in the field too long." The first weeks in the field result in more accurate data because they involve actual interviews with people who are willing to be counted. The final weeks in the field result in less accurate data because they involve more interviews with people who have resisted repeated attempts to count them, more proxy interviews to "close out" cases for which a direct interview cannot be obtained, and more fabrication of interviews in response to pressure to close out as many cases as possible before the deadline.

Shortening the amount of time in the field does not eliminate those final weeks of interviewing in which high error rates can be expected. The final weeks of interviewing will still be there, with all of their pressure to close out the

difficult cases. Instead of eliminating the *final* weeks of interviewing, the current plan would, in effect, eliminate the *initial* weeks of interviewing in which lower error rates can be expected. By calling for more PES interviews in a shorter period of time with inadequate staff, the current plan creates a danger that the initial weeks of interviewing will be as error-prone as the final weeks of interviewing were in 1990.

It should be noted that the accuracy problems in the final weeks of interviewing and the concerns about truncated time frames apply both to the census itself and to the post-enumeration survey. Proxy interviews, fabrication by interviewers, and unreliable reports by respondents are problems for the PES as well as for the census—in fact, they are even more serious when they occur in the PES. The timetable for Census 2000 involves very tight time frames for both the census and the PES.

[See also the response to Questions 24(a.) and 24(c.) below.]

22. **In order to address the problem of declining public response, the GAO suggested exploring a radically streamlined questionnaire in future censuses. Would you give us your thoughts on how effective this approach might be in increasing response, and also its effect on perhaps diminishing the usefulness of census data?**

I have not studied this question in detail. I understand that the Census Bureau has concluded from its research that shortening the form would not have a large impact on response rates. I do know, based on the involvement of my office in the Census Bureau's survey of data users and from its work in disseminating census data and in using census data to address needs of data users, that the information on both the long form and the short form is very widely used in both the public and private sectors. A radically shortened questionnaire would greatly diminish the value of the census. However, *if* we have a successful census in 2000, and *if* the Continuous Measurement program is adequately funded and successfully implemented, it should be possible to eliminate the long form in 2010.

23. **In its 1992 capping report on the 1990 census, the GAO concluded that "the results and experiences of the 1990 census demonstrate that the American public has grown too diverse and dynamic to be accurately counted solely by the traditional "headcount" approach and that fundamental changes must be implemented for a successful census in**

2000." Do you agree with that conclusion? If you disagree, please explain why.

It is not entirely fair to criticize a statement removed from its context within a larger report, so the following comments should not be interpreted as a criticism of the GAO or its 1992 report.

(a.) First, it is important to realize that our diverse and dynamic population is not a new development. Our history has included settlement of the frontier, Indian wars, emancipation of slaves, massive foreign immigration, industrialization, urbanization, the Great Depression, suburbanization, inter-state redistribution of population, and many other events and changes that have always made our population diverse, dynamic, and challenging to count. As difficult as it is to develop a precise Master Address File for Detroit in 1998, it would have been far more difficult in 1898.

(b.) I agree with the notion that there is considerable room for improvement in the census and that census methods should adapt to changes in the population. However, I am not sure exactly what is meant by "fundamental" changes. The concept of finding out how many people there are by counting them is sound, and I would characterize the required improvements as "incremental" rather than "fundamental."

(c.) The deficiencies of the census require not simply "change" but rather "change for the better." It should be clear from my testimony and the testimony of the other members of the 5/5/98 panel that the particular uses of sampling that have been proposed for Census 2000 would be very serious changes for the worse.

(d.) The 1990 Census approached our "diverse and dynamic" society, in which it is often difficult to find people at home, through a mail-back census form with instructions available in 34 different languages. It is somewhat ironic that the innovation proposed for dealing with these problems is a post-enumeration survey that relies exclusively on *personal interviews* by enumerators, most of whom speak fewer than 34 languages. The proposed innovation is more poorly adapted to our diverse and mobile society than the census itself.

24. (a.) After the 1990 census, GAO concluded that "the amount of error in the census increases precipitously as time and effort are extended to count the last few percentages of the population... This increase in the rate of

error shows that extended reliance on field follow-up activities represents a losing trade-off between augmenting the count and adding more errors." In the last months of the follow-up efforts in 1990, GAO estimated that the error rates approached 30 percent, and that this problem was probably exacerbated by the use of close-out procedures. This appears to be a problem inherent to the methodology of the 1990 census. Don't you agree?

It is inherent not just to the census, but to any survey which must obtain information about people who are difficult to reach or resistant to being counted. These problems apply even more to Sampling for Non-Response and to the post-enumeration survey required for Integrated Coverage Measurement than they do the census itself. These efforts not only involve exhaustive follow-up of difficult cases, but any errors will be multiplied when the sample results are inflated to represent the sampled universe. In fact, given the proposed constraints of time and resources discussed under Question 21 above, the proposed plans for Census 2000 can be expected to make these problems even worse. Again, it must be stressed that we need not just "change," but "change for the better." The proposed changes are even more susceptible to this problem than the old procedure was.

[See also the response to Question 21 above and Question 24 (c.) below.]

(b.) Do you have any information on the error rates for information gathered using close-out procedures?

The Census Bureau would be the most authoritative source for such information.

(c.) Even if sampling is not perfect, isn't its error rate well below the levels for the last percentages of the population using more traditional follow-up procedures?

The premise underlying this question appears to be that sampling is somehow an *alternative* to traditional follow-up procedures. However, traditional follow-up procedures are just as much a part of the proposed uses of sampling as they are of the conventional census: follow-up is a critical part of Integrated Coverage Measurement, and follow-up is what Sampling for Non-Response is all about. Both of these efforts involve exhaustive efforts to obtain information about that last percentage of the population, and the associated errors will be compounded when the sample findings are inflated to represent the sampled universe. The pertinent comparisons would therefore be between the overall error of the traditional census and the overall error of the modified census, or

else between the error resulting from close-out procedures for the samples and the error resulting from close-out procedures for a traditional census. It should be obvious from the discussion above that these comparisons would not be favorable to the proposed sampling methodology.

That having been said, we are still left with a question about the overall error rate for sampling. With regard to sampling for undercount, a Census Bureau report estimated that identified errors accounted for about 33% of the net undercount suggested by the 1990 PES. A subsequent analysis by the same author raised this estimate to about 57%, and a further analysis by Dr. Leo Breiman raised the estimate to about 70%. (These reports are cited on pages 11-13 of my second paper.[2]) Similarly, the Census Bureau's Report of the Committee on Adjustment of Postcensal Estimates (the "CAPE Report," released on 8/7/92) stated that "about 45% of the revised estimated undercount is actually measured bias and not measured undercount. In 7 of the 10 evaluation strata, 50% or more of the estimated undercount is bias." These error rates compare unfavorably with error rates for virtually any aspect of the census process, regardless of whether or not such comparisons can be pertinently drawn.

(d.) If this is the case, then doesn't that logically lead to GAO's and the Commerce Department's Inspector General's conclusion that sampling at least a portion of the nonresponding households would increase the accuracy and decrease the cost of conducting the census?

Even if the sampling methodologies did not share the census's reliance on error-prone efforts to resolve difficult cases, the issues raised in the response to Question 12 above would still be pertinent. While there may be a place for sampling in improving the census, the particular procedure proposed for sampling nonrespondents appears to have some serious shortcomings.

25. **GAO also concluded after the 1990 census that a high level of public cooperation is key to obtaining an accurate census at reasonable cost. Unfortunately, the mail response rate has fallen with every census since 1970, and was only approximately 65% in 1990. The reasons for this decline are in many instances outside of the Census Bureau's control, for example the increase in commercial mail and telephone solicitations and in nontraditional household arrangements. For these reasons, the Bureau is planning a public education campaign for the 2000 census, surpassing any previous attempts. Given the response in 1990, do you believe this is money well spent?**

Do you believe that this public education campaign can succeed in arresting the decline in response rates?

Even if it does, wouldn't some use of sampling be warranted to solve the problems associated with reaching the last few percentages of nonresponding households?

Taking the last question first, some of the appropriate and inappropriate uses of sampling with respect to non-response are addressed in the answer to Question 12 above.

I agree that a high level of public cooperation and a high response rate are keys both to obtaining an accurate census and to holding down costs. While I have not reviewed the Census Bureau's publicity plans, I understand that they involve improvements to both the quality and the timing of the publicity efforts. (See also the answers to Question 2 and Question 5 above regarding the success of "traditional methods" in improving census participation.)

It should be noted that the issue of undercount adjustment also has very significant implications for levels of public cooperation and response:

- On the one hand, there is reason to believe that a decision to adjust the census would have a very serious negative effect on census participation. If people expect the census count to be adjusted, they may not think that the effort required to complete their census form is necessary. Similarly, the critical involvement of public officials and temporary census employees in securing high participation rates might be jeopardized by a decision to adjust the census. In the "Notice of Final Decision" on adjustment of the 1990 Census, then-Secretary of Commerce Robert Mosbacher wrote:

> I am worried that an adjustment would remove the incentive of states and localities to join in the effort to get a full and complete count. The Census Bureau relies heavily on the active support of state and local leaders to encourage census participation in their communities... If civic leaders and local officials believe that an adjustment will rectify the failures in the census, they will be hard pressed to justify putting census outreach programs above the many other needs clamoring for their limited resources. Without the partnership of states and cities in creating public awareness and a sense of involvement in the census, the result is

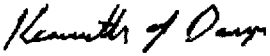
likely to be a further decline in participation. [*Congressional Record*, 7/22/91, page 33584.]

There is a real risk that, with an expectation of a correction through adjustment, the field staff would not have the same sense of commitment and public mission in future censuses and, as a result, careless and incomplete work would increase, thereby decreasing the quality of census data. These are the workers the Bureau depends on to collect the data from the groups that are hardest to enumerate. If these data suffer, the information lost at the margin is information that is especially important to policy development. [*Congressional Record*, 7/22/91, page 33605.]

- On the other hand, the current controversy over adjustment may play a positive role in encouraging census participation. This controversy has increased awareness of the importance of being included in the census on the part of civic leaders, local government officials, civil rights organizations, and the general public. It might be possible to translate this awareness into something that everybody will find superior to an adjustment for undercount: a census in which people get counted the first time.

Thank you again for the opportunity to address these questions. I hope that these answers promote a greater understanding of the issues surrounding census undercount adjustment and that the resulting dialog will lead to a better census.

Sincerely,



Kenneth J. Darga, Senior Demographer
Michigan Department of Management and Budget

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[1]Kenneth J. Darga, "Straining Out Gnats and Swallowing Camels: The Perils of Adjusting for Census Undercount," Office of the State Demographer, Michigan Information Center, Michigan Department of Management and Budget. Paper submitted as testimony to the House Subcommittee on the Census, May 5, 1998.

[2]Kenneth J. Darga, "Quantifying Measurement Error and Bias in the 1990 Undercount Estimates," Office of the State Demographer, Michigan Information Center, Michigan Department of Management and Budget. Paper submitted as testimony to the House Subcommittee on the Census, May 5, 1998.

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May 13, 1998

Jerry L. Coffey, Ph.D.
119 Tetterton Avenue
Vienna, VA 22182

Dear Dr. Coffey,

Thank you for testifying before the Government Reform and Oversight Subcommittee on the Census on May 5, 1998. Because of time constraints, I was left with a number of questions unanswered. Therefore, I request that you answer the following questions:

1. Can you tell us about a statistical or scientific activity that you've worked on that either worked perfectly the first time you tried it, or that didn't work as well as you had hoped the first time so you abandoned the idea altogether without making an effort to improve or redesign it?

2. Despite the fact that the Census Bureau made improving the count among minorities a major goal of the 1990 Census, the 4.4 percent differential in the 1990 undercount between Blacks and non-Blacks was the highest ever recorded. Experts have repeatedly said that spending more money on traditional methods will not reduce this differential. If not through statistics, how do you propose to reduce this differential?

3. You have mentioned your concerns about block level accuracy. Can you discuss you thoughts on the accuracy of census numbers at the state level if Dual System Estimation is used in 2000? Do you have any evidence that suggests that the census counts will be more accurate at the state level in 2000 if DSE is not used?

4. Secretary Mosbacher, in testimony before both the House and the Senate, said that the Post Enumeration Survey would make the majority of the states more accurate. Is that statement correct? If so, why is his testimony so at odds with your testimony?

5. The 1990 census cost 20 percent more per household in real dollars than the 1980 census. The 1980 census cost twice as much per household in real dollars as the

1970 census. That is an increase in real dollar cost per household of 250 percent with no improvement in the differential undercount. Does that suggest to you that spending more on traditional methods will reduce the differential undercount?

6. Demographic analysis showed higher undercounts of African Americans than the undercounts demonstrated by the Post Enumeration Survey. That suggests that the Post Enumeration Survey understates, not overstates, the undercount, especially for minorities. In other words, isn't it likely that the 1990 census missed more African-Americans that would have been added back into the census by the Post Enumeration Survey?

7. You have talked a lot about bias in the Post Enumeration Survey but have not talked much about the bias in the census. The differential undercount measured by demographic analysis shows that bias in the census is quite real. If there is no Integrated Coverage Measurement, is it not the case that this bias in the census will continue?

8. Do you believe that it is acceptable for the census to consistently miss certain segments of the population -- Africans Americans, Latinos, Asian Americans, poor people in rural and urban communities -- at greater rates than the White population? If that is not acceptable, what do you propose be done to reduce the differential undercount? Can you offer any evidence that you proposal(s) will reduce the differential undercount?

9. It has been stated that one of the faults of the 1990 PES was correlation bias. Can you explain correlation bias? I understand that it is the likelihood that the people missed in the census may be the same people missed in the PES. Said another way, both the census and the survey miss the same people, for example, young Black males. How does correlation bias affect the accuracy count of those traditionally undercounted, Blacks, Hispanics, Asians, Native Americans, renters?

10. Wouldn't the only risk of correlation bias be minimization of the undercount rather than an overestimation the undercount?

11. In testimony before the Senate Committee on Governmental Affairs approximately one year ago, Dr. Lawrence Brown, Professor of Statistics at the University of Pennsylvania, stated that, "Statistical sampling methods can be used in an effective and objective way to assist the census process." Do you agree with Dr. Brown's statement? If you disagree, please explain why.

12. Dr. Lawrence Brown also testified before Senator Thompson that the Sampling for Nonresponse Follow-up plan "is an objective procedure all the way around [and] has a very good chance of working as desired." Do you agree with that statement? If you disagree, please explain why.

13. In addition, Dr. Brown testified that the Census Bureau's 2000 census plan had been "drastically simplified and improved. ...[these changes] make it possible to now believe that the Integrated Coverage Measurement might work as well as desired to correct the undercount." Do you agree with that statement? If you disagree, please explain why.

14. With regard to concerns that the Integrated Coverage Measurement process could be manipulated to achieve a particular outcome in terms of the population counts, Dr. Brown testified that, "if all of this planning is done in advance, it is very, very hard for me to see how one could direct these subjective decisions towards any desired goal." Do you agree with Dr. Brown that if the procedures and protocols for the Integrated Coverage Measurement are set forth in advance and subject to expert and public scrutiny, that it is very unlikely that the sampling and statistical estimation process will be subject to manipulation, possibly for political advantage? If you disagree, please explain why.

