Impact of Census Error Adjustments on State Population Projections: The Case of Ohio[1]

DAVID A. SWANSON, Department of Sociology, Pacific Lutheran University, Tacoma, WA 98447, KANHAIYA VAIDYA and RIAD YEHYA, Department of Sociology, Bowling Green State University, Bowling Green, OH 43403, BARRY BENNETT and RON PREVOST,[2] Ohio Data Users Center, Ohio Department of Development, Columbus, OH 43266-0101

ABSTRACT. **Census enumeration errors affect local, state and national level population projections. It has long been a practice to produce projections that reflect adjustments for net census undercount errors. Unfortunately, the Ohio Data Users Center (ODUC), like other state demographic centers, has had little knowledge of the effect of adjustments because undercount adjustment factors for 1980 had not been officially released by the Bureau of the Census as of 1987. We have obtained information on 1980 undercount factors and used them to develop an adjusted projection for Ohio. Thus, we examine the effect of using 1980 national undercount adjustment factors in preparing Ohio population projections by comparing projections based on 1980 undercount adjustment factors to projections based on no adjustment. We also examine the effect of using 1970 national undercount adjustments by comparing the projections based on these adjustments to projections based on no adjustment. The findings suggest that decisions concerning adjustment factors have varying effects on short-term, long-term, and strategic forecasting. These effects are particularly salient for selected age-groups and the impact on state government budget decisions typically associated with these age-groups. We recommend that the effects of alternative adjustment possibilities be examined by state demographic centers and budget offices.**

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INTRODUCTION

An important consideration in any assessment of the future is the size and composition of the human population (eg., The Commission on Population Growth and the American Future 1972). For all its limitations (Moen 1984, Pittenger 1977, 1980), it is clear that population forecasting is an important and widely used planning tool (Isserman and Fisher 1984, Keyfitz 1972, 1981, Pittenger 1976, 1977). Ohio is typical of most states in that it uses population forecasting produced by the Ohio Data Users Center for both information and resource allocation (Office of the Governor 1984, Ohio Data Users Center 1983, 1985). In terms of both of these purposes, population forecasting is usually found in three activities:

1) "short-term" operating budget development;
2) social overhead capital decisions, which tend to be "long-term;"
3) long-range strategic planning.

Government officials find a population forecast useful for short-term operating budget development because "people" represent both a major source of revenues and a major source of expenditures, as has been pointed out by McKibben et al. (1985). From the standpoint of social overhead capital decisions, population forecasts are useful because they guide officials in examining the needed level of capital stock of such items as schools, roads, and sewers (Henry 1980). In terms of strategic planning, the utility of population forecasting is that it can be used to explore plausible portraits of the future and inform policy on choices associated with these alternative futures (McKibben et al. 1985).

At the state level, population forecasting is usually accomplished using the "cohort-component method." This method takes a "jump-off" population, subjects its age and sex structure to forecasted age-sex specific fertility, mortality, and migration rates, and moves the jump-off population into the future. For a full description of this method see Pittenger (1976).

Population forecasting with the cohort-component method is essentially subject to errors from two sources: judgments on the part of the forecaster about the levels and trends of future mortality, fertility, and migration; and the data used at the "jump-off" point to initialize the projection. Errors in the jump-off data are primarily due to net census undercount since the jump-off population is virtually always the population counted at the time of the most recent census. These net census undercount errors can, in turn, be classified into two general types: coverage; and content, which is the misreporting of characteristics such as age, sex, or income (Rives 1976). Together, coverage and content errors constitute net census undercount, which is the type of error that we examine for Ohio in this report.

Since net census undercount has been known to affect the accuracy of the population used in the jump-off year of the forecast, it has long been a common practice to adjust jump-off populations and components of change by using net undercount factors developed by the U.S. Bureau of the Census in its post-enumeration programs (Pittenger 1976, U.S. Bureau of the Census 1977). This type of adjustment is made because state demographic centers are interested in determining the "true" population, as best it can be ascertained in a manner that is independent of "arbitrary and capricious decisions" (Krebs et al. 1977).

