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A main conclusion from the papers of this session is that we need some theory for estimating the completeness of censuses. We know too little of the merits of a post-enumeration survey with matching of individual names as against a demographic calculation using data pertaining to the period prior to the census.

The United States Census of 1980 will be evaluated in both ways, but more weight is to be put on the demographic calculation. Preceding births less deaths make possible an estimate independent of the census for those up to age 45; Medicare records give those 65 and over; for those in between recourse can be had to previous censuses; with these data plus migration statistics an estimate will be derived of the number of people that should have been counted by the census, classified by age, sex and race. Messrs. Passel and Robinson provide a full and satisfying account of the data and the calculation that will be used.

No one can doubt that under ideal conditions a matching study provides more information than such a calculation. The Bureau of the Census is asking in the Current Population Survey of August and December where each respondent was living on April 1, 1980; it already has the CPS for April. The information on location will enable it to search the census schedule and see if the person was recorded or not. The fraction not recorded is the undercount. This is the method of evaluation to be used in Canada, with only the difference that the list to be searched to the census is not the Current Population Survey but a composite sample from the previous census, births, and immigration records. A sample from the administrative records is traced to the census, with assistance in the tracing from tax, family allowance, and old-age security files.

Extra-censal records are themselves incomplete, and persons missed in the one file are likely to be missed in the other. The matching gives more information than the demographic comparison if the chance of being missed is independent. For instance, if the census misses 3 percent of the population and the alternative source misses 3 percent, and these are random with regard to one another, then a perfect matching would pick up 97 percent of the undercount, which is close to perfect evaluation in a situation where the demographic overall comparison would fail altogether. Even if half of those omitted on one are omitted on the other, in both directions, a perfect matching will pick up nearly half of the undercount, where gross figures would show nothing.

Unfortunately many individuals are hard to identify in the search from administrative records or p.e.s. to the census. For semi-literate people the spelling of names may vary from one occasion to another. Married women may use their maiden names on some occasions. For imputed individuals no comparisons are possible. All this makes the outcome of the matching process in some degree ambiguous. For the Canadian Census of 1976, as Mr. Gosselin shows, 92.7 percent of the original sample was matched, 4.8 percent unmatched, and 2.5 percent of the sample was apparently omitted from the census.

One might at first worry about the sampling error of the 2.5 percent, recalling that the total sample was only 33,000, so the missed would have been 0.025 x 33,000 = 825 persons. With a Poisson distribution of error the standard deviation of sampling for the 2.5 percent would be less that 0.1 percentage point; even if this had to be doubled for the design effect, and doubled again for 95 percent confidence, we would know that the percent missed was between 2 and 3. That is useful information.

Unfortunately sampling is not the main source of error in this evaluation. It gives rise to less uncertainty than the cases where tracing failed. If the 4.8 percent which these cases constitute of the total were really not present in the census then the true undercount would be 7.3 percent. If they are all present, but under different names or other disguise, then the undercount is only 2.5 percent. Combining this uncertainty with sampling error, we really cannot say much more than that the undercount was between 2 percent and 8 percent. That is not very informative.

It is frustrating that so small a group as 4.8 percent prevent us from knowing the completeness of the census. Yet to suggest spending more money on tracing them is not very helpful. Statistics Canada has already spent up to $20 apiece in

| | Non-match | |
	Low	High
Extracensal data		
Good	Both valid	Demographic only
Poor	Matching only	Neither

FIGURE Validity of demographic and matching evaluation of census, supposing some degree of independence in cases missed in two sources.

an effort to locate each one.

The Figure suggests the possibility of some theory on the circumstances in which matching will produce the better estimate of the undercount and when the demographic calculation is better. If the extracensal data (births, deaths, etc., or else the p.e.s.) are good, and if there is a low nonmatch, then both methods can be used. (The U.S. Bureau of the Census is trying both, and with luck will find itself in this cell. If so then the question of how to weight the two estimates will arise.) With a low nonmatch and poor extracensal data one is confined to the matching method; this is apparently the condition that the Canadians feel themselves to be in; they consider that the same people tend to be missed in the census and the p.e.s., but that the misses of successive censuses are in some degree independent. With high nonmatch and poor previous data neither method is useful, and this represents the position of the Australians; they will evaluate quality of answers, but not completeness. Whether these different approaches correspond to differences in national conditions I do not know. The Canadians may put their money on a matching evaluation, while the United States goes for the demographic, because the population of the U.S. is larger and more mobile, which makes matching harder. On the other hand, it may be the personal impressions and preferences of those who make the decisions in the several countries that are determining.