15. Dr. Brown also testified that even after the non-response follow-up phase of the census is complete, there "would still [be] the undercount problem of those people who just refuse to be counted or are very difficult to count." Do you agree with that statement? If you disagree, please explain why.

16. With regard to the post-enumeration survey in the 1990 census, Dr. Brown testified that many of the difficulties with the procedure "can be traced to the fact that the PES sample was much too small to support the kind of objective, reliable analyses that are desired." Do you agree with that? If you disagree, please explain why.

17. The size of the sample in the Integrated Coverage Management (ICM) is 750,000 households. Is that a proper size for such an endeavor?

18. The results of the PES in 1990 showed that census was less accurate than its predecessor. That result was confirmed by demographic analysis, which has been performed on every census since 1940. We certainly know that the 1990 census was much more expensive than the 1980 census. Do you agree with the conclusion that 1990 was less also less accurate than 1980?

19. Please explain the difference between net over- or undercount in the 1990 census count and actual over- and undercounts (mistakes) made int he 1990 count. I know that a net undercount of 1.6% sounds relatively small but for census purposes, aren't those 26 million mistakes a concern?

20. I understand that improvement in the average does not necessarily mean that there will be improvement in every case. In 1990, there was criticism about the strata being broken down by region. If statistical methods are used in 2000, with strata

broken down by state in 2000, can we expect more states with improved accuracy than there were in 1990?

21. Representative Sawyer pointed out that the longer the Census Bureau is in the field, the higher the error rate in the information collected. I believe that information came from one of the many GAO studies he and his Republican colleagues commissioned. You have stated your concern about the Census Bureau not be in the field for enough days in the 2000 plan. Can you explain the difference in opinion?

22. In order to address the problem of declining public response, the GAO suggested exploring a radically streamlined questionnaire in future censuses. Would you give us your thoughts on how effective this approach might be in increasing response, and also its effect on perhaps diminishing the usefulness of census data?

23. In its 1992 capping report on the 1990 census, the GAO concluded that "the results and experiences of the 1990 census demonstrate that the American public has grown too diverse and dynamic to be accurately counted solely by the tradition 'headcount' approach and that fundamental changes must be implemented for a successful census in 2000." Do you agree with that conclusion? If you disagree, please explain why.

24. After the 1990 census, GAO concluded that "the amount of error in the census increases precipitously as time and effort are extended to count the last few percentages of the population....This increase in the rate of error shows that extended reliance on field follow-up activities represents a losing trade-off between augmenting the count and adding more errors." In the last months of the follow-up efforts in 1990, GAO estimated that the error rates approached 30 percent, and that this problem was probably exacerbated by the use of close-out procedures. This appears to be a problem inherent to the methodology of the 1990 census. Don't you agree?

    Do you have any information on the error rates for information gathered using close-out procedures?

    Even if sampling is not perfect, isn't its error rate well below the levels for the last percentages of the population using more traditional follow-up procedures?

    If this is the case, then doesn't that logically lead to GAO's and the Commerce Department's Inspector General's conclusion that sampling at least a portion of the nonresponding households would increase the accuracy and decrease the cost of conducting the census?

25. GAO also concluded after the 1990 census that a high level of public cooperation is key to obtaining an accurate census at reasonable cost. Unfortunately the mail

response rate has fallen with every census since 1970, and was only approximately 65 percent in 1990. The reasons for this decline are in many instances outside of the Census Bureaus control, for example the increase in commercial mail and telephone solicitations and in nontraditional household arrangements. For these reasons, the Bureau is planning a public education campaign for the 2000 census, surpassing any previous attempts. Given the response in 1990, do you believe this is money well-spent?

Do you believe that this public education campaign can succeed in arresting the decline in response rates?

Even if it does, wouldn't some use of sampling be warranted to solve the problems associated with reaching the last few percentages of nonresponding households?

My questions and your answers will be part of the permanent record of the May 5, 1998, hearing. Again, thank you for your impute into this most important process.

Sincerely,

Carolyn B. Maloney
Ranking Minority Member
Subcommittee on the Census

cc: The Honorable Dan Miller

Responses to Representative Maloney --

1. Can you tell us about a statistical or scientific activity that you've worked on that either worked perfectly the first time you tried it, or that didn't work as well as you had hoped the first time so you abandoned the idea altogether without making an effort to improve or redesign it?

A. I have been a hard-nosed advocate of "getting it right the first time" for many years, and won over many of my colleagues at OMB. This approach emphasizes planning that not only covers what you expect, but also is robust with respect to things that may go wrong. It works well even when it doesn't work perfectly.

2. Despite the fact that the Census Bureau made improving the count among minorities a major goal of the 1990 Census, the 4.4 percent differential in the 1990 undercount between Blacks and non-Blacks was the highest ever recorded. Experts have repeatedly said that spending more money on traditional methods will not reduce this differential. If not through statistics, how do you propose to reduce this differential?

A. The undercount is by its nature a nonresponse problem (or in many cases a refusal problem). A refusal rate as low as 1% would be considered an outstanding achievement for most surveys. There are two factors that draw attention to this particular problem in the Census:

a) The problem of missing data in the census data base is much larger than this, but these other gaps are susceptible to "imputation," which, by its nature, leaves little or no evidence of the alteration (imputed items, for better or worse, are designed to look like the actual data on which they are based). The evidence of the undercount gap is external. The comparative estimates may not be completely accurate, but they are highly visible.

b) The requirement for a complete enumeration goes substantially beyond the arena where statistical methods are most effective (and beyond the arena where the usual statistical standards for an acceptable level of error can be applied).

On this second point, comparison with the "voluntary" income tax system is instructive. IRS has used statistical principles in its approach to tax returns (e.g., it offers taxpayers the option of selecting an imputed average minimum deduction, the "standard deduction," in lieu of documenting actual deductions), but an explicit statistical adjustment to the tax liability of willing taxpayers to offset the loss due to those who refuse to file would be considered arbitrary and capricious. Rather we live with the consequences (reduced revenue) and IRS spends an extraordinary amount of research and auditing effort to discover those who refuse to pay or underpay their taxes and correcting these problems on a case by case basis. Such a statistical adjustment strategy could eliminate the estimated revenue shortfall and make the revenue per person with tax liabilities more "accurate" on the average, but it would be less accurate for almost every individual who actually pays his or her taxes. Most statistical methods do not deal well with the issues of individual fairness that are critical to administrative systems such as the tax system or to an "actual enumeration" intended to provide "fair" representation for every

individual.

Some lessons of the tax system are also useful for a census. Look for classes of individuals who represent a disproportionate share of the refusals (the differential undercount), and use this information to refine and focus your strategy for bringing those individuals into the system. Demographic Analysis has provided some of the most important insights into the gross characteristics of census refusals, but Dual System estimates of those characteristics (because of the large confounded bias component and the substantial inconsistency with DA results) may be counterproductive for such a strategy (e.g., if attributes that arise from this very large bias are misinterpreted as actual attributes of the refusal population, efforts and funds may be substantially mistargetted).

"Traditional" efforts have missed some important opportunities to improve response in the past and I have commented on these in my responses to questions #8, #23, and #25 below.

3. You have mentioned your concerns about block level accuracy. Can you discuss you (sic) thoughts on the accuracy of census numbers at the state level if Dual System Estimation is used in 2000? Do you have any evidence that suggests that the census counts will be more accurate at the state level in 2000 if DSE is not used?

A. I did not comment on block-level accuracy per se. Three important attributes of an enumeration that must not be discarded lightly are 1) simple robustness, 2) uniform accuracy in both large and small areas and 3) additivity. As a practical matter, block level accuracy is one way these properties can be substantially preserved. I have commented on the shortcomings of compromise accuracy targets in my response to Miller question #1. As to the performance of DSE, I only note that it failed even the test of state-level accuracy in the one large scale evaluation we have (the 1990 PES) -- this is elaborated in my response to question #4 below.

4. Secretary Mosbacher, in testimony before both the House and the Senate, said that the Post Enumeration Survey would make the majority of the states more accurate. Is that statement correct? If so, why is his testimony so at odds with your testimony?

A The statement by Secretary Mosbacher in 1991 was based on the original Census Bureau adjustment estimate, which was later found by the Census Bureau to be substantially inaccurate. Indeed the Secretary noted that the tally of 29 more accurate versus 21 less accurate, based on the original 2.1% adjustment, had already been reversed (to about 21-23 more accurate and 27-29 less accurate) based on the findings of independent analysts. A year later the census Bureau acknowledged that the original adjustments were substantially in error, revising the overall PES undercount estimate downward to 1.58%. By August of 1992, the CAPE report had been completed and it showed that even the revised estimate overstated the PES measured undercount by an amount much larger than the July 1992 "correction"; in other words the revised undercount data set reflected in about equal parts the characteristics of the undercounted and the characteristics of measured bias.

The 1991 statement by the Secretary reflected what the Census Bureau had told him at the time. Due in large part to the efforts of the Secretary in commissioning the comprehensive CAPE evaluation, the 1991 data set on which these 1991 claims were based turned out to be more error than fact.

5. The 1990 census cost 20 percent more per household in real dollars than the 1980 census. The 1980 census cost twice as much per household in real dollars as the 1970 census. That is an increase in real dollar cost per household of 250 percent with no improvement in the differential undercount. Does that suggest to you that spending more on traditional methods will reduce the differential undercount?

A. As I indicated in my response to question #2, the undercount is a nonresponse problem more than a design problem. While I was at OMB, I was consistently critical of Census Bureau arguments that revolved around the premise that "we have always done it that way." OMB regulations prevent me from discussing the detailed information that came to me in the course of my employment, but suffice it to say that we made a number of recommendations for improving response to the Census prior to 1990. I am gratified that the Census Bureau under Martha Riche adopted some of these recommendations for the 2000 census. Other recommendations for improving the performance of the count have never been acted on by the Census Bureau (I have commented on some of these in my response to question #8). Because of the high visibility of this undertaking the Census Bureau has been risk-averse for a long time. It has been slow to embrace response theories (due as much to cognitive psychologists as to statisticians) that have proven very effective over the past two decades.

6. Demographic analysis showed higher undercounts of African Americans than the undercounts demonstrated by the Post Enumeration Survey. That suggests that the Post Enumeration Survey understates, not overstates, the undercount, especially for minorities. In other words, isn't it likely that the 1990 census missed more African-Americans that would have been added back into the census by the Post Enumeration Survey?

A. The substantial inconsistencies between the picture of the undercount population implied by demographic analysis (DA) and that implied by the 1990 Post Enumeration Survey (DSE methodology) were of great concern to the expert panel supporting the CAPE evaluation. In comparing the two, the panel drew attention (in Attachment 8) to several sources of error in the DA estimates -- some that would generally exaggerate the number of persons not counted and others that would specifically exaggerate the number of blacks and Hispanics not counted. While DA may be subject to these biases, they pale in comparison to documented biases in the PES. The DSE methodology used in the PES was able to measure undercounted persons accounting for, at best, about 0.9 percent of the population.

If the undercounted population is any larger than this (as is implied by DA), then the racial and ethnic characteristics of the missing group are unknown to PES (in DSE there is no data on the missing group). This is why the expert panel pressed the Census Bureau so persistently to

remove this large remaining bias -- unless and until that large bias is removed, it is impossible to isolate the true racial and ethnic characteristics of the (measured) DSE undercount group from the spurious racial and ethnic characteristics attributable to the millions of spurious undercount cases inferred by DSE but actually contributed by the DSE bias processes. [Note: the previous sentence refers only to the net effect of bias -- the errors due to DSE that produced this measured bias in the net figure actually contributed much larger numbers of spurious undercounts and spurious overcounts inferred by the DSE methodology -- some of these spurious inferences may be related to the numbers that appear in question #19.)

In short, DA may somewhat exaggerate the number of persons undercounted, but the DSE methodology measured a far smaller undercount group than that implied by DA, and could not estimate the racial and ethnic composition of this measured undercount group with any accuracy in the presence of DSE's very large measured bias.

If you could remove the bias from the dual system PES estimates, and you were willing to make the leap of faith (as we are asked to do in the 2000 Census plan) that DSE works, (i.e., its measured undercount group accurately represents the actual undercount), you are left with the unavoidable conclusion that demographic analysis substantially overstated the 1990 undercount (probably by exaggerating black and Hispanic components of the differential undercount) and that the 1990 Census was the most accurate census in history.

7. You have talked a lot about bias in the Post Enumeration Survey but have not talked much about the bias in the census. The differential undercount measured by demographic analysis shows that bias in the census is quite real. If there is no Integrated Coverage Measurement, is it not the case that this bias in the census will continue?

A. There are several types of bias in the count. They generally reflect the kind of nonsampling error statisticians classify as "nonresponse," and reflect a level of nonresponse that would be considered trivial in almost any sample survey (remember that the accuracy standards expected of an enumeration vastly exceed those that sample surveys are typically capable of meeting). Based on external benchmarks (demographic analysis), there is an overall downward bias in the count of about one percent. If this bias were uniform, it would make virtually no difference to the objective of supporting an accurate apportionment. The same external benchmark suggests that the bias may not be uniform across all potential Congressional districts. The evidence here is in proxy demographic variables, e.g., race and ethnicity. Once again, if the racial and ethnic characteristics of the populations in each potential Congressional district were uniform, there would be virtually no effect on the accuracy of apportionment. So one must explore the mechanisms that produce these differences.

If the Census Bureau address listing methodology disproportionately misses black or Hispanic households, then this error affects both the count and the DSE. Likewise, if a disproportionate number of black and Hispanic households deliberately avoid participation the census, they will be missed by both the count and the DSE. DSE is blind to these particular types of errors and impotent to "correct" them. The presence or absence of ICM has no effect on errors of this kind.

The bias they produce will persist until the nonresponse problems are addressed directly by such things as better listing, more effective follow-up (refusal conversion), and eliminating root causes of mistrust.

The value of coverage measurement is a different story. The DSE methodology requires data and is thus not very useful for dealing with true non-response, but this is not to say that a well-designed coverage measurement program cannot contribute significantly to improving the accuracy of the count. During the period when my OMB colleague, the late Maria Gonzalez, was reviewing plans for the 1990 Census, we discussed the role of coverage measurement at length. I had the temerity to suggest that, with all the expectations placed on the PES, the sample should be larger. Maria gently took me to task, pointing out that a sample small enough to be performed quickly by an expert staff could detect performance problems and errors early enough to correct problems in the count. (These advantages of a small manageable sample are also reflected in the September 1996 Report of the American Statistical Association Blue Ribbon Panel on Uses of Sampling in the Census.) This potential for feedback is the critical difference between effective quality control and simple quality measurement.

8. Do you believe that it is acceptable for the census to consistently miss certain segments of the population -- Africans (sic) Americans, Latinos, Asian Americans, poor people in rural and urban communities -- at greater rates than the White population? *If that is not* acceptable, what do you propose be done to reduce the differential undercount? Can you offer any evidence that you (sic) proposal(s) will reduce the differential undercount?

A. I believe most of these problems must be recognized and addressed for what they are -- deficiencies in performance and highly motivated refusals. The Census Bureau is aware of large differences in response performance even among its regular staff, but has been reluctant to admit or address this problem administratively for a variety of reasons (possible litigation risk?). After the 1980 Census, focus groups were conducted in high undercount areas -- the results were reported by GAO. This research identified some strong, perfectly rational motivations for resisting the Census, most of them related to the numerous questions on the long form. This is a dilemma for the Census Bureau. Local agencies lobby heavily to retain the questions so that they can use block-level data to target such programs as housing code enforcement. But people who have observed the housing inspectors moving into their neighborhoods after the block-level data are released can make the connection for themselves -- and tell their neighbors about it next time. Even those who simply wonder why those questions are there can put two and two together.