Our primary interest is in evaluating the effect of using the 1980 jump-off population as reported, relative to using one adjusted with 1980 national undercount factors. However, we also evaluate the effects of using the 1970 undercount factors to adjust the 1980 jump-off population. We are also interested in both the short and long-term consequences of making adjustment de-

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[2]Present Address: Estimates Branch, Population Division, U. S. Bureau of the Census, Washington, DC 20203

cisions. Thus, we use a very long projection horizon of 100 years.

We present this research as a contribution toward filling the gap in the literature dealing with census errors. As pointed out by the National Research Council (1985), the research that has been conducted focuses on the effects of census error on legislative redistricting, reapportionment, and immediate funding allocations. An additional point of interest is that the U.S. Bureau of the Census has been entangled in legal and technical issues regarding the adjustment of census figures for net undercount prior to release (National Research Council, 1985). Thus, this paper also provides insight into the effects of simple adjustment procedures on population forecasting.

METHODS

We used a computer simulation experiment similar to one employed by Rives (1976) in his evaluation of the impact of 1970 census errors on national population projections. The experiment consisted of three separate population projections, each of which was based on the cohort-component method and used 1980 census data for Ohio as the jump-off population. The computer program used to generate the projections is written in PL/1 and structured to run on an IBM mainframe. It is available from the authors (as are all data pertinent to the study). As a simplifying procedure, each projection excluded the effects of migration and maintained the 1980 fertility and mortality structure as constant over the entire 100 years.

This approach precludes the ability to analyze the effects of net undercount adjustment ratios on migration, which is an important aspect of population change. However, it reduces a great deal of complexity that would otherwise require much more space to describe. Briefly, the major additional complicating factors introduced by migration are:

1) having to examine unadjusted and adjusted 1970 and 1980 population counts, if 1970–80 migration flows are desired. This would involve multiple adjustments for migration and survivorship;

2) having to consider what type of adjustments to make on 1975–80 migration flow data generated directly from the question on "residence 5 years ago" in the 1980 census if 5-year migration flows are desired. To correctly capture net undercount adjustment, we would have to adjust not only Ohio's 1980 population but the in and out migrants, which could entail adjusting populations external to Ohio;

3) ambiguities concerning the measurement of migration and the development of migration rates (Shryock et al. 1976); and

4) the difficulty involved in attempting to disentangle errors of judgment from errors resulting from measurement in analyzing migration (ODUC 1986).

We use the term "projection" in referring to the work done in this report and "forecast" to work done by ODUC and most other state demographic centers. This distinction is maintained because we are not attempting to generate the most-likely population in the year 2080. We are simply taking a set of assumptions about the components of population change, applying these to the jump-off population, and projecting it 100 years into the future for purposes of a computer simulation experiment. Like other state demographic centers, however, ODUC works under "real world" conditions and can not, for example, simply state that fertility rates will be constant in the future. Such an assumption is justified neither by past fertility rates nor by expectations about the future. Thus, ODUC must rely upon the judgment of its professional demographers to foresee changes in fertility. This use of judgment is what constitutes "forecasting" as opposed to the "projections" presented in this report.

The first projection incorporated the 1980 jump-off population as reported by the U.S. Bureau of the Census (1982) without any adjustment. Further, the 1980 mortality and fertility rates were not adjusted. The jump-off population, the age-specific life expectancy resulting from the life table produced from the unadjusted mortality rates, and the age-specific fertility rates are found in Appendix Tables A, C, and D.

The second projection used as a jump-off population the 1980 census data as reported by the U.S. Bureau of the Census (1982) and adjusted in accordance with 1970 national undercount factors by age, race, and sex (U.S. Bureau of the Census 1977). The jump-off population is provided in Appendix Table A. The 1980 age-specific life expectancies by sex, resulting from the adjusted morality rates, are given in Appendix Table C; the 1980 age-specific fertility rates are displayed in Appendix Table D.

The third projection was based on the 1980 jump-off population adjusted with preliminary net undercount factors found at the national level for the 1980 census (Fay 1985). The denominators in the 1980 mortality and fertility rates were also modified in accordance with these undercount factors. The jump-off population, age-specific life expectancy for each sex, and the fertility rates are given in Appendix Tables A, C, and D.

In selecting the two adjustment scenarios, we considered the choices described by Keyfitz (1980), who argued that undercount adjustment procedures fall into three groups:

1) accepting the census as enumerated;
2) adjusting the census count by a simple objective method that anyone can apply to all jurisdictions; and
3) using all existing data and doing the best one can, jurisdiction by jurisdiction, and foregoing the uniqueness and objectivity of convention.

