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Alternative Projections of the U.S. Population

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The U.S. Bureau of the Census recently released a set of population projections that include middle and high projections that we argue are too conservative. The projections discount the possibility of future baby booms and assume slow rates of mortality decline and low levels of immigration. In this article we explore the impact on the size and age composition of the U.S. population of alternative scenarios of plausible fertility, mortality, and immigration assumptions. We conclude that (1) the Census Bureau's highest projection might be interpreted as a reasonable middle projection, (2) a reasonable high projection would yield a U.S. population in 2080 some 300 million persons larger than the Bureau's highest projection, with the population 85 and older more than twice the Bureau's greatest estimate, and (3) uncertainty about the pace of population growth is substantially greater than the Bureau's projections suggest.

The U.S. Bureau of the Census recently released a new set of population projections (Spencer 1989). The release of the projections is an important event because, unlike other areas of economic and social prognostication, the field of population forecasting for the United States is dominated by the Census Bureau[1] and the projections provide critical input for many other forecasts[2] and public perceptions about the demographic future of the United States. The first sentence of the Census Bureau's report highlights the salience of their projections: "After 1995, the population may grow more slowly than ever before—more slowly than even during the Great Depression of the 1930's" (p. 1). Our alternative projections indicate, however, that the U.S. population may grow substantially and at rates comparable to the average growth rates of the last 50 years.

Census Bureau projections are conservative because they tend to be heavily influenced by recent trends in fertility, mortality, and migration. That is, they tend to exhibit what Ascher (1978, pp. 53–54) has termed "assumption drag." This conservatism has been criticized by Lee (1974) and Ahlburg (1982) and has been responsible for the Census Bureau's consistently underestimating fertility upswings, overestimating in the downswings (Ahlburg 1982, p. 370), and overestimating mortality (Alho in press; Myers 1981; Olshanksy 1988).

The current set of projections continues the past conservative approach. Fertility rates are assumed to remain approximately constant, with a total fertility rate (TFR) of 1.850 in 1990 declining to 1.800 by 2050. This assumption is "consistent with recent levels of fertility, women's expectations of future births, and social and economic trends tending to maintain low fertility" (Spencer 1989, p. 20). Trends in mortality until 2005 are assumed to be "similar to the observed trends since 1950 except for the unusually rapid period of change during the 1970s" (Spencer 1989, p. 2). After 2005, the Bureau assumes that progress in reducing

mortality rates will be substantially slower because "it will be increasingly difficult to improve mortality conditions for the general population" (Spencer 1989, p. 24). Immigration is assumed to be "similar to the estimated level of net annual immigration in the past several years" (Spencer 1989, p. 2). The Census Bureau assumes net immigration of 0 (lowest), 300,000 per year (low), 500,000 (middle), and 800,000 (high). It is argued that the latter assumption should accommodate most of the concerns about changes in legislation, refugees, and illegals, even though Long and McMillen (1987) concluded that "actual levels of [illegal immigration] may have been such that total net immigration is closer to 750 thousand" (p. 156).

The future paths of the components of population change are very uncertain, and the Census Bureau has tried to capture the spirit of this uncertainty by reporting "reasonable high" and "reasonable low" series that may be thought to provide upper and lower bounds to this uncertainty. We think, however, that actual population levels may rise well past the Census Bureau's highest estimates or fall well below their lowest estimates, especially by 2050 or 2080. Many younger people alive today will survive into the middle of the next century, and some current policy issues, such as Social Security reform and planning for a more racially diverse society, hinge in part on long-run estimates of population size and composition. Hence although we do not question the relevance of long-run projections, we do argue that an appropriately broad range of alternative scenarios should be explored to capture and convey the great uncertainty in such projections.

The population of the United States could be quite small, even zero, by the middle of the next century given the various scourges of nuclear and chemical warfare, AIDS, environmental collapse, and so on, afflicting the 20th century and given the very low levels of fertility prevailing in large portions of Europe. Low-population scenarios deserve attention but are beyond the scope of this article.