The attraction of the rich, geographically detailed Census research data base for enforcement authorities creates some perverse incentives. For anyone who may have reason to avoid the notice of enforcement authorities, the only safe course may be to avoid the census altogether or to file a false report that appears consistent with local regulations (e.g., omit listing some occupants to avoid evidence of overcrowding).

Some steps have already been taken --

a) Making more forms available for willing respondents may offset differential problems in the mailing list (though I still have some concerns here about double counting or other fictitious reports).

b) Reducing the number of questions on the long form may help if the changes reduce suspicions among groups with high refusal rates.

One other way to address this problem is to decouple the research component (the long form) of the Census from the count (the short form). The temptation to piggy-back this huge sample (about 20 million) on the basic count has outweighed the possibility of reducing the undercount. The Continuous Measurement program had the potential for accomplishing this, but this has been deferred, trading off potential reductions in undercount for 2000 for one more bite at a huge long form sample.

Yet another possibility that has been proposed is to reduce the size of the long-form sample. Ironically, the long form sample size claimed to be the "minimum" needed to gather research information adequate to make program decisions is about 25 times larger than the sample size proposed to "correct" the constitutionally required count. I suspect these sampling judgments have more to say about the priorities of the research community and various bureaucracies than any reasonable statistical calculation. If the sample size of the research component is reduced across the board, then some resources are freed up for more extensive follow-up of the count. If the research community will not stand for this, even a reduction of the long form sampling rate in high undercount areas would be useful. There are also sound technical reasons for reducing the sampling rate in areas of high population density (what determines sampling error is sample size, but sampling rates are easier to sell to nonstatisticians -- the resulting distortion has affected the sample designs for both the long form and coverage measurement.).

9. It has been stated that one of the faults of the 1990 PES was correlation bias. Can you explain correlation bias? I understand that it is the likelihood that the people missed in the census may be the same people missed in the PES. Said another way, both the census and the survey miss the same people, for example, young Black males. How does correlation bias affect the accuracy count of those traditionally undercounted, Blacks, Hispanics, Asians, Native Americans, renters?

A. There are two reasons for using the term "correlation bias." The first has to do with the fact that the two samples being compared are not independent. Census argues that this effect is small. Another reason is that cases missing from either the count and/or the PES are correlated. However for the critical "4th cell" (the unobserved cases missing from both), your interpretation is correct -- some unknown number of missed cases (for which there are no data whatever) are assumed to make up this cell. But since there are no data, there are no attributes (black, Hispanic, young, male, etc.) to measure. Correlation bias is a property of the DSE methodology, not the underlying count. It represents that hypothetical portion of the undercount for which neither the count nor the follow-up survey have produced any useful information. Even the size of this bias can only be inferred indirectly by reference to other information. In other words it

represents a (hopefully small) chunk of ignorance which adds nothing to our knowledge of the undercount.

Its effect on the accuracy of estimated characteristics of the undercounted population must also be inferred indirectly. The CAPE report breaks down the DSE (revised) estimate of 1.58 percent undercount as 0.85% actual measured undercount and 0.73% measured bias. Note that the correlation bias has not yet appeared. The 0.71% bias reflects the measurable errors made in the DSE analysis, e.g., correct counts incorrectly classified as overcounts or undercounts. If the characteristics of these bias cases could be removed (as the expert panel urged) then what would be left would be a set of accurate characteristics (race, ethnicity, etc.) of the actual undercount group found by DES. But the Census Bureau determined that the processes available to remove the effect of the bias would add additional error. So the only characteristics of the 1.58% DSE estimate of undercount that can be tabulated consist of the unknown real characteristics of the true undercount group mixed with the unknown spurious characteristics contributed by the bias group. Since the detailed characteristics of the undercount group in DSE are knowable but are, in fact, unknown, any adjustment for the offsetting "correlation bias" (whose characteristics are unknowable within DSE by definition) can only be made at the most aggregate level. Based on other information, the Census Bureau estimated the size of the correlation bias (relative to the 1.58% estimate) at 0.38%, leaving an overall estimate of about 1.2% undercount consisting of 0.85% actual measured undercount within DSE (net of measured bias) plus 0.38% undercount missed by DSE. About the only thing we do know after all this is that the results of DSE are clearly inconsistent with the 1.8% undercount estimate derived from demographic analysis.

On another level, however, we can indirectly infer something about the accuracy of undercount characteristics that are theoretically observable in DSE. If we could remove the measured bias, and if the correlation bias were large enough to account for the difference between the 0.85% measured undercount observed in DSE and the 1.8% total undercount implied by DA, we would be left in the position of trying to estimate the characteristics of the whole undercount population (1.8%) from DSE information that represents only a minor fragment (0.85%) of that population. This is why I asserted that the DSE methodology becomes unreliable if the correlation bias is large.

10. Wouldn't the only risk of correlation bias be minimization of the undercount rather than an overestimation (sic) the undercount?

A. No. The risk if the correlation bias is large is that you have no information about most of the undercount population. Statistical estimates based on no information are notoriously unreliable.

11. In testimony before the Senate Committee on Governmental Affairs approximately one year ago, Dr. Lawrence Brown, Professor of Statistics at the University of Pennsylvania, stated that, "Statistical sampling methods can be used in an effective and objective way to assist the census process." Do you agree with Dr. Brown's statement? If you disagree, please explain why.

A. Yes, I agree. Sampling methods have been used in this way for over 50 years.

12. Dr. Brown also testified before Senator Thompson that the Sampling for Nonresponse Follow-up plan "is an objective procedure all the way around (and) has a very good chance of working as desired." Do you agree with that statement? If you disagree, please explain why.

A. The statement is too speculative for my tastes and, as Dr. Brown noted, is based in part "on idealized statistical assumptions." In fairness to Dr. Brown, he also noted risk of bias, several real-world problems, and some potentially troublesome interactions, concluding on balance that "if Congress can find the money, I'd prefer to see a full follow-up rather than the current sample response follow-up plan." I fully agree with that conclusion.

13. In addition, Dr. Brown testified that the Census Bureau's 2000 census plan had been "drastically simplified and improved. ...(these changes) make it possible to now believe that the Integrated Coverage Measurement might work as well as desired to correct the undercount." Do you agree with that statement? If you disagree, please explain why.

A. I believe the statement with ellipsis and insertion(s) does not accurately convey the view expressed by Dr. Brown. There were two slightly different statements, one in his prepared testimony and the other in the transcript. The clearer of the two was in the transcript:

> "As of a month ago, the plans for the first stage were drastically simplified and improved, I believe. And these first stage changes lead me to believe that that stage can work to provide suitably accurate numbers. And some other changes they have announced to the ICM protocol make it possible to believe that that it might work as well as desired." [note -- the written statement also included the words "to correct undercount" at the end of this sentence]

The first part of the quotation is an endorsement of the improvements made to the first stage (sampling for follow-up) -- I agree that improvements have been made. The second part of the quotation is an extremely guarded expression of optimism that ICM may work after all. I am much less sanguine than Dr. Brown. A lot depends on what is meant by suitable accuracy or working "as well as desired." My views are based, not on the highly charged debate in the literature, but on the comprehensive evaluation (CAPE) performed by the Census Bureau itself.

14. With regard to concerns that the Integrated Coverage Measurement process could be manipulated to achieve a particular outcome in terms of the population counts, Dr. Brown testified that, "if all of this planning is done in advance, it is very, very hard for me to see how one could direct these subjective decisions towards any desired goal." Do you agree with Dr. Brown that if the procedures and protocols for the Integrated Coverage

Measurement are set forth in advance and subject to expert and public scrutiny, that it is very unlikely that the sampling and statistical estimation process will be subject to manipulation, possibly for political advantage? If you disagree, please explain why.

A. Variations on this approach have always held some attraction for OMB, particularly when there was potential for subtle abuses. The results have been mixed. Public or even expert scrutiny may reach consensus long before it has reached the whole truth. Constraints on processes tend to reward conservative methods and inhibit innovative breakthroughs. But the most potent risks arise in the case of procedures that are not inherently robust. All the careful caveats devised by statisticians cannot prevent a motivated advocate from changing the results by altering sensitive assumptions. Some statisticians believe that they have discharged their professional obligations by adding caveats to a frail result. I do not share that view.

I applaud the four minimum principles for effectiveness and objectivity advanced by Dr. Brown in paragraph 2 of his prepared testimony, and I would add robustness to the list for the reasons indicated above. I also share the concern expressed in his notes about ICM procedures:

> "such a procedure violates my principle 2(iii). But this contradiction at present seems unavoidable if one hopes to use reasonable ICM procedures to reduce the differential undercount problem below where it stood in 1990 and 1980." [emphasis added]

15. Dr. Brown also testified that even after the non-response follow-up phase of the census is complete, there "would still (be) the undercount problem of those people who just refuse to be counted or are very difficult to count." Do you agree with that statement? If you disagree, please explain why.

A. I agree that there will always be some residual refusals and performance errors, but my response to question #8 above indicated the potential for reducing these below the currently accepted levels. I would certainly not write off the current level of refusals as unavoidable if that is what is being inferred from Dr. Brown's statement.

16. With regard to the post-enumeration survey in the 1990 census, Dr. Brown testified that many of the difficulties with the procedure "can be traced to the fact that the PES sample was much too small to support the kind of objective, reliable analyses that are desired." Do you agree with that? If you disagree, please explain why.

A. From the content and context of his statement, I believe Dr. Brown was referring to the shortcomings of the PES as an analytical tool. There are also indications in the CAPE report that additional data might have resolved some of the intractable problems of the evaluation, for example the inability to remove the measured bias. On the other hand, increasing sample size does not generally reduce the size of such biases, and it was the size and relationship of the biases that was the downfall of the PES as a tool for accurately allocating the undercount.

17. The size of the sample in the Integrated Coverage Management (ICM) is 750,000 households. Is that a proper size for such an endeavor?

A. It is much too large and unmanageable to provide quality control or even to secure the advantages touted by the ASA Blue Ribbon Panel (e.g., tighter control using expert staff to reduce nonsampling error). The Census Bureau has experienced differential performance problems using regular staff in samples as small as 20,000 households. And if the DSE methodology fails because the type of nonsampling error known as correlation bias is too large (a distinct possibility based on the PES experience), then any sample size is too large.

18. The results of the PES in 1990 showed that the census was less accurate than its predecessor. That result was confirmed by demographic analysis, which has been performed on every census since 1940. We certainly know that the 1990 census was much more expensive that the 1980 census. Do you agree with the conclusion that 1990 was less (sic) also less accurate than 1980?

A. As indicated in my response to questions # 6 and #9, the PES results were in substantial conflict with 1990 demographic analysis results. If you believe the DSE methodology worked, then 1990 looks more accurate than 1980. I tend to agree with Dr. Brown -- it was pretty much a wash. I can still remember the wide-spread consternation with the unprecedented "surprises" and errors that occurred in the 1980 Census (the largest "closure error" in history by a wide margin, compromised quality control, and many horror stories from the field). This large deviation from expectations (closure error) probably made it much more difficult to detect and correct other, smaller discrepancies. So I would not be surprised if the performance indicators were a bit soft in 1980. Demographic analysis has provided the most consistent benchmark, but its methods and assumptions have changed over time and I doubt that comparisons are reliable to tenths of a percent. In 1990, there were some suspicions that the DA figures might be too high. You also have to make allowances for the fact that the most recent census is almost always bad-mouthed in the course of justifying more funds for the next one.

19. Please explain the difference between net over- or undercount in the 1990 census count and actual over- and undercounts (mistakes) made in the 1990 count. I know that a net undercount of 1.6% sounds relatively small but for census purposes aren't those 26 million mistakes a concern?

A. I have some difficulty understanding this question, but I will try to respond. First, 26 million would be about 10% of the count, but I am not sure what that figure refers to. Undercount, overcount, and the "net" are less haphazard and less precise than might be inferred from the details of this question. No count is perfect, so it is assumed that there are some undetected double counts and undetected undercounts that are reflected in the total enumeration. Since they are undetected, we don't know how many there are from the count itself. By means of external comparisons.(principally demographic analysis), we can estimate (with some error) how far off the count may be. Since the external comparison doesn't tell us anything about the mix of over-

and undercount, we can logically infer things only about the net effect. In the past, coverage evaluation has provided some incomplete estimates of the mix of over- and undercount, but this should not be confused with the 1990 output of DSE (about half of those net errors were DSE errors, which is why they were classified as "measured bias"). (see also the response to question #6 above)

I have always been chagrined that millions of people may not take the census seriously or refuse to participate. OMB gets some misdirected census returns that are really bizarre. OMB also gets both complaints and misdirected hate mail that display distrust of the Census or the Census Bureau or both.

20. I understand that improvement in the average does not necessarily mean that there will be improvement in every case. In 1990, there was criticism about the strata being broken down by region. If statistical methods are used in 2000, with strata broken down by state in 2000, can we expect more states with improved accuracy than there were in 1990?

A. Finer geographic stratification is a two-edged sword. In theory, criteria other than political boundaries should be the deciding factors -- strata that are geographically diffuse can be perfectly valid and may perform better. Consider a case where census staff in some states are much more proficient at converting refusals than staffs in other states. With geographically diffuse strata, the effect tends to average out, but with state-based strata, the effect produces another kind of differential undercount that directly distorts apportionment information. It is entirely possible that state-based strata are a political palliative that imposes real penalties on accuracy.

21. Representative Sawyer pointed out that the longer the Census Bureau is in the field, the higher the error rate in the information collected. I believe that information came from one of the many GAO studies he and his Republican colleagues commissioned. You have stated your concern about the Census Bureau not be (sic) in the field for enough days in the 2000 plan. Can you explain the difference in opinion?

A. The phenomenon described by Representative Sawyer is not a matter of opinion. This pattern is well known -- it is not unique to the Census enumeration, it occurs in sample surveys as well (and for the same reasons). As the achieved response rate rises, productivity tends to fall and error rates tend to rise. Early respondents are self motivated to cooperate. Reluctant or forgetful respondents tend to pay less attention to the task and thus make more errors. Resistant respondents reached late in the process are often distracted by irritation and have less motivation to consider questions carefully. The stress of dealing with respondent irritation or the pressure of a final close-out process may also cause data collectors to make additional errors of their own.

But while the error rate (per observation) goes up, total error is generally reduced by filling in gaps that contribute to non-response error with 70% or 80% or 90% accurate information. Depending on error characteristics, there may be a break-even point at some very high response rate, but this point is rarely reached in most sample survey designs because follow-up is

terminated at a lower level due to cost considerations. Surveys to capture very rare attributes or those which are bias-sensitive may spend the extra money to reach the break-even point. The census enumeration probably qualifies on both counts. There is a world of difference between flirting with the break-even point (as may be happening in some areas in the full enumeration) and calling it quits after a couple of tries.

22. In order to address the problem of declining public response, the GAO suggested exploring a radically streamlined questionnaire in future censuses. Would you give us your thoughts on how effective this approach might be in increasing response, and also its effect on perhaps diminishing the usefulness of census data?