Keyfitz (1980) also stated that the simplest of the "simple objective methods" is to apply the national net undercount adjustment factors uniformly to each jurisdiction, county, state, or region.

Like Keyfitz (1980), we recognize that adjustment, like the census count itself, is essentially arbitrary. This arbitrariness is not in the sense that figures are made-up, but in the sense that a variety of reasonable procedures, definitions, and conventions could be used, each of which would produce slightly different results, yet be technically defensible. Thus, in order to retain the simplicity as well as the potential for replication in other states, we selected the 1970 national undercount factors as the basis for the adjustments used in the second projection scenario rather than 1970 undercount factors specific to Ohio, which are found in U.S. Bureau of the Census (1977). This approach is also supported by the findings of Schirm and Preston (1987) who argued that using national undercount adjustment factors does, on average, improve the accuracy of the geographic distribution of population by state.

The numerators of the fertility and mortality rates are not modified in the two "adjusted" projection scenarios. That is, the reported 1980 births by age of mother and reported 1980 deaths by age and sex were used as given. This means that we assume, in accordance with considerable evidence (Rives 1976), that there is a very small level of error associated with reported resident births and deaths for the state of Ohio, and that the effects of these errors are negligible.

In terms of evaluating the effects of the census error adjustment factors on Ohio population projections, we use two approaches. The first looks at the projected total male and female populations resulting from the 1970 and 1980 adjustment factors related to the projections resulting from no adjustment. In the second approach, we examine selected age group differences.

RESULTS

EFFECTS ON THE TOTAL POPULATION, THE NUMBER OF MALES AND THE NUMBER OF FEMALES. Table 1 provides the total population generated under each of the three scenarios in 10-year increments from 1980 to 2080. Under each scenario, Ohio's population shows an initial increase, which peaks in 2010. Thereafter, the population in each scenario declines. The maximum population achieved in 2010 is 12,156,201 which is from the scenario resulting from the 1970 undercount adjustment factors. This same scenario produces the highest population of any of the three in each of the 10-year increments during the period of 1980 to 2030. However, by 2040 the highest total population is produced by the scenario resulting from the 1980 undercount adjustment factors. This scenario continues to produce the largest population through 2080. It is also noteworthy that the no adjustment scenario produces the lowest total population during the first 60 years. However, during the period 2050 to 2080 it generates the second highest population total.

TABLE 1

Total population in Ohio under each scenario, 1980-2080

Year	Census undercount adjustment using: None	1970 factors	1980 factors
1980	10,797,630	11,086,692	10,896,788
1990	11,453,684	11,734,428	11,550,918
2000	11,806,784	12,065,121	11,902,639
2010	11,926,591	12,156,201	12,024,043
2020	11,860,130	12,022,696	11,948,764
2030	11,568,567	11,665,829	11,654,797
2040	11,039,532	11,068,257	11,129,672
2050	10,393,486	10,341,302	10,488,067
2060	9,770,234	9,645,493	9,871,511
2070	9,219,053	9,028,602	9,323,202
2080	8,664,389	8,424,155	8,774,556
Average annual growth rate			
1980-2080	−0.00220	−0.00275	−0.00217

The average annual growth rate for the entire projection period is given for each scenario at the bottom of Table 1. Even with migration held to zero, the growth rates are negative because projected deaths exceed projected births between 1980 and 2080.

Table 2 provides the percent difference between the baseline scenario and the scenarios derived with the 1970 and 1980 undercount adjustment factors. The percent differences are presented for the total population and each sex separately.

In the case of the projection derived from the 1970 undercount adjustment factors, the largest percent difference is in 2080, when this projected population is 2.77% less than the projected baseline. In general, for the total population and each sex separately, the highest positive percent difference is found in 1980, the lowest at 2040. Further, the absolute value of the percent difference for females is consistently less than that for males.