Our purpose here is to explore the impact of reasonable assumptions that produce larger populations than projected by the Census Bureau. We think that gains in life expectancy are likely to be significantly greater than those assumed by the Bureau and that the possibility of another baby boom cannot be totally dismissed. In addition, immigration, particularly among those of young working age, is currently higher than the official levels used by the Census Bureau and may increase as the world's population grows, as naturalized immigrants bring in relatives, if legislation changes, and if a labor shortage develops in the United States over the next 5 or 10 years.

In any case, lower mortality, higher fertility, and greater immigration are likely enough that these possibilities should at least be considered in reasonable high projections. The Census Bureau's highest projections, however, assume little decline in mortality, fertility just above replacement levels, and low levels of immigration. As Wolf, Wils, Lutz, and Scherbov (1988) remarked, "the characteristic of all three [fertility, mortality, and migration assumptions] historically has been the occurrence of unexpected events—surprises—especially in the area of fertility. We have no reason to suppose that the future is without surprises" (pp. 22–23).

In this article, we investigate the impact of a range of alternative assumptions on the change in the size and age structure of the U.S. population from 1990 to 2080. We are mindful of Keyfitz's (1981) remark that "relatively short-term forecasts, say up to 10 or 20 years, do tell us something, but . . . beyond a quarter of a center or so we simply do not know what the population will be" (p. 583). We report projections to 2080 because this is the period of the Census Bureau's projections and we want to compare our numbers with theirs. This comparison demonstrates that uncertainty about the distant future is much greater than Census Bureau forecasts indicate.

Beyond this, our concerns are broader than Keyfitz's focus on forecast accuracy. There are three ways to increase population size: higher fertility, greater net immigration, and

lower mortality. To gain insights into the relative impact of these three sources of population growth, it is useful to examine long-run projections. The logic of doing this is similar to the rationale for using life tables or stable population theory to better understand the implications of current demographic rates.

Finally, we want to convey the range of possible future populations for the United States. An understanding of the breadth of possibilities may be helpful to policymakers in designing policies flexible enough to cope with alternative population trajectories and perhaps also in formulating policies that increase the likelihood of trajectories that are considered desirable (Behn & Vaupel 1979). Our basic concern is similar to that expressed by Morrison (1986): if the official set of population projections that critically shapes legislators' views is considered too narrow (or too broad), it is incumbent on other forecasters to present the "plausible range of demographic possibilities" (p. 15).

Alternative Mortality Assumptions

We make three mortality assumptions in the scenarios reported in this article: mortality rates stay at 1987 levels, decline at 1% per year at all ages, or decline at 2% per year at all ages. Crimmins (1981) documented the remarkably rapid progress made in reducing mortality rates from 1968 to 1977. Further rapid progress was made between 1977 and 1982, but the rate of progress slowed after that. At most ages, however, including older ages, mortality rates over the past quarter of a century have been declining at a rate of 1% or 2% per year. The recent research of Himes, Condran, and Preston (1990) on old-age mortality patterns in low mortality countries with reliable data confirms that this has also been the case in other developed countries.

Because mortality rates in the United States are low before the age of 50, assuming higher or lower rates of progress in reducing mortality rates at younger ages makes relatively little difference: what is crucial is the rate of progress after the age of 50 and especially between the ages of 65 and 90 (Vaupel 1986). At these ages it seems reasonable to assume continuing progress at a rate of 1% or 2% per year..

As noted earlier, various kinds of disasters could substantially increase mortality rates: they are ignored here because our focus is on the upper tail of the probability distribution of future population size. The AIDS epidemic will increase mortality rates but probably not by enough to alter substantially the overall pattern of mortality decline. Again, we do not dispute the possibility of a decimating spread of AIDS: our intention is not to hide uncertainties but to highlight them. Hence in examining high-population scenarios, we assume that the AIDS epidemic has a very limited effect.

Another possibility is that progress in reducing mortality rates will gradually slow to zero as life expectancy approaches some maximum attainable plateau. Fries popularized the view that "the median natural human life span is set at a maximum of 85 years" (Fries & Crapo 1981, p. 140). This view, however, is controversial and is not well supported by available evidence (Myers & Manton 1984). Furthermore, as noted by Demeny (1984), an "upper limit to life expectancy may yield to technological change in medicine and to changes in life style, perhaps even within the next few decades" (p. 120).