A. The GAO suggestion is sound. OMB has made similar recommendations. Though many other factors influence respondent cooperation, questionnaire length is one of a handful of factors that has consistently shown a correlation with response rates. Other attributes of a "streamlined" approach (visual simplicity, user-friendliness) also have a salutary effect on response. If this is incorporated into one of the "decoupling" strategies described in my response to question #8, there are opportunities for a much more sophisticated research program (e.g, more frequent measurement, much more powerful and efficient sample designs, etc.) which can make the data-rich research component more useful as well.

23. In its 1992 capping report on the 1990 census, the GAO concluded that "the results and experiences of the 1990 census demonstrate that the American public has grown too diverse and dynamic to be accurately counted solely by the tradition (sic) 'headcount' approach and that fundamental changes must be implemented for a successful census in 2000." Do you agree with that conclusion? If you disagree, please explain why.

A. I would go farther. I would not simply supplement the traditional headcount approach, I would replace most of it with a modern headcount approach. Until recently, only a few innovators in the Census Bureau paid much attention to the extraordinary improvements that have been made in mail survey methods or the lessons of cognitive psychology. But there are some cracks in the traditional conservative edifice. In 1990, the Census Bureau was persuaded to use a stratified design for the long form sample (only 5 decades after Neyman demonstrated the power of this technique). The Bureau has been listening seriously to some of the architects of the methodological advances of the 1970's and 1980's. Modern, simpler form designs that tested very well but were rejected in the 1980's may have made a comeback for 2000.

But the basic Census 2000 plan still represents 1980's thinking. Fundamental changes such as decoupling strategies that would liberate both the enumeration and the research component of the traditional census approach have been deferred because of risk averse client groups. I agree with GAO -- the time for these fundamental changes is now.

24. After the 1990 census, GAO concluded that "the amount of error in the census

increases precipitously as time and effort are extended to count the last few percentages of the population. ...This increase in the rate of error shows that extended reliance on field follow-up activities represents a losing trade-off between augmenting the count and adding more errors." In the last months of the follow-up efforts in 1990, GAO estimated that the error rates approached 30 percent, and that this problem was probably exacerbated by the use of close-out procedures. This appears to be a problem inherent to the methodology of the 1990 census. Don't you agree?

Do you have any information on the error rates for information gathered using close-out procedures?

Even if sampling is not perfect, isn't its error rate well below the levels for the last percentages of the population using more traditional follow-up procedures?

If this is the case, then doesn't that logically lead to GAO's and the Commerce Department's Inspector General's conclusion that sampling at least a portion of the nonresponding households would increase the accuracy and decrease the cost of conducting the census?

A. I believe that GAO is discussing the same phenomenon discussed in my response to question #21, i.e., the increase in the per-observation error rate when pursuing high response. There would only be 3% total error at stake in the decision whether to pursue the last 3% of the count, so the 30% figure cited by GAO must be the error rate per observation.

If cost considerations are set aside, then the (quality) break-even point is higher than the trade-off point implied by the GAO statement. A per-observation error rate of 30% is clearly preferable, from a quality standpoint, to the 100% per-observation error rate of completely missing an observation (some accurate data is usually better than no data). But error phenomena are not so well behaved as this, so there usually is a (quality) break-even point short of 100% response.

How is this affected by sampling? If you select a large sample and then pursue a 100% response rate among those selected for the sample, you will see the same rise in error rates as before. And then the small component due to sampling error must be added to this error. Sampling does not reduce the total error produced by pursuing high response rates, it increases it.

25. GAO also concluded after the 1990 census that a high level of public cooperation is key to obtaining an accurate census at reasonable cost. Unfortunately the mail response rate has fallen with every census since 1970, and was only approximately 65 percent in 1990. The reasons for this decline are in many instances outside of the Census Bureaus (sic) control, for example the increase in commercial mail and telephone solicitations and in nontraditional household arrangements. For these reasons, the Bureau is planning a public education campaign for the 2000 census, surpassing any previous attempts. Given

the response in 1990, do you believe this is money well-spent?

Do you believe that this public education campaign can succeed in arresting the decline in response rates?

Even if it does, wouldn't some use of sampling be warranted to solve the problems associated with reaching the last few percentages of nonresponding households?

A. Some of the trend in mail response rates is due to the fact that the mail portion of each successive census covered a larger fraction of the population. In the earlier censuses, the target population for mail was more selective and easier to reach successfully. By 1990 the mail portion was virtually the whole census and none of the problems could be avoided. But now that 100% has been reached, this element of the decline should plateau. Response to telephone surveys has been hit hard by telemarketing and call-screening technologies. Response to traditional mail survey methods (like the census) has also declined, but more modern mail survey methodologies have bucked the trend (see my response to question #23).

One of the most effective elements in the modern revival of mail methodologies is the multiple contact strategy. These are almost always personalized contacts, but a "public education" campaign that drew attention and raised interest in the census might produce some of the same effect. If the campaign is as bureaucratic and condescending as its title, it probably wont produce that effect.

Modernization of mail methods is the best bet for reversing the "decline" experienced by traditional mail methods. Don Dillman ("Total Design Method") argues that there is a synergy among the various elements of his method that cannot be achieved piecemeal. Before he started updating his book, he was making fairly regular visits to Suitland. I hope the right people were listening.

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INDEPENDENT

May 13, 1998

Philip B. Stark, Ph.D.
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Dear Dr. Stark,

Thank you for testifying before the Government Reform and Oversight Subcommittee on the Census on May 5, 1998. Because of time constraints, I was left with a number of questions unanswered. Therefore, I request that you answer the following questions:

1. Can you tell us about a statistical or scientific activity that you've worked on that either worked perfectly the first time you tried it, or that didn't work as well as you had hoped the first time so you abandoned the idea altogether without making an effort to improve or redesign it?

2. Despite the fact that the Census Bureau made improving the count among minorities a major goal of the 1990 Census, the 4.4 percent differential in the 1990 undercount between Blacks and non-Blacks was the highest ever recorded. Experts have repeatedly said that spending more money on traditional methods will not reduce this differential. If not through statistics, how do you propose to reduce this differential?

3. You have mentioned your concerns about block level accuracy. Can you discuss you thoughts on the accuracy of census numbers at the state level if Dual System Estimation is used in 2000? Do you have any evidence that suggests that the census counts will be more accurate at the state level in 2000 if DSE is not used?

4. Secretary Mosbacher, in testimony before both the House and the Senate, said that the Post Enumeration Survey would make the majority of the states more accurate. Is that statement correct? If so, why is his testimony so at odds with your testimony?

5. The 1990 census cost 20 percent more per household in real dollars than the 1980 census. The 1980 census cost twice as much per household in real dollars as the 1970 census. That is an increase in real dollar cost per household of 250 percent with no improvement in the differential undercount. Does that suggest to you that spending more on traditional methods will reduce the differential undercount?

6. Demographic analysis showed higher undercounts of African Americans than the undercounts demonstrated by the Post Enumeration Survey. That suggests that the Post Enumeration Survey understates, not overstates, the undercount, especially for minorities. In other words, isn't it likely that the 1990 census missed more African-Americans that would have been added back into the census by the Post Enumeration Survey?

7. You have talked a lot about bias in the Post Enumeration Survey but have not talked much about the bias in the census. The differential undercount measured by demographic analysis shows that bias in the census is quite real. If there is no Integrated Coverage Measurement, is it not the case that this bias in the census will continue?

8. Do you believe that it is acceptable for the census to consistently miss certain segments of the population -- Africans Americans, Latinos, Asian Americans, poor people in rural and urban communities -- at greater rates than the White population? If that is not acceptable, what do you propose be done to reduce the differential undercount? Can you offer any evidence that you proposal(s) will reduce the differential undercount?

9. It has been stated that one of the faults of the 1990 PES was correlation bias. Can you explain correlation bias? I understand that it is the likelihood that the people missed in the census may be the same people missed in the PES. Said another way, both the census and the survey miss the same people, for example, young Black males. How does correlation bias affect the accuracy count of those traditionally undercounted, Blacks, Hispanics, Asians, Native Americans, renters?

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[and] has a very good chance of working as desired." Do you agree with that statement? If you disagree, please explain why.

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17. The size of the sample in the Integrated Coverage Management (ICM) is 750,000 households. Is that a proper size for such an endeavor?

18. The results of the PES in 1990 showed that census was less accurate than its predecessor. That result was confirmed by demographic analysis, which has been performed on every census since 1940. We certainly know that the 1990 census was much more expensive than the 1980 census. Do you agree with the conclusion that 1990 was less also less accurate than 1980?

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24. After the 1990 census, GAO concluded that "the amount of error in the census increases precipitously as time and effort are extended to count the last few percentages of the population....This increase in the rate of error shows that extended reliance on field follow-up activities represents a losing trade-off between augmenting the count and adding more errors." In the last months of the follow-up efforts in 1990, GAO estimated that the error rates approached 30 percent, and that this problem was probably exacerbated by the use of close-out procedures. This appears to be a problem inherent to the methodology of the 1990 census. Don't you agree?

    Do you have any information on the error rates for information gathered using close-out procedures?

    Even if sampling is not perfect, isn't its error rate well below the levels for the last percentages of the population using more traditional follow-up procedures?

    If this is the case, then doesn't that logically lead to GAO's and the Commerce Department's Inspector General's conclusion that sampling at least a portion of the nonresponding households would increase the accuracy and decrease the cost of conducting the census?

25. GAO also concluded after the 1990 census that a high level of public cooperation is key to obtaining an accurate census at reasonable cost. Unfortunately the mail response rate has fallen with every census since 1970, and was only approximately 65 percent in 1990. The reasons for this decline are in many instances outside of the Census Bureaus control, for example the increase in commercial mail and telephone solicitations and in nontraditional household arrangements. For these reasons, the Bureau is planning a public education campaign for the 2000 census, surpassing any previous attempts. Given the response in 1990, do you believe this is money well-spent?

    Do you believe that this public education campaign can succeed in arresting the decline in response rates?

    Even if it does, wouldn't some use of sampling be warranted to solve the problems associated with reaching the last few percentages of nonresponding households?

My questions and your answers will be part of the permanent record of the May 5, 1998, hearing. Again, thank you for your impute into this most important process.

Sincerely,

Carolyn B. Maloney
Ranking Minority Member
Subcommittee on the Census

cc: The Honorable Dan Miller

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26 June 1998

The Honorable Carolyn B. Maloney
Ranking Minority Member
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Committee on Government Reform and Oversight
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Thank you for your questions of 13 May 1998. I shall answer them by number.

1) *Can you tell us about a statistical or scientific activity that you've worked on that either worked perfectly the first time you tried it, or that didn't work as well as you had hoped the first time so you abandoned the idea altogether without making an effort to improve it?*

It has happened on several occasions that I had a conjecture I hoped was true, tried to prove it, found a counterexample, and immediately abandoned it. It has also happened several times that the first approach to a problem I tried worked perfectly. Sometimes a technique "almost" works, and I try to improve it. The sampling-based (DSE) approach to adjusting the census did not "almost" work in 1990. The problems with the DSE are not minor details that can be repaired by increasing the sample size or other incremental refinements: the experience from 1990 suggests that the approach is unworkable, because its biases are so large. The biases come from failures of the assumptions on which the method is based, and from insurmountable practical problems in implementing the approach on such a large scale. The situation is analogous to finding a counterexample to a conjecture. Science progresses by finding counterexamples and publishing them, so that others can pursue more promising approaches. The experience in 1990 seems to be a counterexample to the hypothesis that DSE can be used to improve the accuracy of the census.

2) *Despite the fact that the Census Bureau made improving the count among minorities a major goal of the 1990 Census, the 4.4 percent differential in the 1990 undercount between Blacks and non-Blacks was the highest ever recorded. Experts have repeatedly said that spending more money on traditional methods will not reduce this differential. If not through statistics, how do you propose to reduce this differential?*

First of all, the 4.4 percent figure you quote is not a fact—it is an estimate, and I am unsure of its source. I believe it to be based on demographic analysis, which has uncertainty of its own. The true undercount differential is unknown. Regardless, every

set of data has some limit on its accuracy. The 1990 sampling-based adjustments really seem to make the accuracy worse, not better. The primary problem with the census is non response. The single best thing that could be done to improve census accuracy and decrease its cost is to motivate the public, especially undercounted groups, to fill out and return their census forms in a timely way. This is an area in which elected public leaders can make a big contribution.

If the question were "we can afford to spend x dollars on the census—how can we get the highest accuracy at that cost?," the answer might involve sampling, at least sampling for non-response follow-up. However, the results would probably be less accurate than a full head count.

3) *You have mentioned your concerns about block level accuracy. Can you discuss [your] thoughts on the accuracy of census numbers at the state level if Dual System Estimation is used in 2000? Do you have any evidence that suggests that the census counts will be more accurate at the state level in 2000 if DSE is not used?*

My testimony concerned state-level accuracy, not block-level accuracy. The evidence that adjusting the 1990 census using DSE would have made the accuracy of state shares worse is quite strong—see the "Technical Notes" section of my 5 May 1998 written testimony. Based on that evidence, and my review of the details available for the proposed 2000 ICM, I believe the 2000 census counts would be more accurate at the state level if DSE is *not* used. Many serious problems with the 1990 DSE are present in the 2000 ICM, so the failure of the 1990 DSE is evidence that the proposed 2000 ICM would be less accurate than a simple census.

4) *Secretary Mosbacher, in testimony before both the House and the Senate, said that the Post Enumeration Survey would make the majority of the states more accurate. Is that statement correct? If so, why is his testimony so at odds with your testimony?*

I do not have a copy of Secretary Mossbacher's testimony. I would be happy to read it and reply in detail if you wish. I believe that using the 1990 Post-Enumeration Survey and Dual System Estimate would have made state shares less accurate.

5) *The 1990 census cost 20 percent more per household in real dollars than the 1980 census. The 1980 census cost twice as much per household in real dollars as the 1970 census. That is an increase in real dollar cost per household of 250 percent with no improvement in the differential undercount. Does that suggest to you that spending more on traditional methods will reduce the differential undercount?*

I think that there must be ways to motivate more of the population to respond to the census by mail. That would improve accuracy, and cut follow-up costs. Whether or not it

would decrease the differential undercount is an empirical question that I cannot answer *a priori.*

6) *Demographic analysis showed higher undercounts of African Americans than the undercounts demonstrated by the Post Enumeration Survey. That suggests that the Post Enumeration Survey understates, not overstates, the undercount, especially for minorities. In other words, isn't it likely that the 1990 census missed more African-Americans [than] would have been added back into the census by the Post Enumeration Survey?*

I think the primary issue is shares, not totals. Shares can be worse if people are put in the wrong place than if no adjustment were made. For example, suppose there are only two states, A and B; only two ethnicities, pink and green; and no gender. Suppose the census finds:

State	pink	green	total
A	100	10	110 (55.6%)
B	80	8	88 (44.4%)
total	180 (90.9%)	18 (9.1%)	198

Suppose we know (from some perfect demographic analysis, perhaps) that nationwide, 3 pink people (1.7 percent) and 1 green person (5.6 percent) are missing. Then the true population fraction of pink people is 90.6 percent, the true population fraction of green people is 9.4 percent, and the differential undercount rate is about 3.9 percent. The DSE says 2 pink people and 1 green person are missing, all from state A. It would appear that adjusting the counts is a good idea, because it makes the totals closer to the Demographic Analysis. The adjusted counts would be:

State	pink	green	total
A	102	11	113 (56.2%)
B	80	8	88 (43.8%)
total	182 (90.5%)	19 (9.5%)	201

The percentages of pink and green people in the overall population in the adjusted census are closer to those in the demographic analysis. Suppose the DSE adjustment is mostly bias in the DSE. In fact, the 3 missing pink people are missing from state B, and the 1 missing green person is missing from state A. Then the truth is:

State	pink	green	total
A	100	11	111 (55.0%)
B	83	8	91 (45.0%)
total	183 (90.6%)	19 (9.4%)	202

Adjustment made state shares less accurate (they are off by 1.2 percent, while the census was off by only 0.6 percent), even though it made the totals more accurate.