TABLE 2

Percent difference between the total baseline population, by sex, and each alternative scenario, 1980-2080

	Population derived with 1970 undercount adjustment factors*			Population derived with 1980 adjustment factors*		
Year	Total population	Male	Female	Total population	Male	Female
1980	2.68	3.46	1.94	0.92	1.86	0.04
1990	2.45	3.14	1.81	0.85	1.69	0.06
2000	2.19	2.82	1.59	0.81	1.55	0.12
2010	1.93	2.38	1.50	0.82	1.39	0.28
2020	1.37	1.65	1.10	0.75	1.16	0.36
2030	0.84	0.90	0.79	0.75	1.01	0.50
2040	0.26	0.10	0.41	0.82	0.96	0.69
2050	−0.50	−0.75	−0.27	0.91	0.98	0.84
2060	−1.28	−1.53	−1.04	1.04	1.10	0.98
2070	−2.07	−2.30	−1.84	1.13	1.20	1.06
2080	−2.77	−3.02	−2.54	1.27	1.34	1.21

*Population derived with no undercount adjustment factors is used as the denominator in calculating the percent difference. Thus, a negative percent difference means that the adjusted population is less than the one derived with no adjustment factors.

The pattern is very different for the percent differences between the baseline and the one resulting from the 1980 undercount adjustment factors. The most noticeable feature is that the percent difference declines each cycle from 1980 to 2020 for the total population; from 2030 to 2080 it increases consistently. In the case of males, the percent difference follows a pattern similar to that of the total population. However, the minimum percent difference does not occur until 2040. For females, the percent difference is consistently less than that for males and increases consistently over the projection period.

EFFECTS ON AGE STRUCTURE. Table 3 displays percent differences between the baseline scenario and the alternatives for three selected age groups. These three age-groups correspond to the primary school-age population (5-14 yr) the working-age population (20-64 yr) and the retirement-age population (65+ yr), each of which is of interest to state policy-makers.

In the case of the primary school-age population, the baseline projection shows consistent decline from 1980 to 2080. Relative to the baseline, the projection based on 1970 undercount adjustment factors is higher until 1990. By 2000 it is lower, and declines constantly over the remainder of the projection period. The maximum positive difference (2.20%) occurs in 1980, and the maximum negative difference (−5.57%) in 2080. The projections based on the 1980 undercount adjustment factors show that this age group is consistently higher and increases relative to the baseline. The range between the two alternative scenarios relative to the baseline is noteworthy. By 2080 it is from −5.57% to 1.42%.

The baseline for the working-age population (20-64 yr) shows an increase to 2010, with decline thereafter. Relative to the baseline, the projection based on the 1970 adjustment factors is higher until 2030 and lower thereafter. The working-age projection based on the 1980 undercount adjustment factors is consistently higher than the baseline. However, the difference declines from 1980 to 2020, and increases thereafter.

For the retired-age population (65+ yr), the baseline projections show an increase from 1980 to 2030, with declines thereafter. Relative to the baseline, the alternative based on 1970 adjustment factors is higher over the entire period from 1980 to 2080, with a peak difference of 5.51% in 2020. The alternative based on the 1980 adjustment factors is also higher over the entire period but here the maximum percent difference (2.15) relative to the baseline occurs in 2010.

DISCUSSION

Perhaps the single most striking feature in the tables in the preceding section is the timing pattern of the percent differences found between the two alternative projections and the baseline. The total population based on the 1970 adjustment factors shows a pattern of declining overestimation from 1980 to 2040 and increasing underestimation from 2050 to 2080. This pattern is also found for both males and females. However, for the total projection resulting from the 1980 adjustments, the percent differences with the baseline are consistently positive, with a decline in the absolute percent difference between 1980 and 2020 and an increase from 2030 to 2080. For males, a similar pattern is

TABLE 3

Baseline number of persons projected in selected age groups derived with no undercount adjustment and percent differences with the alternative projections