The Census Bureau discounts the speed of mortality decline in the 1970s when framing the mortality assumptions for their projections, except that the most optimistic mortality assumption has the rate of mortality improvement exhibited during the 1970s continuing for another 20 years. Advances in the biological, medical, and gerontological sciences (Rosenfeld 1985; Walford 1983) suggest, however, that the progress of the last 20 years may continue or even accelerate. In addition, studies by Myers (1981), Manton (1987), Olshansky (1988), and Alho (in press) have shown that, overall, the official forecasts of mortality have been too high and the growth of the elderly population largely unanticipated. Indeed, "too

heavy a reliance on expert opinion seems to have biased the forecasts towards high mortality in the last two or three decades [in the United States]" (Alho in press).

In light of the conflicting theories and evidence about the rates of future mortality change and their importance to Social Security, Medicare and Medicaid, and other programs, we think that it is judicious to admit uncertainty and explore the demographic consequences of alternative mortality scenarios. We present some projections that assume no further mortality progress, but our emphasis is on scenarios with a continued gain of 1% or 2% per year at each age. Two percent progress would produce a life expectancy at birth in 2080 of 100 years for females and 96 years for males. This compares with 85 years for females and 78 years for males in the Census Bureau's middle projection. Their low mortality assumption yields life expectancies of 91 for females and 85 for males in 2080. Our 1% progress scenarios imply life expectancies that fall between these two Census Bureau projections: 89 for females and 84 for males.

In doing the research underlying this article, we also explored numerous intermediate scenarios that allowed mortality rates to decline at different rates at different ages and scenarios that took into account the effects of heterogeneity in frailty (Vaupel, Manton, & Stallard 1979). The projections based on these intermediate scenarios yielded no surprises: they fell between the scenarios of 2% progress and no further progress in reducing mortality rates.

Alternative Fertility and Immigration Assumptions

There are also conflicting theories and evidence about the direction and pace of fertility change. The TFR has risen from 1.842 in 1985 to about 2.0 in 1990. Most of the rise has come from women in their late 20s and early 30s. The cohorts of the baby boom were expected to have childlessness of around 25%. It now appears that this will be between 15% and 18% with TFRs close to 2, implying that the TFRs of the 1980s may be too low for the 1990s. Fertility rates of younger women have, however, been quite flat since 1975. It is here that signs of a new baby boom would be expected to emerge first. The labor force participation rates of young women appear to have topped out, and if a labor shortage of young workers forces institutional change that accommodate work and childbearing, the fertility of young women may rise.

Given this information it is very difficult to read the future path of fertility. In particular, it is not clear whether fertility will stay at roughly constant levels or exhibit marked cycles of boom and bust (Lee 1987). A common view is that fertility will stay below the replacement level, as assumed in the Census Bureau's projections. This assumption would probably be supported by many demographers and economists of the "new household economics" school, even though the empirical basis of this view—Butz and Ward (1979)—has been convincingly undermined (Kramer & Neusser 1984; Macunovich 1990). There is an alternative theory about the likely path of fertility. Easterlin argues that fertility is inversely related to the size of a cohort, largely because the economic fortunes of a cohort are inversely related to its size and fertility is positively related to a cohort's economic fortunes (Easterlin 1987). Although there is substantial evidence on the inverse relationship between cohort size and a cohort's economic fortunes (Berger 1984, 1985, 1989; Lillard & Macunovich, 1988; Welch 1979), the evidence on the effect of relative income on fertility is not very strong (Ahlburg 1989; Behrman & Taubman 1989).