The situation is the same for the 1990 DSE: most of the adjustment is bias, and it is implausible that the adjustment put the missing people more or less where they belonged. As a result, the adjusted state shares are probably less accurate than the census state shares. Even if the DSE added the right number of people nationally, it probably put them in the wrong places. The result is less accurate state shares.

7) *You have talked a lot about bias in the Post Enumeration Survey but have not talked much about the bias in the census. The differential undercount measured by demographic analysis shows that the bias in the census is quite real. If there is no Integrated Coverage Measurement, is it not the case that this bias in the census will continue?*

The census does seem to be biased at the level of national totals, and is probably biased at the level of state shares. The ICM is unlikely to fix the bias in the census. It just adds different biases.

8) *Do you believe that it is acceptable for the census to consistently miss certain segments of the population -- [African] Americans, Latinos, Asian Americans, poor people in rural and urban communities -- at greater rates than the White population? If that is not acceptable, what do you propose be done to reduce the differential undercount? Can you offer any evidence that [your] proposal(s) will reduce the differential undercount?*

It is a regrettable fact that the census makes mistakes. It is a regrettable fact that DSE does not fix those mistakes—it just makes different mistakes. I wish the differential undercount could be eliminated, or at least reduced. The best way to decrease the differential undercount is to motivate undercounted groups to respond to the mail-out census questionnaires.

9) *It has been stated that one of the faults of the 1990 PES was correlation bias. Can you explain correlation bias? I understand that it is the likelihood that the people missed in the census may be the same people missed in the PES. Said another way, both the census and the survey miss the same people, for example, young Black makes. How does correlation bias affect the accuracy count of those traditionally undercounted, Blacks, Hispanics, Asians, Native Americans, renters?*

"Correlation bias" is a label for two kinds of failure of the hypotheses on which the DSE is based: (i) being "caught" by the census can influence the chance of being "caught" by the PES, and (ii) different individuals within a post-stratum have different chances of being caught either by the census or by the PES. The existence of people who are unreachable by both the census and the PES is a failure of the second kind. Correlation

bias does not affect the accuracy of the census; it is a source of error in DSE adjustments. Some demographers say that such unreachable people are especially likely to be in dense inner cities, which often have large minority populations. Because such people are "caught" neither by the census nor by the PES, DSE adjustment does not take them into account.

10) *Wouldn't the only risk of correlation bias be minimization of the undercount rather than an overestimation of the undercount?*

No. If correlation bias is different in different places, that can reduce the accuracy of state shares estimated by the DSE.

11) *In testimony before the Senate Committee on Governmental Affairs approximately one year ago, Dr. Lawrence Brown, Professor of Statistics at the University of Pennsylvania, stated that, "Statistical sampling methods can be used in an effective and objective way to assist the census process." Do you agree with Dr. Brown's statement? If you disagree, please explain why.*

I agree. For example, I understand that sampling methods are used successfully by the Census Bureau for quality control of interviews.

12) *Dr. Lawrence Brown also testified before Senator Thompson that the Sampling for Nonresponse Follow-up plan "is an objective procedure all the way around [and] has a very good chance of working as desired." Do you agree with that statement? If you disagree, please explain why.*

The plan appears to be objective (although it involves many *ad hoc* choices), but it seems unlikely to reduce the biases in the census. I believe that sampling for non-response follow-up will decrease data quality, and introduce a new source of error into DSE adjustments. However, I am more troubled by the sampling-based DSE adjustments than by sampling for non-response follow-up.

13) *In addition, Dr. Brown testified that the Census Bureau's 2000 census plan had been "drastically simplified and improved ... [these changes] make it possible to believe that that the Integrated Coverage Measurement might work as well as desired to correct the undercount." Do you agree with that statement? If you disagree, please explain why.*

I agree that the current proposal for the 2000 ICM is simpler than some past proposals, and that the data analysis is simpler in some respects than the 1990 DSE. The statement you cite is hardly an endorsement of the planned 2000 ICM: it is possible to believe that the proposed ICM might reduce the undercount, but I am convinced that will make state shares less accurate. For the ICM to improve state shares would require an implausible

cancellation of large errors. Moreover, there will never be a way to tell whether such a cancellation occurrs. Therefore, it cannot be shown that the ICM improves the census.

14) *With regard to concerns that the Integrated Coverage Measurement process could be manipulated to achieve a particular outcome in terms of the population counts, Dr. Brown testified that, "if all of this planning is done in advance, it is very, very hard for me to see how one could direct these subjective decisions towards any desired goal." Do you agree with Dr. Brown that if the procedures and protocols for the Integrated Coverage Measurement are set forth in advance and subject to expert and public scrutiny, that it is very unlikely that the sampling and statistical estimation process will be subject to manipulation, possibly for political advantage? If you disagree, please explain why.*

I have no opinion about this.

15) *Dr. Brown also testified that even after the non-response follow-up phase of the census is complete, there "would still [be] the undercount problem of those people who just refuse to be counted or are very difficult to count." Do you agree with that? If you disagree, please explain why.*

I agree.

16) *With regard to the post-enumeration survey in the 1990 census, Dr. Brown testified that many of the difficulties with the procedure "can be traced to the fact that the PES sample was much too small to support the kind of objective, reliable analyses that are desired." Do you agree with that? If you disagree, please explain why.*

The sample size was inadequate, but there were many other serious problems with the analysis, such as the biases discussed in my 5 May 1998 testimony. Increasing the sample size would not decrease those biases. It would probably exacerbate them.

17) *The size of the sample in the Integrated Coverage Measurement (ICM) is 750,000 households. Is that a proper size for such an endeavor?*

There is no proper sample size for the ICM, because the main problem is bias, not sampling error.

18) *The results of the PES in 1990 showed that census was less accurate than its predecessor. That result was confirmed by demographic analysis, which has been performed on every census since 1940. We certainly know that the 1990 census was much more expensive than the 1980 census. Do you agree with the conclusion that 1990 was also less accurate than 1980?*

Because demographic analysis does not estimate state shares, it is not possible to tell from demographic analysis whether the 1990 census was less accurate than the 1980 census at the level of states, or for state shares. Because of the uncertainties in demographic analysis, it is not clear whether the 1990 census was less accurate than the 1980 census at the national level, but the evidence suggests that at the national level the 1990 census was the second most accurate census, if not the most accurate census, in U.S. history.

19) *Please explain the difference between net over- or undercount in the 1990 census count and actual over- and undercounts (mistakes) made [in the] 1990 count. I know that a net undercount of 1.6% sounds relatively small but for census purposes, aren't those 26 million mistakes a concern?*

Net undercount is the number of people counted erroneously, minus the number of people who were not counted. Both of these terms are computed at the block level, not at the national level. That is, the same person, who really lives somewhere in the US, can contribute both an erroneous enumeration and a gross omission, if his or her address is incorrect in the census (the person will be a gross omission where the person really lives, and an erroneous enumeration at the incorrect address). The importance of the two errors depends on the geographic level one cares about: at the block level, both errors are important, but for such a person, the errors cancel at the national level. Overall, the gross omissions and erroneous enumerations in the census cancel to some degree, although not perfectly, when aggregated to states or the nation. The figure of 1.6% you cite appears to reflect some of the revisions in the PES since it was first published; I believe the figure of 26 million mistakes may not reflect those revisions. The large size of the revisions should make such estimates suspect.

20) *I understand that improvement in the average does not necessarily mean that there will be improvement in every case. In 1990, there was criticism about the strata being broken down by region. If statistical methods are used in 2000, with strata broken down by state in 2000, can we expect more states with improved accuracy than there were in 1990?*

No. First of all, bias is probably more important than the sampling error. The bias in 1990 was so large that, in my opinion, the 1990 DSE was not trustworthy. I have not seen anything in the 2000 plan that would reduce the level of bias to the point that adjustment reasonably would be expected to improve census accuracy. Furthermore, even though the proposed sample size is larger, the number of post strata is also larger, so there is a tradeoff that might increase the sampling error too.

21) *Representative Sawyer pointed out that the longer the Census Bureau is in the field, the higher the error rate in the information collected. I believe that information came from one of the many GAO studies he and his Republican colleagues commissioned. You have stated*

your concern about the Census Bureau not [being] in the field for enough days in the 2000 plan. Can you explain the difference in opinion?

The quality of data will suffer if the Census Bureau tries to work so quickly that it uses poorly trained or less competent field workers, or allows too little time for it to be possible to do their work well. Data quality will also suffer if too much time goes by, because people move and memories fade. Therefore, I see no contradiction.

22) *In order to address the problem of declining public response, the GAO suggested exploring a radically streamlined questionnaire in future censuses. Would you give us your thoughts on how effective this approach might be in increasing response, and also its effect on perhaps diminishing the usefulness of census data?*

Everyday experience suggests that it is easier to get 5 minutes of someone's time than 2 hours. Data from a shorter questionnaire could be less useful.

23) *In its 1992 capping report on the 1990 census, the GAO concluded that "the results and experience of the 1990 census demonstrate that the American public has grown too diverse and dynamic to be accurately counted solely by the [traditional] 'headcount' approach and that fundamental changes must be implemented for a successful census in 2000." Do you agree with that conclusion? If you disagree, please explain why.*

I believe that a headcount is the most accurate method available. Perhaps someday someone will devise a better approach, but the 1990 experience indicates that the DSE is less accurate than a headcount.

24) *After the 1990 census, GAO concluded that "the amount of error in the census increases precipitously as time and effort are extended to count the last few percentages of the population ... This increase in the rate of error shows that extended reliance on field follow-up activities represents a losing trade-off between augmenting the count and adding more errors." In the last months of the follow-up efforts in 1990, the GAO estimated that the error rates approached 30 percent, and that this problem was probably exacerbated by the use of close-out procedures. This appears to be a problem inherent to the methodology of the 1990 census. Do you agree?*

Do you have any information on the error rates for information gathered using close-out procedures?

Even if sampling is not perfect, isn't its error rate well below the levels for the last percentages of the population using more traditional follow-up procedures?

If this is the case, then doesn't that logically lead to GAO's and the Commerce Department's Inspector General's conclusion that sampling at least a portion of the nonresponding households would increase the accuracy and decrease the cost of conducting the census?

The problem in reaching the last few percent does not go away with sampling---one still needs to reach the last few percent of the sample, or the same kinds of errors occur and are magnified. The likely cost savings from a 90 percent sample with complete follow-up in the sample, versus the 1990 approach to head counting, seems rather small, and accuracy would probably suffer. If follow-up within the *sample* is incomplete, the resulting errors are just magnified by the sampling ratio. Only if follow-up within the sample is truncated could there be significant cost savings, but that would substantially reduce the accuracy for the hardest households to count, which are already the biggest problem. For both the census and the PES, the data quality is worst for the cases that are hardest to follow up, and a disproportionate part of the expense is in following up the hardest cases. Furthermore, sampling for non-response follow-up will make the DSE even more difficult, and even less accurate. Data quality problems in the PES follow-up are magnified enormously by the DSE. Thus the problem is worse for the DSE than for a headcount.

25) *GAO also concluded after the 1990 census that a high level of public cooperation is key to obtaining an accurate census at reasonable cost. Unfortunately the mail response rate has fallen with every census since 1970, and was only approximately 65 percent in 1990. The reasons for this decline are in many instances outside of the Census Bureau control, for example the increase in commercial mail and telephone solicitations and in nontraditional household arrangements. For these reasons, the Bureau is planning a public education campaign for the 2000 census, surpassing any previous attempts. Given the response in 1990, do you believe this is money well spent?*

Do you believe that this public education campaign can succeed in arresting the decline in response rate?

Even if it does, wouldn't some use of sampling be warranted to solve the problems associated with reaching the last few [percent] of nonresponding households?

I am not expert at motivating the public, but I think that such a campaign could be very helpful. The details of the campaign would be crucial to its success. See my answer to the previous question (24) in response to the last part of this one.

Mr. MILLER. And we'll proceed now to Mr. Wade Henderson.

Before you set down Mr. Henderson, raise your right hand.

[Witness sworn.]

Mr. MILLER. Thank you.

Your official statement will be included in the record, of course, which we have received, thank you. We have plenty of time because there is not going to be a vote for a little while yet.

STATEMENT OF WADE HENDERSON, EXECUTIVE DIRECTOR, LEADERSHIP CONFERENCE ON CIVIL RIGHTS

Mr. HENDERSON. Thank you, Mr. Chairman. Good afternoon, Mr. Chairman, members of the subcommittee. I'm Wade Henderson, the executive director of the Leadership Conference on Civil Rights. And on behalf of Leadership Conference, I appreciate the opportunity to appear before you today on what can only be characterized as one of the highest priorities of the civil rights community, that of ensuring a fair and accurate census count in the year 2000.

The subcommittee's decision to hold a hearing revisiting the 1990 census is a laudable one; and I am hopeful that in doing so, our Nation may move a step closer to ensuring that we do not repeat the same mistakes again.

By way of background, the Leadership Conference on Civil Rights is the Nation's oldest, largest, and most diverse coalition of organizations committed to the protection of civil and human rights in the United States. Today, the Leadership Conference has over 180 national organizations representing virtually every aspect of the American policy and working together in a bipartisan fashion to resolve the pressing civil rights problems of the day.

We have established, of course, throughout this hearing, the constitutional basis for the census count, and I think we certainly agree that the census is at the core of our Democratic system of Government? As such, the census has a profound impact on the life of every resident in the country. And while the primary reason for the collection of census data is the apportionment of representation in Congress, census data also provides the statistical basis for Government planners, policy advocates, and private industry to shape future domestic policy. Now I agree with former 1990 census Bureau Director, Barbara Bryant, who observed that the census is about moving power and money. It is one of the most profound innovations of Democratic government.

Because the accuracy of the census directly affects our Nation's ability to ensure equal representation and equal access to important governmental resources for all persons under our Constitution, ensuring a fair and accurate census must be regarded as one of the most significant civil rights issues facing our country today. By my view, the census count for the year 2000 is the "sleeper" civil rights issue of the 105th Congress.

Now the 1990 census, as has been established here today, was both the most expensive and least accurate census in modern times. It certainly marked the first time in five decades that a census was less accurate than its predecessor. And on the basis of demographic analysis, as has been mentioned, the undercount was approximately 4.7 million people.

As an aside, Mr. Chairman, I saw a chart earlier today that pointed out that the demographic analysis revealed, in actuality, a 5.7 percent undercount for the black population, not the 4.4 percent that's been indicated at least on one chart.

In addition, the 1990 undercount of racial and ethnic minority groups, referred to as the differential undercount, was the highest ever recorded since the Census Bureau began conducting post-census evaluations in 1940, missing 4.5 percent of the African-American population, 5 percent of persons of Hispanic origin, 2.3 percent of Asians and Pacific Islanders, and over 12 percent of Native Americans living on reservations.

