

DISCUSSION

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Although the first two papers have dealt with the improvement and measurement of coverage and not with the matter of adjusting the census, I could not keep from placing all three papers on a figurative spectrum with respect to adjustment. On your far left over here you have Canada, where, as I understand it, there is still not much serious consideration of adjusting census figures. (I noted one sentence in the paper by Carter and Royce, page 5-- "The higher undercoverage in 1986 has led to renewed interest in the possibility of adjusting census counts." This, however, is the only mention that I could find.) At the other end of the spectrum there is Australia, where adjustments of population estimates are actually being made. (The census counts are published without adjustment.) Finally, the United States has floated somewhere in between, the Department of Commerce having definitely decided not to prepare for adjustment after the next census, but with a lot of heat coming from Congress and doubtless more to come from local areas in 1990.

It seems to be a sad but nevertheless indisputable fact that modern wars have brought about great leaps in technological development. Analogously, I do not think that we would have seen the tremendous advances in the theory and methodology of undercount estimation that have taken place, had it not been for the great brouhaha over adjustment that followed the 1980 Census in the United States. Thus in spite of the "carnage" in premature aging of Census personnel and the frayed nerves, statistical science has benefitted greatly during this troubled and frantic period. Although the Hogan and Wolter paper makes little mention of it, there is also a lot of U.S. effort going into the planning of means to improve coverage in 1990. Some of us have our doubts about the marginal gains in cooperation and enumeration from these efforts, but at least a lot of money will be spent in a valiant attempt to get a better count-- and as observed by the authors, the net undercount in the U.S. has decreased over recent decades.

I have one comment on the U.S. paper-- on page 6 the authors mention the development of the Tiger System and the expectation that it will reduce the number of duplicated housing units in 1990, thus reducing the gross overcount. It follows, then, that if the gross undercount is not reduced very much by all of the listing improvements and outreach activities that are planned, the net undercount may well increase over that in 1980. This underlines the importance of discussing the coverage problem in terms of under- and overcounts in separate pieces, rather than making so much over the net results as the Bureau seems to do.

Moving northward to Canada, I cannot imagine there being a more serious population problem at present than the out-migration of Wayne Gretzky. Putting that national disaster aside, however, I want to commend Carter and Royce for their thorough description of Canadian activities in coverage improvement and measurement. Many of the steps enumerated in their paper are also a part of the United States program, and I daresay, without knowing for sure, also similar to Australian coverage activities, since there is much sharing of planning and information among these countries with a common language.

One unique hallmark, however, of Canadian census activities is the Reverse Record Check. There was, as you may know, interest in implementing such a program in

the U.S., but 1985 test results were discouraging. I have been told by the experts that our population is just too mobile for the method to be economically feasible. As my understanding of census operations has grown, I have been envious of the Canadians' ability to make the RRC effective, and it is therefore interesting to hear today of the disadvantages and to learn that a post-enumeration survey is contemplated as a parallel coverage estimation activity in 1991. Again, I speculate that the PES would not be such a hot item in Canada were it not for the strides that have been made in matching and in other respects in the U.S. program during the last few years.

Now for the Australian paper, which is the most technical of the three. (My prepared discussion is based on the earlier version by Steel and Choi, not having received this latest draft in time, but it still applies.)

This very stimulating report discusses some new methodological explorations aimed at providing defensible estimates of the undercount at the level of local government authorities (LGAs). As explained, there are eight Australian states, each containing a number of LGAs. In 1980 there were eleven cities of 100,000 population or more, accounting for 70 percent of the total population of Australia, and there were close to 900 local governmental authorities.

The Australian post-enumeration survey involved a sample of 35,000 private dwellings in 1986. This number should be compared to the 150,000 housing units planned for the U.S. in 1990. From this PES, direct estimates of undercount were obtained by age and sex at the national level. In addition, state estimates by sex were obtained. Then the age by sex and state by sex marginals were used as the basis for iterative proportional fitting to provide a three-way age by sex by state set of underenumeration rates. In 1981 and 1986 there was apparently a further breakdown in estimation by the categories capital city vs. remainder and Australian born vs. foreign born. It is not clear to me whether these finer estimates are the result of direct estimation or iterative proportional fitting. At any rate, as I read it, all estimation at the LGA level through 1986 was by synthetic estimation, using age, sex, part of state, and birthplace as the sources of the synthesis.

There are basically two new approaches to LGA-level estimation under investigation:

1. Person-level logistic regression: The logit of the fraction of persons missed is fitted to a six-way table, where the six classification variables were selected out of a larger set using a forward selection process. LGA estimates are then obtained by synthetic estimation.

2. Regression models using the directly estimated LGA underenumeration rate as the dependent variable: There have been various sub-explorations under this heading, involving

- a. Weighted vs. unweighted regression
- b. Hierarchical Bayes procedures
- c. Allowance for geographic effects through spatially correlated disturbances
- d. Spatial smoothing

I believe that the person-level logistic regression approach is the closest to that planned for the U.S. in 1990. As I understand the procedure currently planned for the United States, direct undercount estimates will be calculated for 1,332 post-strata-- I would rather call them "domains" since these post-strata cut across the sampling strata. At any rate, these post-strata estimates will be

regressed on their various indicator-variable identifying characteristics. Then hierarchical Bayes procedures can be used to produce weighted averages of the regression estimate and the original estimate for each post-stratum. Finally, a small area underenumeration rate can be constructed synthetically. It is not clear how low the reported level of undercount estimation will be, but probably not below that of major metropolitan areas and states. It will be possible, however, to provide the 1,332 post-stratum estimates as a do-it-yourself kit for "power users" of census data who will be able to perform their own synthesis for any small area of their choosing.

I have no specific critical comments on the Steel and Poulton paper, except to say that the barrage of models presented to us is a bit overwhelming, and I am wondering how the Australian Bureau of Statistics will deal with the possible charge of arbitrariness in its final choice. We would, of course, like to be able to say that one approach is best because it is the most accurate. This leads me to close with a mention of the intensive efforts that have taken place in the United States to investigate the components of non-sampling error in undercount estimation-- again, largely as a result of the vigorous debate over adjustment. In another paper Hogan and Wolter (1988) discuss and provide numerical estimates of the error from

eight different sources-- among them, erroneous matching and correlation bias. A paper presented at the 8:30 invited session this morning (Mulry and Spencer, 1988) provides estimates by simulation of the total error in coverage estimation from the Los Angeles test of the PES procedures. My point is not that we have definitive measures of accuracy now, but that a body of methods and systems is under development that will routinely produce total error estimates in the future. I want to ask our Canadian and Australian colleagues if they are engaged in similar activities. Clearly, statements of sampling error, alone, are not enough when dealing with an issue as politically sensitive as adjustment.

REFERENCES

Hogan, H. and Wolter, K.M. (1988). Measuring accuracy in a post-enumeration survey. U.S. Bureau of the Census technical paper.

Mulry, M.H. and Spencer, B.D. (1988). Total Error in Dual System Estimates of Coverage Error in the 1986 Census of Central Los Angeles County. Proceedings of the Survey Research Methods Section of the American Statistical Association.