Lillard and Macunovich (1988) predicted that entry-level wages of high school and college graduates will rise from 1985 to 2000 because of fluctuations in cohort size. Assuming that Easterlin's hypothesized link between relative incomes and fertility exists, then a new baby boom peaking at around 2005 is a possibility. Further, if we assume the continuation of the cyclical element in fertility analyzed by Wachter (1975), then this new baby boom will be followed by a baby bust hitting a minimum in 2030 and another baby boom peaking

in 2055 and so on. Ahlburg (1983) discussed the modeling of such cycles in fertility; other recent research on modeling birth cycles includes Wachter and Lee (1987) and Tuljapurkar (1987).

The Census Bureau assumes continued low fertility: a TFR falling slightly from 1.85 in 1990 to a constant 1.8 by 2050 for their middle series and a TFR rising to a constant 2.2 by 2050 for their high series. We also explore a low fertility scenario with a constant TFR at the current level of 2.0. In addition, we explore two possible alternatives on the up side: a moderate baby boom/bust 50-year cycle with TFRs from 1.84 to 2.746 and a big baby boom/bust 50-year cycle with TFRs from 1.84 to 3.2 The peak level of 2.746 corresponds to the average TFR during 1965–1967, the first 3 years after the baby boom, when the TFR fell below 3. The peak level of 3.2 corresponds to the average TFR from 1947 through 1952, the first 5 years of the baby boom, and is considerably lower than the TFRs of 3.6–3.8 that prevailed at the peak of the baby boom, 1956–1961.

Hence although these TFR assumptions are admittedly arbitrary, they are moderate compared with past experience and provide an illustration of the impact of damped fertility cycles on population growth and age structure. Our past inability to predict the direction of change, let alone its magnitude, makes this a worthwhile exercise. For convenience we assume the current age structure of fertility, even though it is known to change with fluctuations in the TFR. This will result in somewhat slower population growth in the upswing and faster growth in the downswing, but it should have relatively little overall impact because the level of cohort fertility is the dominant component of the fertility assumption (Siegel 1972).

Given the extent of "uncertainty as to the future course of refugee movements, possible changes in immigration legislation or border control" (Spencer 1989, p. 2), the uncertain economic future of many developing countries, the possibility of a labor shortage's developing in the United States, and the tendency for naturalized immigrants to bring in relatives (Bean, Schmandt, & Weintraub 1989; Bean, Vernez, & Keeley 1989; Greenwood & McDowell 1986; Jasso & Rosenzweig 1990; Teitelbaum 1986), we made two immigration assumptions: (1) immigration remains at a constant level of 1 million per year, which appears to be close to current levels of official and undocumented immigration, or (2) immigration linearly increases from 1 million to 2 million per year by 2080.

Methods

The projections were made using the cohort-component method of the Census Bureau. Briefly, male and female mortality rates, by single year of age, are applied to the population at the beginning of the period to obtain deaths, age-specific fertility rates are applied to the female population to obtain births, and values for male and female net immigration, by single year of age, are added to obtain the next period's population. For a detailed discussion of the method, see Long and McMillen (1987). The base-period population is that of July 1, 1987. The base-period mortality is the most recently available, adjusted to the 1987 life expectancy at birth. Mortality rates by single year of age from 86 to 120 were taken from Farber (1982). The oldest-old are assumed to die at 120. We assume that the current age structure of female fertility will be maintained and that the imposed baby booms and busts shift fertility rates for this age pattern up and down. The low value of fertility in each scenario is 1.84 and cycles, from peak to peak, are 50 years long. The age and sex pattern for immigration is that supplied by Spencer at the Census Bureau and is based on 1983 data. In our immigration scenarios, immigration is assumed not to affect fertility; this assumption was also made in the Census Bureau's projections.

To summarize: we assume a baseline scenario of no further gains against mortality, a TFR of 1.84, and 500,000 immigrants per year; we assume 1% or 2% reductions in mortality

at all ages per year; we assume three further fertility levels—constant fertility after 1990 at the current TFR of 2.0 as well as baby bust/boom cycles from 1.84 to 2.746 and 1.84 to 3.2, with 25 years from peak to trough; we assume two further levels of immigration—1 million per year and 1 million linearly increasing to 2 million per year in 2080.