Most disturbing, however, is how badly the 1990 census undercounted children. While children under the age of 18 represented 26 percent of the total national population that year, they are counted for an incredible 52 percent of the undercount. But the undercount of these populations is only a part of the problem of the 1990 census. The real problem of the 1990 census was in the total undercount. The number of individuals missed, and those individuals who were double-counted was about 10 million people. That is the equivalent of disregarding the entire population of the State of Ohio, or the State of Michigan, or most of Illinois. Moreover, the people missed did not live in the same communities as the people who were counted twice. The mistakes did not, in other words, cancel each other out. Ultimately, the 1990 enumeration cost $2.6 billion dollars, an amount double that of the 1970 census, and 25 percent greater than the 1980 census in inflation-adjusted dollars. The logical question, therefore, is how did such a comprehensive effort result in the first count known to be less accurate than its predecessor, even after spending an unprecedented amount of money? The answer is simply that traditional census methods were unable to manage the increased mobility and looser family structure of contemporary Americans and new immigrants.

In 1990 the Census Bureau sent about 100 million questionnaires to housing units. The Bureau received a mail response rate of approximately 65 percent, down from the 75 percent received in 1980, and 78 percent received in 1970. The Bureau then attempted to physically count the remaining 35 percent of the population, or over 34 million cases through the use of followup census enumerators. The census enumerators had the task of visiting every nonresponding residence in an attempt to count the Nation's true population.

A 1992 General Accounting Office report to Congress stated, and I quote, "The results and experiences of the 1990 census demonstrate that the American public has grown too diverse and dynamic to be accurately counted solely by the traditional head-count approach, and that fundamental changes must be implemented for a successful census in 2000."

The issue before us, therefore, becomes how best to uphold the spirit of the constitutional requirement when traditional methods are not adequate to make an accurate count.

Some individuals have suggested that failing to count 1.6 percent of the population is not particularly problematic, and that some inaccuracy in the census count should be expected. But whether it's elderly citizens in Sarasota, people of color in New York City, the

rural poor in central Illinois, the urban poor in Chicago, immigrants in Fairfax County and Prince William County, Native Americans, Latinos in Phoenix in Scottsdale, or poor children in Kansas City, each congressional district is adversely affected when the census misses that many people.

Now it's really not necessary to accept the Leadership Conference analysis of the failures of the 1990 census count to persuade you. Instead, listen to just a few words of some of your colleagues and their reaction to the failures of the 1990 census count.

In an April 30, 1991, letter, Speaker of the House Newt Gingrich, quote, "strongly urged" Robert Mosbacher, then the U.S. Commerce Secretary, to adjust Georgia's population by a figure of about 300,000. That 300,000 figure was calculated by the Census Bureau through a form of sampling conducted to determine how many people the traditional head count actually missed. Mr. Gingrich went on to add, and I quote, "Needless to say, if the undercount is not corrected, it would have a serious negative impact on Georgia."

In an August 19, 1994, letter to President Clinton, 32 Members of the congressional "Sunbelt Caucus" including Republican Representatives and Senators from Virginia, Florida, North Carolina, South Carolina, Mississippi, Louisiana, and New Mexico, called on the President to, quote, "Let stand a recent decision by the Second Circuit Court of Appeals to overturn a lower court ruling that let the census figures remain unadjusted." The Members added, and I quote, "A failure to win adjustment of the census has meant a continuing hardship for sunbelt States and regional officials. One must ask, therefore, what is the intent and purpose of Federal funding that is—that has a population component other than to assist State and local governments in serving their actual number of residents? This is strictly a fairness issue." And, we agree.

It was precisely because the 1990 census was such a miserably failed census, that in 1991, Congress asked the National Academy of Sciences to study the viability of redesigning the Census Bureau's methods for the 2000 census. The overarching goals set by Congress were to constrain costs and improve accuracy, with a particular focus on reducing the differential undercount.

The Census Bureau has worked hard over the past several years to research, test, and evaluate census methods to achieve these objectives. It has been guided by recommendations from independent experts, including three panels of the National Academy of Sciences, the General Accounting Office, and the Commerce Department's Office of Inspector General.

The resulting plan for 2000 combines a more aggressive enumeration effort. It doesn't abandon it; it combines a more aggressive enumeration effort, including sending replacement questionnaires to non-responding households, using paid advertising, designing an easier-to-understand form, and making forms available in public places, with modern scientific sampling techniques to complete the count of the final non-responding households and to eliminate the pervasive undercount of children, people of color, and the urban and rural poor.

Mr. Chairman, I thought it was necessary to state what the 2000 census and the Census Bureau propose to do, because from some of the testimony this afternoon, one may get the impression that

only sampling is being used. Sampling, of course, is being used to complement what is going to be the most aggressive enumeration effort ever undertaken by the Census Bureau. The scientific sampling methods would not substitute for an aggressive method to count everyone directly. Instead, as a complement to an aggressive enumeration effort, scientific sampling would help the Bureau account for all residents, even those who historically have been the hardest to reach through traditional counting methods.

As the statisticians testifying before me noted, the sampling methods used in 1990 were not perfect. The outcome was not as reliable or precise as we would have hoped. I am confident, however, that if the decision had been made to use the adjusted population numbers for the reapportionment of Congress and other purposes, the figures would have been scrutinized more thoroughly and the errors, perhaps, would have been caught in time.

Are there uncertainties associated with the Census Bureau's plan for 2000? Of course there are, and anyone who says otherwise would be mistaken. However, just because there are uncertainties, does that mean that we should abandon a process that Congress, itself, designed to provide the best and most accurate count possible? And that we do not make an effort to improve and refine techniques.

The Census Bureau's plan to use——

Mr. MILLER. Mr. Henderson, excuse me.

Mr. HENDERSON. Yes, sir.

Mr. MILLER. We have some votes going on——

Mr. HENDERSON. OK.

Mr. MILLER [continuing]. And what we're going to do is recess and take the votes and then those that can come back—Congresswoman Maloney may not be able to come back. Unfortunately, it will be—we have five votes in a row. The first one is right now, and then there will be 5-minute votes. So I'm saying, I would guess right now, 40 minutes. I apologize for that. Can you be here when we come back?

Mr. HENDERSON. Mr. Chairman, I'd hate to lose the opportunity to complete my testimony before you. However, I stand at your pleasure, sir, so if you are prepared to come back, I'm certainly prepared to be here for you.

Mr. MILLER. Thank you.

Mrs. MALONEY. Or as an alternative, we could have Mr. Henderson lead off at our next hearing when all——

Mr. MILLER. Well, we're always going to have——

Mrs. MALONEY [continuing]. The Members would be there.

Mr. MILLER [continuing]. This tight time constraint, so if you're willing to come back—I'll be back as soon as we get the last vote. Well, at least both of us, I hope you all can join us. Mr. Davis said he'll be able to come back, too.

Mr. HENDERSON. OK.

Mr. MILLER. Hopefully, Mr. Shadegg, and maybe we can get a couple of your members back.

I apologize for the delay——

Mr. HENDERSON. It's all right, Mr. Chairman.

Mr. MILLER [continuing]. I thought the vote was going to be a little later than that.

Mr. HENDERSON. OK.

Mr. MILLER. Thank you, Mr. Henderson.

Mr. HENDERSON. Well, thank you.

[Recess.]

Mr. MILLER. We'll begin—return to the witness.

Mr. Henderson, as I said a few minutes ago, we apologize for the delay. These things go a little longer than we thought, and I didn't realize how many votes. We thought we could complete it. But I appreciate your staying and look forward to the rest of your comments and then some discussion. Thank you very much.

Mr. HENDERSON. Well, Mr. Chairman, thank you very much. Thank you for your courtesy this afternoon. And I do appreciate, indeed, your willingness and the other members of the committee to return. Obviously, it's been a long day for you all, in particular, but your willingness to come back and complete this hearing is much appreciated.

Let me also say that the importance of this hearing to those of us in the civil rights community really can't be overstated. My willingness to stay today was not merely to accommodate your courtesy in inviting me, but also to emphasize the importance of this issue—a fair and accurate census count to the Nation, as a whole, and to emphasize the importance of this issue as a genuine civil rights concern that's often overlooked. And as I stated earlier in my testimony, the use of census data has such a profound impact on the country, as a whole, and is not genuinely appreciated by many in our Nation. And so my presence here today is designed to emphasize it.

I will conclude my remarks by simply reminding the committee that the Census Bureau's plan to address the disproportionate undercount is, by all accounts, the most cost-effective proposal under consideration. Cost, however, is not the real issue, because no matter how much money we throw behind outdated methodology, most experts agree, we will not eliminate the disproportionate undercount utilizing the same methods as were used in 1990. The deterioration in the accuracy of the census between 1980 and 1990 cannot be attributed to inadequate funding by Congress. This is simply not a situation where allocating more resources will solve the problem, per se.

Mr. Chairman, the original text of the Constitution indeed sanctioned a differential undercount in the census by including only three-fifths of the enslaved population in the enumeration. Even with the removal of this offensive language through the adoption of the 14th amendment to the Constitution, the census continues to miss a disproportionate number of people of color, persons living in rural and urban areas, particularly the poor, and children. And we believe that under the proposed plan for the year 2000, the constitutional mandate to count every person in our country, at least that spirit will be addressed by that proposal.

Now we recognize that the census will never produce a perfect result; but our Nation should not accept an effort that reaches no further than those who are the easiest to count or those who want to be counted. Preventing the Census Bureau from continuing to develop and to explain their plans to improve upon on their past efforts to provide the most accurate census possible, we believe is

not in the national interest. And with that, I have concluded my formal presentation.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Henderson follows:]

Mr. Chairman and members of the Subcommittee, I am Wade Henderson, Executive Director of the Leadership Conference on Civil Rights (LCCR). On behalf of the Leadership Conference, I appreciate the opportunity to appear before you today on what can only be characterized as one of the highest priorities of the civil rights community, that of ensuring a fair and accurate census count in the year 2000. The Subcommittee's decision to hold a hearing revisiting the 1990 census is a laudable one; and I am hopeful that in doing so, our nation may move a step closer to ensuring that we do not repeat the same mistakes again.

By way of background, the Leadership Conference on Civil Rights is the nation's oldest, largest and most diverse coalition of organizations committed to the protection of civil and human rights in the United States. The Leadership Conference was created by A. Philip Randolph, Arnold Aronson, and Roy Wilkins in 1950 as an independent body to promote passage and the implementation of civil rights laws designed to achieve equality under law for all persons in the United States.[1] Today the LCCR has over 180 organizations that work in a bipartisan fashion to resolve the pressing civil rights problems of the day. These organizations include groups representing persons of color, women, labor organizations, persons with disabilities, older Americans, gays and lesbians, major religious groups, and civil liberties and human rights interests.

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[1] A. Philip Randolph was the Founder and President of the Brotherhood of Sleeping Car Porters; Arnold Aronson was Program Director of the National Jewish Community Relations Advisory Council, a coalition of major Jewish organizations; and Roy Wilkins was acting Executive Secretary of the NAACP.

Article I, Section 2, Clause 3 of the United States' Constitution[2] places the census at the core of our democratic system of governance. As such, the census has a profound impact on the life of every resident of this country. While the primary reason for the collection of census data is the apportionment of representation in Congress, census data also provide the statistical basis for government planners, policy advocates and private industry to shape future domestic policy. The data are also then used to apportion electoral college votes to each state; to carry out congressional, state, and local redistricting; and to monitor and enforce compliance with civil rights statutes, including the Voting Rights Act of 1965, and employment, housing, lending, and education anti-discrimination laws. Census results also serve as the basis for the annual distribution of billions of dollars in federal and state funds. As former Census Bureau Director Barbara Bryant observed, the census is about "moving power and money...[It is] one of the most profound innovations of democratic government."[3]

Because the accuracy of the census directly affects our nation's ability to ensure equal representation and equal access to important governmental resources for all Americans, ensuring a fair and accurate census must be regarded as one of the most significant civil rights issues facing the country today. This was confirmed just two weeks ago at the Leadership Conference's Annual National Board Meeting, when the National Board reaffirmed that ensuring a fair and accurate census count through the limited use of statistical sampling will remain among the Leadership Conference's highest legislative priorities.

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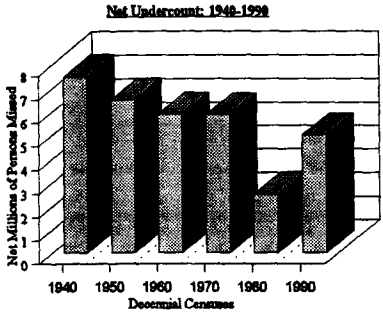
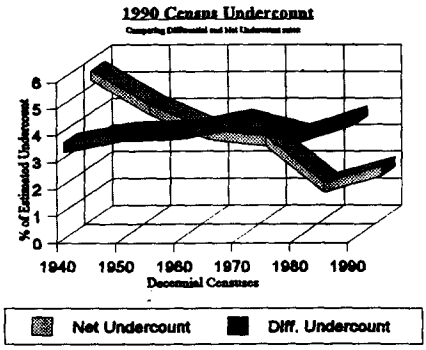
[2]The Constitution of the United States requires the Congress to conduct an "actual enumeration" of the "whole number of persons within each state" every ten years.

[3]Society: Population, Politics, and Race, at 20.

The 1990 census was both the most expensive and least accurate census in modern times. It marked the first time in five decades that a census was less accurate than its predecessor. On the basis of "demographic analysis,"[4] the undercount was 4.7 million people; the undercount rate of 1.8 percent in 1990 was 50 percent greater than the rate had been in 1980.[5] In addition, the 1990 undercount of racial and ethnic minority groups, referred to as the "differential undercount," was the highest ever recorded since the Census Bureau began conducting post-census evaluations in 1940, missing 4.5 percent of African Americans; 5 percent of Americans of Hispanic origin; 2.3 percent of Asians and





[4]Demographic Analysis is one of the two standard methods that the Census Bureau uses to measure coverage, that is the extent that the official census totals cover or completely account for the true total. Demographic analysis is the only method for analyzing historical trends in the shortfall in coverage, the national undercount. In "Report to Congress--The Plan for Census 2000", Bureau of the Census, United States Department of Commerce, July 1997, Revised August 1997.

[5]Ibid. pp. 2.

Pacific Islanders; and, over 12 percent of Native Americans living on reservations. Most disturbing is how badly the 1990 census undercounted children. While children under the age of 18 represented 26 percent of the total national population that year, they accounted for an incredible 52 percent of the undercount.[6] But the undercount of these populations is only part of the problem of the 1990 census.

The real problem of the 1990 census was that the total undercount -- the number of individuals missed and those individuals who were double-counted -- was about 10 million people, according to evaluations by the General Accounting Office.[7] That is the equivalent of disregarding the entire population of the State of Ohio, or the State of Michigan, or most of Illinois. Moreover, the people missed did not live in the same communities as the people who were counted twice, the mistakes did not cancel each other out.

Ultimately, the 1990 enumeration cost $2.6 billion -- an amount double that of the 1970 census and 25 percent greater than the 1980 census – in inflation adjusted dollars.[8] The logical question is how did such a comprehensive effort result in the first count known to be less accurate than its predecessor, even after spending an unprecedented amount of money?