	Number in the baseline projected age group derived with no undercount adjustment factors			Percent difference between the baseline number projected with no undercount adjustment factors and the number in the projected age group:* Derived with 1970 undercount adjustment factors			Derived with 1980 undercount adjustment factors		
Year	5-14	20-64	65+	5-14	20-64	65+	5-14	20-64	65+
1980	1,708,105	6,125,236	1,169,460	2.20	3.08	1.96	0.38	1.23	1.00
1990	1,624,962	6,744,308	1,429,413	1.59	2.72	3.55	0.70	0.98	0.82
2000	1,620,463	7,098,736	1,511,079	−0.48	2.99	3.69	0.11	0.93	1.49
2010	1,446,544	7,444,485	1,545,545	−0.07	2.23	4.85	0.84	0.60	2.15
2020	1,398,534	7,191,780	1,887,650	−1.49	1.33	5.51	0.64	0.46	1.89
2030	1,315,152	6,635,893	2,303,051	−2.18	0.79	4.41	0.77	0.64	1.02
2040	1,224,435	6,316,746	2,264,711	−2.68	−0.15	4.68	1.03	0.68	1.01
2050	1,164,317	5,968,754	2,101,596	−3.66	−0.99	4.28	1.02	0.75	1.21
2060	1,090,891	5,579,033	2,006,324	−4.27	−1.61	2.92	1.20	0.95	1.12
2070	1,026,390	5,279,061	1,885,875	−4.99	−2.47	2.25	1.33	1.01	1.26
2080	968,256	4,959,712	1,768,755	−5.77	−3.16	1.56	1.42	1.15	1.44

*Population derived with no undercount adjustment factors is used as the denominator in calculating the percent difference.

found although the lowest absolute percent difference is not reached until 2040. On the other hand, the pattern for females is one of consistently increasing overestimation over the entire projection period.

The differences discussed above are due to the differential size of the three projections at the 1980 jump-off point and the subsequent operation of the fertility and mortality rates associated with each scenario. In terms of initial population size, the 1980 population resulting from the 1970-based adjustment factors is the largest and the "no-adjustment" scenario is the smallest. However, the fertility rates associated with each scenario do not follow the same order (Appendix Table D). The total fertility rate (TFR) associated with the 1970-based adjustment is the lowest of the three at 1.7679 expected births per woman; the TFRs associated with the remaining two scenarios are virtually equal, with 1.8043 for the unadjusted scenario and 1.8092 for the one with the 1980 undercount adjustment factors.

In examining the mortality structure associated with each projection scenario (Appendix Table C), only slight differences are observed. For example, the range of life expectancy values at birth for males is only from 69.70 to 70.05 years; for females, it is 77.05 to 77.50 years. The highest life expectancy at birth is associated with the 1970-based adjustment scenario and the lowest with the "no-adjustment" one.

By looking at the differential jump-off population size associated with each scenario in combination with the differential fertility rates, the reason for the changes in the rank-ordering of the total population projected under each scenario becomes apparent. The scenario resulting from the 1970-based adjustment generates the largest population from 1980 to 2030 because it has the largest jump-off population in 1980. Its size differential decreases, however, because this scenario has the *lowest* fertility rate structure. By 2040, the scenario with the highest TFR (i.e., the 1980-based adjustment) generates the largest population and continues to do so throughout the remainder of the projection period. By 2050, the "no-adjustment" scenario, which has the second highest TFR, also generates a larger total population than does the one based on the 1970 undercount adjustment factors. Since there are only very small differentials in mortality, the effects on Ohio's population forecasts of undercount adjustments acting through this component of population change are clearly minimal. However, the effects of these adjustments through the differential jump-off populations are most important in the short-term, whereas their effects through the fertility component are most important in the long-term.

In looking at the projected age-groups, important differences emerge among the three scenarios. For the school-age population, for example, the projections based on the 1970 adjustment factors show a rapid decline from a high in 1980 (1,745,621) to a low in 2020 (912,388). The 1980 figure is 37,516 higher (2.20%) than that using no adjustment and the 2080 figure is 55,868 lower (−5.77%). Compared to the series with the 1980 adjustment factors, the one with 1970 adjustment factors is 31,025 higher in 1980 and 69,617 lower by 2080. Differences of a similar magnitude are found for the working-age and retirement-age populations, although maxima and minima occur at different years.