The U.S. Population Under Alternative Scenarios

In Table 1 we report projections for 2020, 2050, and 2080, based on the baseline scenario, seven scenarios that capture the relative effects of changes in mortality versus fertility versus immigration, four combined scenarios, and the Census Bureau's middle and high projections of the U.S. population. The last column of the table sheds light on the components of population change by giving the difference between the various scenarios and the baseline in 2080. Some interesting results for the first group of scenarios are as follows:

- Under the baseline scenario, with a constant TFR of 1.84, low immigration of 500,000 people per year, and no further progress against mortality, the U.S. population slowly increases and then declines, reaching 265 million in 2080.
- Baseline fertility and immigration coupled with continued mortality progress at 1% or 2% per year leads to a population of 307 million or 349 million in 2080: lifesaving adds some 42 million or 84 million persons to the population.

Table 1. Projections of the U.S. Population From 1990 to 2020, 2050, and 2080 (in millions, July 1)

Scenario	Year				Difference from baseline in 2080
	1990	2020	2050	2080	
Baseline	250	286	.280	265	—
Baseline except					
1% mortality progress	250	294	307	307	42
2% mortality progress	250	302	333	349	84
Constant fertility (TFR = 2)	250	293	303	309	44
Moderate fertility cycles	250	321	365	426	161
Large fertility cycles	250	339	413	528	263
1 million immigrants	251	306	320	322	57
1–2 million immigrants	251	312	346	380	115
Combined scenarios					
1% mortality progress (TFR = 2, 1–2 million immigrants)	252	329	402	487	222
2% mortality progress (TFR = 2) 1–2 million immigrants)	252	337	430	539	274
2% mortality progress (moderate fertility cycles, 1 million immigrants)	252	359	470	611	346
2% mortality progress (large fertility cycles, 1–2 million immigrants)	252	385	553	811	546
Census Bureau projections					
Middle	250	294	300	292	27
High	252	335	414	501	236

- A continuing TFR of 2.0 has, by itself, roughly the same effect as 1% progress in reducing mortality rates. Baby boom/bust cycles have a much greater impact. The population in 2080 would be 426 million if fertility peaks at 2.746 and 528 million if fertility rises to 3.2 in fertility upswings. Thus sizable baby boom/bust cycles could, by themselves, more than double the U.S. population within 90 years. As Spencer (1989) noted, "fairly small persistent changes in fertility trends obviously can generate huge variations in the future size of the population" (p. 16). Perhaps our baby booms are not "fairly small," but they are cyclical and not monotonic trends.
- The two immigration assumptions also produce sizable effects, with net immigration at a rate of 1 million persons per year adding 57 million people to the baseline population and immigration gradually growing to 2 million persons per year, adding more than twice as many.

The next four scenarios in Table 1 combine various mortality, fertility, and immigration assumptions. We think that a reasonable middle projection might involve continuing progress in reducing mortality rates at a rate of 1% or 2% per year, constant fertility at the current TFR of 2.0, and immigration gradually increasing from 1 million to 2 million people per year. These two scenarios lead to population growth trajectories that bracket the Census Bureau's high projection. We conclude that their high projection might be treated as a reasonable middle forecast.

The two other scenarios presented in Table 1 represent our middle-high and high projections. In both, mortality progress is assumed to run at 2% per year. In the first, there is a moderate baby boom/bust cycle with a stream of 1 million immigrants per year; in the second, fertility cycles reach a TFR of 3.2 and immigration grows to 2 million people per year. The moderate-high and high projections for 2020 are 24 million and 50 million persons bigger than the Census Bureau's high projection. By 2080 our high projection is more than 300 million people bigger than their high projection. A U.S. population of 800 million may seem incredible, but the annual average growth rate that produces it runs at only 1.3% per year. This is the same as the average annual growth rate that has prevailed in the United States over the last half-century and not too much above the 1% average annual growth rate of the last decade.