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[6]Ibid. pp. 3.

[7] "Capping Report" U.S. General Accounting Office, Washington, D.C. June, 1992.

[8]See Decennial Census: Fundamental Design Decisions Merit Congressional Attention, U.S. General Accounting Office, Washington, D.C. (GAO/T-GGD-96-37, October 25, 1995) pp.4.

The answer is simply that traditional census methods were unable to manage the increased mobility and looser family structure of contemporary Americans and new immigrants. In 1990, the Census Bureau sent about 100 million questionnaires to housing units. The Census Bureau received a mail response rate of 65 percent, down from 75 percent in 1980, and 78 percent in 1970.[9] The Bureau then attempted to physically count the remaining 35 percent of the population, or over 34 million cases, through the use of follow-up census enumerators. These census enumerators had the task of visiting every non-responding residence in an attempt to count the nation's true population. A 1992 General Accounting Office report to Congress stated, "the results and experiences of the 1990 census demonstrate that the American public has grown too diverse and dynamic to be accurately counted solely by the 'traditional' headcount approach and that fundamental changes must be implemented for a successful census in 2000.[10]

Some individuals have suggested that failing to count 1.6 percent of the population is not particularly problematic and that some inaccuracy in the census count should be expected. To those who are willing to settle for similar results in 2000, one may ask, how will we explain this to persons who are among the undercounted? What will we say to the elderly who rely on census data for funding of senior citizen centers and various health programs? What will we say to persons with disabilities who count on accurate census numbers for assisted housing programs or to battered women who rely on these figures for Violence Against Women formula grants? What will we say to Native Americans who rely on accurate census data for employment and training

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[9]Ibid. pp.60.

[10]Ibid. pp.2.

programs at the Department of Labor. What will we say to the poor children who rely on accurate census data to fund Head Start and the school lunch program, or to the rural poor who rely on federal funds for rural electrification loans? And what will we say to Latinos, African Americans, and Asian Pacific Americans who were disproportionately undercounted in 1990, and who will be again, if the Census Bureau uses the same methods that were used in 1990, methods that we know will produce an unacceptable differential undercount?

Whether it be elderly citizens in Sarasota, people of color in New York City, the rural poor in Central Illinois, the urban poor in Chicago, immigrants in Fairfax and Prince Williams Counties, Native Americans and Latinos in Phoenix and Scottsdale, or poor children in Kansas City, each of your districts are adversely affected when the census misses this many people.

It is not necessary to accept my analysis on the failures of the 1990 census. Instead, listen to how some of your colleagues reacted to the failures of the 1990 census:

- In an April 30, 1991, letter, Speaker of the House, Newt Gingrich, "strongly urge[d]" Robert Mosbacher, then the U.S. Commerce Secretary, to adjust Georgia's population figure by about 300,000. That 300,000 figure was calculated by the Census Bureau through a form of sampling conducted to determine how many people the traditional headcount missed. Mr. Gingrich went on to add, "Needless to say, if the undercount is not corrected, it would have a serious negative impact on Georgia."[11]

- In an August 19, 1994, letter to President Clinton, 32 members of the Congressional

[11]The Honorable Newt Gingrich, April 30, 1991. Letter to United States Secretary of Commerce, Robert Mosbacher.

"Sunbelt Caucus" – including Republican Representatives and Senators from Virginia, Florida, North Carolina, South Carolina, Mississippi, Louisiana, and New Mexico. – called on the President to "let stand a recent decision by the Second Circuit Court to overturn a lower court ruling that let the Census figures remain unadjusted." The members added, "Failure to win adjustment of the census has meant a continuing hardship for Sunbelt state and regional officials. In each year of the decade, the decision affects every child sitting in a classroom, every person driving on a highway, every person filing for unemployment, every state or local government applying for revenue bonds, every elderly person needing health care, every local government working to clean its air, and every police force fighting crime. Each day, our region's state and local governments struggle to serve their actual number of residents, while they receive funds based on inaccurate population counts in the Official Census count....One must ask: what is the intent and purpose of federal funding that has a population component other than to assist state and local governments in serving their actual number of residents? This is strictly a fairness issue."[12]

Mr. Chairman and members of the Committee, these are the words of your own colleagues. Moreover, just two weeks ago, in a forum sponsored by the LCCR on Census 2000, Matthew Glavin, President and CEO, Southeastern Legal Foundation which is sponsoring one of the two lawsuits seeking to bar statistical sampling said, "The 1990 Census was a miserably failed census."[13]

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[12]Congressional Sunbelt Caucus, August 19, 1994, Letter to United States President William Jefferson Clinton.

[13]Matthew Glavin, President and CEO, Southeastern Legal Foundation, at the LCCR Civil Rights Conference, April 20, 1998.

It was precisely because the 1990 census was such a "miserably failed census" that in 1991 Congress asked the National Academy of Sciences to study the viability of redesigning the Census Bureau's methods for the 2000 census. The overarching goals set by Congress were to constrain costs and improve accuracy, with a particular focus on reducing the differential undercount.[14]

The Census Bureau has worked hard over the past several years to research, test, and evaluate census methods to achieve these objectives. It has been guided by recommendations from independent experts, including three panels of the National Academy of Sciences, the General Accounting Office, and the Commerce Department's Office of Inspector General.

The resulting plan for 2000 combines a more aggressive enumeration effort -- including sending replacement questionnaires to non-responding households, using paid advertising, designing an easier-to-understand form, and making forms available in public places -- with modern scientific sampling techniques to complete the count of the final non-responding households and to eliminate the pervasive undercount of children, people of color and the urban and rural poor.

The scientific sampling methods would not substitute for an aggressive effort to count everyone directly. Instead, as a complement to an aggressive enumeration effort, scientific sampling would help the Bureau *account* for all residents, even those who historically have been hardest to reach through traditional counting methods.

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[14]Decennial Census Improvement Act of 1991, Public Law 102-125.

As the statisticians testifying before me noted, the sampling methods used in 1990 were not perfect. The outcome was not as reliable or precise as we would have hoped. I am confident, however, that if the decision had been made to use the adjusted population numbers for the reapportionment of Congress and other purposes, the figures would have been scrutinized more thoroughly and the error would have been caught in time. Are there uncertainties associated with the Census Bureau's plan for 2000? Of course there are; and anyone who says otherwise would be mistaken.

However, just because there are uncertainties, does that mean we should abandon a process that Congress designed to provide the best count; that we do not make an effort to improve and refine the techniques. If we approached every scientific endeavor with such an attitude, there would be no cure for polio, no vaccination against small pox. We would be sitting in this room reading by candlelight. There is always a risk in deviating from the way things have been done in the past. However, the Census Bureau did not develop its sampling methods overnight. Its plan is the product of many decades of research and testing and evaluation. The Census Bureau is itself one of the world's premier scientific agencies, and it has been guided by the nation's leading statistical experts.

The Census Bureau's plan to use limited statistical sampling has been endorsed by a broad group of professional associations and organizations including the American Statistical Association, the National Association of Business Economists, the Council of Professional

Associations on Federal Statistics, the Association of Public Data Users, not to mention a broad range of stakeholders like the National League of Cities, the U.S. Conference of Mayors, the National Association of Counties, the Cuban American National Council, Inc., the National Asian Pacific American Legal Consortium, the National Council of La Raza, the Mexican American Legal Defense and Educational Fund, the American Arab-Anti-Discrimination League and the National Association for the Advancement of Colored People. Each of these associations and organizations endorses the Census Bureau's plan to address the undercount by an aggressive counting effort combined with limited statistical sampling methods.

The Census Bureau's plan to address the disproportionate undercount is by all accounts the most cost-effective proposal under consideration. Cost, however, is not the real issue because no matter how much money we throw behind out-dated counting methods, all experts agree, we will not eliminate the disproportionate undercount utilizing the same methods as were used in 1990. The deterioration in the accuracy of the census between the 1980 and 1990 counts cannot be attributed to inadequate funding by Congress. This is simply not a situation where allocating more money solves the problem.

Mr. Chairman, the original text of the Constitution sanctioned a 'differential undercount' in the census by including only three-fifths of the enslaved population in the enumeration. Even with the removal of this offensive language through adoption of the Fourteenth Amendment, the census continues to miss disproportionate numbers of people of color, the rural and urban poor and children. Under the Census Bureau's plan for 2000, no person under the Constitution has to be invisible.

The census will never produce a perfect result; but our nation should not accept an effort that reaches no further than those who are easiest to count or who want to be counted. To those opposed to the Census Bureau's plan, one question must be posed, "How many more decades must the nation wait before trying a new method?" Preventing the Census Bureau from continuing to develop and explain their plans to improve upon their past efforts to provide the most accurate census possible would not serve this nation well.

Mr. MILLER. Thank you, Mr. Henderson.

What I'd like to do now is call on Mr. Davis first, because he has to leave, then Mrs. Maloney and I'll go after that.

Mr. Davis.

Mr. DAVIS of Virginia. Mr. Henderson, thank you for being here today, and I think your perspective is a welcome one, one which we value. I think we have the same goals in mind, a little bit different perspective. I've got a conclusion I'm trying to get to, and I want to give you time to answer the conclusion. So I want to ask a few—"yes or no"—that I think are pretty easy getting there, and then give you time to amplify when I ask you the question at the end.

You'd agree with me that traditionally the civil rights movement has been about eliminating barriers to the participation of people in society and Government?

Mr. HENDERSON. Absolutely.

Mr. DAVIS of Virginia. And, that some examples of these types of barriers have been such odious practices as Jim Crow laws, poll taxes, literacy tests, denying one person one vote, preventing minorities from registering to vote, and validating the votes of minorities once they were cast?

Mr. HENDERSON. Yes, sir, I would agree with that.

Mr. DAVIS of Virginia. Yes. In fact, your testimony points out that perhaps the most egregious example of all of this was the counting of African-American slaves as less than a whole person?

Mr. HENDERSON. Indeed.

Mr. DAVIS of Virginia. It very accurately describes that. And would you agree that this was particularly awful that, in many cases, this past discrimination and violation of civil rights was actually perpetrated by our own Government at the Federal, State, and local levels?

Mr. HENDERSON. Absolutely.

Mr. DAVIS of Virginia. And you'd agree that it was a major step forward for both our society and the civil rights movement when these types of odious barriers were removed?

Mr. HENDERSON. Indeed.

Mr. DAVIS of Virginia. And Government needs to continue to move forward to remove those barriers that deny people the chance to participate, like the Bureau's 2000 census plan that purports to create the most accurate address list possible—printing the forms in 32 different languages, using a paid advertising program and promotion and outreach targeted toward hard-to-count populations, hiring census takers directly from the neighborhoods they need to count? You would agree that at least these steps are good steps to take to ensure that everybody has a chance to participate?

Mr. HENDERSON. I think those steps are important steps. I would agree, although I am not prepared to say that that alone will produce——

Mr. DAVIS of Virginia. I think you've made it clear it's not alone. You have other ways and—I agree with that. And as the executive director of the Leadership Conference on Civil Rights, it would be correct to say that you'd be strongly opposed to any efforts by Government to go the wrong way and put barriers back up and keep individuals from participating in Government?

Mr. HENDERSON. Certainly I would oppose the creation of new barriers although, Mr. Davis, I think one of the questions that ultimately will be raised is whether the Census Bureau in attempting to develop a methodology for the year 2000 that produces the fairest and most accurate result, whether using all of the techniques that have been proposed will produce the result of creating new barriers. I have heard, for example, that the Census Bureau does propose to examine the returns of some individuals who have completed their file and they may, in fact, compress them in some sort of statistical methodology.

Mr. DAVIS of Virginia. Well, let me get to that. Let me get to that more directly and give you ample time to respond.

As we've heard in earlier testimony, the Bureau's plan to use the sampling in the 2000 census will involve subtracting real people from the census counts on the basis that statistical theory says that they really aren't there, even though they have actual physical proof that they are. These are not duplicate forms that we're talking about. So in effect, they will serve to count some Americans as less than a whole person—the practice your testimony condemns. The organization—I know your organization has endorsed sampling and called it the civil rights issue of the 1990's, and perhaps it is. But subtracting real people from the counts amounts to nothing more than a Government-sponsored civil rights violation, in my judgment, of millions of Americans who took the time to fill out their census forms. These Americans will be deleted, in some cases, from all different types of racial and ethnic groups that your organization represents, in some cases.

And we're going to be introducing legislation to forbid the Census Bureau from removing valid, completed census forms from the counts through the use of statistical inference.

And I think what we'd like to ask is; could we count on your support for that aspect?

Mr. HENDERSON. Certainly, Mr. Davis, I think it is fair to ask the Census Bureau to explain in totality the proposed methodology that it will use for the upcoming census count. And it seems to me that in asking the Bureau to both present and, perhaps, even to revalidate by demonstrating the scientific validity of what they propose is not unreasonable. On the other hand, it seems to me there is a distinction between subtracting forms that may have been completed and submitted to the Census Bureau from a comparison of where actual individuals have been somehow barred from being considered as part of the total population.

I'd—the distinction that I would make is this; I have a knowledge, certainly, of what the Bureau has proposed as the totality of the methodology it will use. On the face of it, it seems to be fair, valid and, I believe, will produce a more accurate result than was the case certainly with 1990. It does not mean that in every aspect of what they've proposed that they are, you know, without a problem. But I do think that to start from the premise that somehow what they are proposing to do in trying to balance out their methodology may, in fact, delete real individuals from the census count is perhaps a little bit of a distortion because I think that the methodology they are proposing to use meets the test that we would employ for scientific validity. And I think it meets the test that was

proposed by the National Academy of Sciences and the General Accounting Office.

Mr. DAVIS of Virginia. But wouldn't you agree that only duplication should take on double counts, not—sampling shouldn't do this. In other words, if somebody takes the time to fill out a completed census form, the bill that we're going to introduce will allow that it could be deleted only when an actual duplicate or fraudulent questionnaire is found. You talked about complementing an aggressive enumeration, and I think——

Mr. HENDERSON. Absolutely.

Mr. DAVIS of Virginia [continuing]. We should look at complementing an aggressive enumeration, but deleting actual people who have filled out the forms when there's no duplication or fraud involved isn't a complement; that's an insult.

Mr. HENDERSON. Well, it seems to me, Mr. Davis, and I understand the rationale behind your bill. And I certainly believe that, you know, we have and you have every right to question the proposed methodology that the Census Bureau would use. On the other hand, it seems to me that if they are making an effort to develop a comprehensive methodology, one which is based on individual enumeration of the largest number of people that can be done complemented with scientifically and a valid methodology to certainly estimate using principles that we all believe to be valid. The total population——

Mr. DAVIS of Virginia. But the problem is not everybody is going to believe they're——

Mr. HENDERSON. Well, and I think that's certainly—no, and I think that's a reasonable question, and I think you have every right to ask them to come in and to reestablish the basis of their assumptions. But I would not, you know, be at this point prepared to embrace the bill that you've identified because it only goes to a small portion of what the Census Bureau proposes to do. And I understand the rationale behind it, and certainly we are not for creating new barriers to opportunities for anyone in our society. But I think in the initial instance, looking at the total proposal would be fair to both, you know, the Census Bureau and to the——

Mr. DAVIS of Virginia. Well, let me know—just sum up if I can——

Mr. HENDERSON. Sure.