IMPLICATIONS AND RECOMMENDATIONS

The analysis presented in this report indicates that in terms of both the total population and the total for each sex, adjustment scenarios are different from the baseline. However, the "1980-adjustment" scenario is more similar to the baseline for both the short- and long-term than the projections resulting from the 1970-based adjustment factors. This reflects, as has been documented

APPENDIX TABLE A

1980 Ohio population by age and sex

Age	Unadjusted for net census undercount*		Adjusted with the 1970 national net census undercount factors*		Adjusted with the 1980 national net census undercount factors*	
	Male	Female	Male	Female	Male	Female
0-4	402,970	384,180	418,063	397,172	409,159	389,854
5-9	420,944	400,536	434,801	412,341	425,282	404,470
10-14	453,689	432,936	460,280	438,199	452,593	432,240
15-19	507,990	499,689	515,857	503,612	505,686	495,954
20-24	494,190	510,729	509,648	517,807	503,734	580,644
25-29	448,273	459,406	476,658	475,103	462,949	460,190
30-34	399,928	415,769	422,021	435,100	410,223	412,966
35-39	311,241	329,353	330,450	333,809	324,361	331,665
40-44	269,713	289,516	283,139	291,085	278,744	288,241
45-49	260,370	278,348	272,730	281,219	271,499	279,081
50-54	283,276	304,613	290,895	304,997	293,198	303,843
55-59	275,126	306,822	283,550	312,736	283,215	304,522
60-64	227,180	261,383	233,662	269,370	231,908	261,465
65-69	176,850	223,911	175,437	219,407	175,665	219,381
70-74	125,787	180,006	125,579	181,591	125,092	178,795
75-79	80,584	135,734	83,662	145,670	81,114	139,449
80-84	46,598	91,564	48,103	97,950	46,907	94,023
85+	32,428	75,998	33,357	81,633	32,643	78,033
TOTAL	5,217,137	5,580,493	5,397,891	5,688,801	5,313,972	5,582,816
Total population	10,797,630		11,086,692		10,896,788	

*From U.S. Bureau of the Census (1982).

elsewhere (National Research Council 1985), that the 1980 national census net undercount adjustment ratios were less extreme than those for 1970. This suggests that the decision to adjust does make a difference in even 10- and 20-year projections. But, more importantly, the major difference is in whether 1970 or 1980 adjustment factors are used. If the Bureau of the Census delays its publication of 1990 census adjustment factors to, say, 1997, then ODUC and other state demographic centers would be faced with using no adjustment or 1980 factors. This would not be a major problem if 1990 net undercount error is less than 1980 undercount error by the same order of magnitude that 1980 was less than 1970. However, research by Schirm and Preston (1987: 965) indirectly indicated that by 1990 we may not be able to expect substantially lower net undercount errors because "... a necessary but not sufficient condition for adjustment to fail to improve the quality of the geographic distribution is that either blacks are most heavily undercounted where they are least prevalent or whites are most heavily undercounted where they are most prevalent. According to the best available empirical evidence, such patterns of covariation do not prevail."

The results found for the three selected age groups also suggested that both the decision to adjust and the choice of adjustment factors have a substantial impact. Especially important here is the "primary school" age group (5-14 yr), which, by law, must be accommodated by public schools in Ohio and other states. Fulfilling this requirement often takes up to 50% of a state's operating budget and a difference of 38,000 students as found in 1980 between the baseline and the 1970 adjustment scenario can entail a great deal of budgetary debate within and between the executive and legislative bodies of a state government. Similar debates could occur over long-term forecasts used for preparation of capital facilities budgets. Here the debate might concern the interest groups associated with different age groups. For example, the 1970 adjustment factors generated a primary school age population in 2020 that is 1.5% less than the baseline, but an elderly population that is 5.5% greater. Clearly, in this case, advocates for the elderly would favor the use of 1970 adjustment factors,

APPENDIX TABLE B

Net undercount ratios

Age	1970 national net census undercount factors*		1980 national net census undercount factors**	
	Females	Males	Females	Males
0-1	0.97496	0.97301	0.98499	0.98465
1-4	0.96522	0.96144	0.98557	0.98494
5-9	0.97137	0.96813	0.99027	0.98980
10-14	0.98799	0.98568	1.00161	1.00242
15-19	0.99221	0.98475	1.00753	1.00456
20-24	0.98633	0.96967	1.00410	0.98105
25-29	0.96696	0.94045	0.99830	0.96830
30-34	0.97805	0.94765	1.00679	0.97490
35-39	0.98665	0.94187	0.99303	0.95955
40-44	0.99461	0.95258	1.00442	0.96760
45-49	0.98979	0.95468	0.99737	0.95901
50-54	0.99874	0.97381	1.00253	0.96616
55-59	0.98109	0.97029	1.00755	0.97144
60-64	0.97035	0.97226	0.99969	0.97961
65-69	1.02053	1.00806	1.02065	1.00675
70-74	0.99127	1.00166	1.00677	1.00556
75-79	0.93179	0.96321	0.97336	0.99347
80-84	0.93480	0.96871	0.97385	0.99341
85+	0.93097	0.97215	0.97392	0.99341

*From Table E.1 (U.S. Bureau of the Census 1977).
**Derived from Table 1 in Fay (1985).