Mr. DAVIS of Virginia. I hope you're not saying that, because the overall good by sampling is helpful, that maybe one or two or five people who filled out the form, statistical sampling would take them out of it, that that somehow justifies that the end——

Mr. HENDERSON. No, I'm not suggesting that. What I am suggesting is that the methodology which is proposed for the year 2000 does need to be examined. It does need to meet the tests of scientific validity and sufficiency. I don't think that's unreasonable. At the same time, I would not be prepared without looking more comprehensively at what the Bureau proposes to do, to sign on to any bill that would seek to inhibit one or a limited aspect of what the census can do to carry out their task even though I understand the method——

Mr. DAVIS of Virginia. Well, we'd hope to involve you——

Mr. HENDERSON. Absolutely.

Mr. DAVIS of Virginia [continuing]. In this and send you copies of this, and it just seems to me any person who fills out that form, and you can't show fraud or duplication, ought to be counted. It shouldn't be discounted because some sampling methodology or some social scientist thinks that they somehow don't fit the methodology that they have gotten.

Mr. HENDERSON. We're certainly prepared——

Mr. DAVIS of Virginia. And I would think you'd be——

Mr. HENDERSON [continuing]. To take a look at that and——

Mr. DAVIS of Virginia [continuing]. Particularly sensitive to that and we'll continue to correspond on that.

Mr. HENDERSON. Of course.

Mr. DAVIS of Virginia. Thank you very much.

Mr. HENDERSON. Thank you.

Mr. MILLER. Thank you. Mrs. Maloney.

Mrs. MALONEY. I'd like to really thank Mr. Henderson for your testimony, and particularly for staying.

Mr. HENDERSON. Oh, thank you.

Mrs. MALONEY. And being here to answer our questions. I know it's a huge contribution of your time.

What is your opinion of whether or not the 1990 census was successful?

Mr. HENDERSON. I think the 1990 census was an incredibly failed census, by any objective standard. I mean, I think if the purpose of the census is to produce the fairest and most accurate count of all persons here in the United States, who reside here, then I think the increased undercount between the 1980—I'm sorry, between the 1970 and 1980, I'm sorry—the 1980 and the 1990 census, it seems to me is a real problem. And I think, by any objective standard, one has to believe that the 1990 census was a failed census.

Mrs. MALONEY. Do you believe that the use of promotion and outreach programs such as checks at homeless centers and soup kitchens, targeted advertising, forms in multiple languages, all the new ideas that they propose to use in the 2000 census can significantly reduce the differential undercount without the use of statistical sampling?

Mr. HENDERSON. I certainly think that those techniques to spread the outreach efforts of the Census Bureau are positive. Having said that, however, I don't think they will be sufficient unto themselves to reduce the differential undercount. And I think, again, by most objective standards at least as I have seen it, and that includes the evaluations that were done over the past 8 years by the General Accounting Office and the National Academy of Sciences, it would seem to indicate that that is the case.

Mrs. MALONEY. Our country is committed to equal rights, without regard to race or ethnicity, yet we know that huge undercounts exist. Does the civil rights community see the census undercount as an equal rights issue?

Mr. HENDERSON. Oh, we certainly see it as an equal rights issue. I mean I think if you examine the populations of persons who are most often left out of a census count, they include discrete and insider populations, people of color—African-Americans, persons of Hispanic origin. They include the poor, whether in rural communities or in urban centers, and they include children. And I think

in each of those instances, the importance of ensuring the adequate representation of all of these groups, and really for that matter, all persons who reside in our country is really the prime directive that I hope, you know, that both Congress and the community at large will embrace.

Mrs. MALONEY. Well, can you explain or elaborate on how the undercount affects these groups, both in funding and political representation? And can you address how urban centers and minorities are adversely affected by the differential undercount?

Mr. HENDERSON. Oh, I think there are many examples, Mrs. Maloney, that indeed make that case. I mean, as has been said here earlier through other witnesses, the census data is used for so many purposes. Obviously, reapportionment is certainly one of them, carrying out the responsibilities of civil right statutes such as the Voting Rights Act or others, and also formula-driven allocations of Federal resources to States have tremendous implication for all of the populations we've identified. It seems to me when we exclude whole cell segments of our population and the failure to provide an accurate count of all persons who reside, we deny the communities in which they live, the resources that they are entitled to, to address needs and services that Congress and the American people certainly have every right to expect, and, moreover, you deny these individuals their right fill representation in the political process.

Now, admittedly, the failure to reach these populations rests both with the outreach effort that's undertaken by the census and obviously there is a responsibility within the communities affected themselves to do more to ensure that there is an adequate participation. But the truth is, that without some additional effort, which I think is adequately reflected in the proposal to augment the enumeration with sampling, I think we're going to continue to have these gaps in our population count and will continue to have dire consequences for all of these groups and for the Nation as a whole.

Mrs. MALONEY. You mentioned in your testimony how badly the 1990 census undercounted children, and I would like you to elaborate on that point. Can you explain why this happened and what we can do about this problem?

Mr. HENDERSON. Well I think that, again as was noted, there is great difficulty in encouraging all segments of our society to take the same approach to the importance of the census. We are not always able to convey in ways that overcome the skepticism, and in some instances, hostility that people have about Government documenting where they reside and how this information will be used. Children, unfortunately, are not in the position to, of course, take on that responsibility themselves. They generally rely on the adults in the households where they reside to ensure that they are accurately counted in whatever census enumeration occurs. And you can't overcome that with the kinds of techniques that the Census Bureau has proposed even with expanded outreach. And the failure to count children as a population really does have a dire impact on the country, as a whole, and I think we've documented that in the kinds of programs that benefit children. But it seems to me that without something more than has been done and, again, consistent with the recommendations of the National Academy of Sciences

and others, these proposals—a failure to adopt them will really certainly produce an outcome which we know will be flawed.

Seems to me that the question that Congress is wrestling with is not between a perfect system on the one hand and a speculative system on the other. The question is you have two flawed proposals in a sense. I mean one is we know a flawed proposal; that was the proposal that produced the substantial differential undercount in 1990. You now have a set of recommendations that were achieved through the best available scientific methodology that Congress had at its disposal. And throughout the process, we have a consistent—almost a consensus, I think, at least within the scientific community, on the importance of using sampling as one technique to augment enumeration. And failure to take advantage of that, it seems to me, would produce a significant shortcoming in the outcome that we're trying to accomplish.

Mrs. MALONEY. Well, my time is up. Thank you very much.

Mr. HENDERSON. Thank you.

Mr. MILLER. Thank you. Mr. Henderson, let me start by saying that we all should agree—and I think everybody here—that we want to have the most accurate census and minimize the undercount.

Mr. HENDERSON. Absolutely.

Mr. MILLER. There is no question about the goal that everybody should be looking for. But what we don't want to do is have a failed census, because a failed census threatens our Democratic system of Government. Because, as you say, the census is the basis for all of most elected officials in America. City councils, school board districts are all adjusted by the census.

I know you refer to the 1990 census as a failed census. I, respectfully, don't disagree with you. What was a failure in 1990 was the attempted use of sampling. And I think most people will acknowledge sampling was a failure in 1990. They did a full enumeration, and then they did this what was called a PES sample of 167,000 households. Based on that, they wanted to adjust the census, and they were going to take a congressional seat from Pennsylvania and one from Wisconsin. This was back in 1991, and Secretary Mosbacher refused to do that. It turned out the following year, they found it was a computer mistake, and they should never have made that recommendation.

The Census Bureau has also stated that the data is less accurate when you get down to 100,000 or less population. So, basically, information you work with on census tracts and census blocks, and certainly for smaller communities, is less accurate. These are the Census Department's own—of their own analysis.

So sampling was a failure in 1990, and what scares us is to totally rely on sampling without any fallback is, to me, irresponsible. At least in 1990, we did have the census, the full enumeration, because right now what they're talking about doing is no full enumeration. They're only going to count 90 percent, and then do a sample of 750,000. They're doing a five times larger sample, but in half the time.

Mr. HENDERSON. Sure.

Mr. MILLER. Which is hard to say that they can achieve it. And when you mentioned a speculative system, this is very speculative

because the one chance we've had to use sampling was a failure in 1990.

With respect to the undercount issue, we all need to address it. I don't know if you know it as a fact that the percentage of blacks counted in the 1990 census was better than 1980. The percentage—and this is Census Department numbers—the percentage of blacks counted in 1990 was better than 1980 and 1970. The 1990 census was the second best in the history, better than 1970 and better than 1960; 1980 was a better census, though, when we have statisticians talking about it, they're questioning the degree of the undercount. But we know there's an undercount and we need to do everything we can to correct the undercount.

Let me ask the question now. [Laughter.]

And I'm not a lawyer; I don't know if you are or not. But, at any rate, the question is—and this committee is not going to spend a lot of time with that issue—is by the constitutionality and the legality of sampling. And you are all familiar with that issue. I think you had this person that was involved in the issue at your panel that day.

Mr. HENDERSON. Yes.

Mr. MILLER. Just assume we don't want to talk about the legal issue.

Mr. HENDERSON. Sure.

Mr. MILLER. If the Supreme Court said sampling can't be used, what we have to do is do the very best census we can. We have to do everything we can to minimize that undercount and put whatever resources we need to in going after the undercount. We know part of the problem, 50 percent of it, is the address list. We know the children issue.

Mr. HENDERSON. Sure.

Mr. MILLER. I don't know if they use it in the WIC program? There's a lot of programs we can use to get on it. Do you have any comments? Running ads in Time magazine may not be the answer, but there are some ideas out there. I mean, because you really, even if you'd sample, you need to get the best percentage in completion as you can.

Mr. HENDERSON. You do. Let me say, Mr. Chairman, that I think the constitutionality of sampling has at least been implicitly addressed in some of the litigation in lower courts that has come between the 1990 census and today. And I think the courts have recognized that Congress had the authority to delegate to the Secretary of the Commerce the ability to employ both a post enumeration survey and sampling, if he chose to do so. And even though there was a challenge to Secretary Mosbacher's authority to adjust the 1990 census, it was not addressed on the basis of constitutionality. I think the courts have spoken to that issue pretty authoritatively, and I think it is unlikely that they will rule that sampling is not constitutional. But let's put that aside for a minute.

I do think there is a question of what happens in the event the courts were to rule in that direction, and what is it that we do? It seems to me that we do precisely what we are going to do in 1990 even with the addition of sampling, which is to say that the Census Bureau, in conjunction with as many national groups, stakeholders, those that have an interest in producing a fair and accurate count

which is literally every entity that we've identified, you make the best effort one can to ensure that you get a full enumeration to the extent possible. But we recognize, even with those best efforts, there will be a tremendous gap between what we are able to accomplish with our best efforts and the total population that needs to be counted. And the question becomes whether there will be methodologies available to the Census Bureau to address that unknown factor. And as I said, I mean you know, I think you begin with the premise that the 1990 census was a flawed census but you attribute that failure to the use of sampling. I think there were a combination of factors, and perhaps the inappropriate application of some aspects of sampling may have been among them. But I think a couple of things are true here.

First, in the wake of that admitted debacle that we all agree was just, you know, a problem, Congress did authorize a process to try to bring the best and brightest to the table to analyze prospectively what could be done. And that result produced, seems to me, a set of recommendations that were adopted by the Academy of Sciences, but also by others who have examined these issues closely and who have no political "ax to grind," in terms of how this issue is resolved. And I'm not suggesting, by the way, that any member of the committee has that ax. I do think, however, that when scientific organizations are asked to examine the methodology that they might employ, one can assume that they are at least not looking at it in quite the same political vein that, you know, Members of Congress and others who are directly affected by this issue might.

The recommendations that were made were then examined carefully, by both the Census Bureau and by Congress. The General Accounting Office examined these issues. The Inspector General let the Department of Commerce and every professional association having some involvement in the use of statistics or demographic data examine this. And they came to the same conclusion; that an enumeration augmented by a sampling approach was the best and soundest use and most effective use of resources available to us. And I think even if Congress were prepared to invest substantial resources above and beyond what has already been allocated, most, you know, fail the objective observers of this system would suggest that that's not going to be adequate. So, I think if the courts were to rule that sampling was not constitutional, they, at least for a time, would be consigning us to a flawed and inaccurate count. And that certainly would be the case in the year 2000 and, perhaps, beyond as well.

Mr. MILLER. Well, if we go with full enumeration we'll have to at least work together to try to make sure——

Mr. HENDERSON. Absolutely.

Mr. MILLER [continuing]. That the undercount is corrected, because we all want to work toward achieving the minimum, if no undercount whatsoever, and get the best census we can.

Mrs. MALONEY. Can I ask him one followup question?

Mr. MILLER. Sure.

Mrs. MALONEY. You were saying, Mr. Henderson, that no matter how much money was spent on more enumerators or even more promotion and outreach, that it would not improve the accuracy of the census count—is that what you're saying?

Mr. HENDERSON. Well, no; I think it will have some impact on improving the overall count. Certainly I think that by investing more resources and enumerators and public education and outreach efforts, it is bound to have some positive effect. However, it will not be sufficient unto itself to deal with a differential undercount which we know existed in 1990.

Mrs. MALONEY. No matter how much you spend?

Mr. HENDERSON. No matter how much you spend.

Mrs. MALONEY. I'd like to submit questions to the record, if I could, for panel two. And I really would like to end, if I could, very briefly with a question that the chairman and I were talking about when we walked down to vote. And I asked him what the next hearing would be on, and he said he really didn't know, but it might be on how we would reduce the differential undercount. And you've touched on it, but I'd just like to be very clear on it. Other than using statistical methods and that which we know is in the plan for the 2000 census, can you think of any way to reduce the differential undercount?

Mr. HENDERSON. Mrs. Maloney, I have really wrestled with this issue for quite awhile. I am not aware of other approaches that are likely to bear greater fruit in this effort than what has already been proposed by the Census Bureau. And obviously, we are searching collectively for any and all techniques and methodology that would augment the actual number of persons counted so that the need for, you know, scientific sampling and other techniques would not be as great as it is today. I just can't think of any other approach. And I certainly think that the recommendations that have been made by the National Academy of Sciences and others, until they have been proven to be or shown to be really ill-conceived, I think are the best evidence that we have available of what can be used effectively to increase the accuracy and fairness of the count.

Mrs. MALONEY. Thank you very much.

Mr. HENDERSON. Thank you.

Mr. MILLER. As we conclude, the one concern we have, and as other witnesses were saying earlier, is that we're changing ways in sampling that one type of error for another type error and some statisticians will say we have a less accurate census. We don't want a less accurate census.

Mr. HENDERSON. Of course not.

Mr. MILLER. We want to get the most accurate that we can and minimize the undercount. So we have a common goal.

Let me thank you, again, for being here today. I'm sure we'll be having an ongoing discussion on this issue for the next couple of years—[laughter]—I ask unanimous consent for the record to remain open for 2 weeks for Members to submit questions for the record and that witnesses submit written answers as soon as practical. Without objection, so ordered.

That was my housekeeping duty. Thank you very much for being here today and the meeting will stand adjourned.

Mr. HENDERSON. Mr. Chairman, thank you.

Mrs. MALONEY. Thank you, Mr. Miller.

Mr. MILLER. Thank you.

Mrs. MALONEY. Thank you, Mr. Henderson.

Mr. HENDERSON. Thank you.

[Whereupon, at 6:53 p.m., the subcommittee adjourned subject to the call of the Chair.]