APPENDIX TABLE C

*1980 Ohio life expectancy by age and sex**

	Females			Males		
Age	Not adjusted	Adjusted for 1970 undercount	Adjusted for 1980 undercount	Not adjusted	Adjusted for 1970 undercount	Adjusted for 1980 undercount
0	77.05	77.50	77.16	69.70	70.05	69.90
5	73.07	73.49	73.16	65.91	66.23	56.09
10	68.16	68.56	68.25	61.03	61.34	61.21
15	63.23	63.65	63.32	56.14	56.46	56.32
20	58.39	58.81	58.48	51.51	51.82	51.69
25	53.56	53.98	53.65	46.97	47.26	47.14
30	48.72	49.14	48.81	42.36	42.64	42.53
35	43.91	44.32	44.01	37.71	37.98	37.87
40	39.17	39.58	39.26	33.10	33.34	33.25
45	34.56	34.97	34.65	28.63	28.85	28.76
50	30.10	30.51	30.19	24.37	24.57	24.48
55	25.81	26.24	25.91	20.45	20.62	20.52
60	21.78	22.20	21.89	16.79	16.93	16.82
65	17.99	18.40	18.10	13.55	13.66	13.55
70	14.50	14.99	14.66	10.79	10.94	10.81
75	11.36	11.91	11.56	8.46	8.66	8.50
80	8.61	9.10	8.79	6.53	6.70	6.57
85	6.54	7.02	6.71	5.00	5.15	5.04

*Data used in constructing the life tables underlying the life expectancy values given here include deaths by age and sex, taken from Ohio Department of Health (1982) and population data from Appendix Table A.

all else being equal; advocates for primary schools would favor the use of 1980 adjustment factors.

We also found that the decisions on adjustment have an impact in terms of strategic planning activities. The use of the 1970 adjustment factors resulted in the highest total population, more males and females, a higher working-age population and substantially more elderly between 1980 and 2030. It also produced, from 2000 to 2080, the lowest school-age population. However, from 2050 on, this scenario produced the lowest total population and the fewest males and females. From 2040 on, it produced the lowest working-age population, and from 2000 on, it produced the lowest primary school-age population.

These findings suggest that the effects of the available alternative adjustment possibilities on short-term, long-term, and strategic forecasting should be examined. Particular attention should be given to the differential in jump-off populations relative to the effects of fertility rates.

In closing, it is recalled that this report has, as mentioned earlier, several limitations, the most important of which is that no attempt was made to examine the effects of adjustment on migration rates. This decision was made for the reasons described earlier. Such an examination of migration is supported, however, by the finding of the pronounced long-term effects of adjusted vs. unadjusted fertility rates. It is highly likely that the decision to adjust or not adjust migration data entails even greater effects. Another important limitation is that only Ohio was studied. However, our findings and suggestions are probably applicable to each state in the industrialized Midwest and Northeast. Further, the general form of our analysis is applicable to every state.

APPENDIX TABLE D

1980 age-specific fertility rates for Ohio resulting from the 1980 population

Age of mother	Not adjusted for undercount*	Adjusted for 1970 national net undercount factors*	Adjusted for 1980 national net undercount factors*
15-19	0.05302	0.05261	0.05342
20-24	0.11702	0.11542	0.11750
25-29	0.11399	0.11022	0.11380
30-34	0.05727	0.05601	0.05766
35-39	0.01625	0.01603	0.01614
40-44	0.00330	0.00329	0.00331
TFR**	1.80425	1.7679	1.80915

*1980 birth data are from Ohio Department of Health (1982).

**TFR = Total fertility rate, which is computed by summing the age-specific birth rates and multiplying the sum by 5 (the width, in years, of the age-interval). The TFR can be interpreted as the mean number of children for each woman going through the childbearing years (15-45).

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