It is informative to compare the four compound scenarios in Table 1 with the seven individual component scenarios. For about 35 years the results are additive, but after that synergy occurs. For example, by 2080 the scenario of 2% progress against mortality, moderate baby boom/bust cycles, and 1 million immigrants per year results in 44 million more people than the simple addition of the individual components of the scenarios. In a series of alternative forecasts for Europe, Wolf et al. (1988) suggested that the population "consequences of combinations of different assumptions . . . would be, for the most part, additive" (p. 17). Our results challenge this suggestion. The scenarios underscore the fact that not only can population change come from any of the three sources but also the components of population change interact.

Changes in Age Structure

Table 2 summarizes the shifts in the age structure of the U.S. population that would occur between 1990 and 2050 under some selected scenarios. The proportion under the age of 18 falls under all of the scenarios except the two with large fertility cycles. Even under these two scenarios, the proportion under 18 remains at roughly 1990 levels. The proportion between 18 and 65, the so-called working-age population, falls under all of the scenarios, and the proportions 65–84 and above 85 rise under all of the scenarios. The U.S. population is aging and even another big baby boom will probably not alter this strong trend.

The growth of the oldest-old population, aged 85 and over, is so dramatic that detailed

Table 2. Percentage of the U.S. Population in 1990 and 2050 in Various Age Groups

Scenario	Age Group			
	0–17	18–64	65–84	85+
In 1990	26	62	11	1
In 2050 under selected alternative scenarios				
Baseline except				
2% mortality progress	18	52	19	11
Large fertility cycles	28	58	12	2
1–2 million immigrants	21	60	16	3
Combined scenarios				
1% mortality progress, TFR = 2, 1–2 million immigrants	21	56	17	6
2% mortality progress, large fertility cycles, 1–2 million immigrants	26	54	13	7
Census Bureau projections				
Middle	20	57	18	5
High	24	55	15	6

information about this explosion of the extremely elderly is provided in Table 3. Even if there is another baby boom or heavy immigration, with no further mortality progress, the oldest-old proportion grows. The radical increase in this proportion when there is substantial mortality progress but low fertility and immigration, however, reveals the importance of lifesaving at older ages, as highlighted by Vaupel (1986) and Vaupel and Gowan (1986).

The two combined scenarios and two Census Bureau projections in Table 3 indicate

Table 3. Percentage of the U.S. Population Aged 85 and Over

Scenario	Year			
	1990	2020	2050	2080
Baseline except				
2% mortality progress	1.3	3.5	11.0	16.6
Large fertility cycles	1.3	1.6	2.4	1.9
1–2 million immigrants	1.3	1.8	3.1	2.8
Combined scenarios				
1% mortality progress, TFR = 2, 1–2 million immigrants	1.3	2.4	5.7	7.0
2% mortality progress, large fertility cycles, 1–2 million immigrants	1.3	2.8	7.0	8.9
Census Bureau projections				
Middle	1.3	2.3	5.1	5.8
High	1.3	2.6	5.8	6.8

a roughly similar multiplication of the proportion above 85. This proportion approximately doubles by 2020, quadruples or quintuples by 2050, and expands by 5- to 7-fold by 2080. As with population growth, our middle projection more or less parallels the Census Bureau's high projection and our high projection substantially outruns their high projection.

By multiplying the proportions in Table 3 by the numbers in Table 1, we can calculate the growth in the numbers of the oldest-old. For example, under either our middle scenario or the Census Bureau's high projection, the population over the age of 85 increases to 34 million by 2080. Under the Census Bureau's middle projection, there would be half as many oldest-old, some 17 million; under our high projection, the extremely elderly would grow to 72 million. Today just over 3 million people in the United States have reached the age of 85.

Dependency Ratios

Table 4 presents trends in three dependency ratios under our middle and high and the Census Bureau's middle and high projections. The youth dependency ratio is given by the population under 18 divided by the working-age population 18–64. The elderly dependency ratio is given by the population over 65 divided by the working-age population. The total dependency ratio is the sum of the two. The three ratios provide some rough indication of the economic and social cost of children and the elderly.

Children require a different mix of services than the elderly, including more education and less medical care. Furthermore, much of the cost of supporting children is born by parents, whereas the elderly tend to rely on personal savings, pensions, and income transfers

Table 4. Number of Persons Under 18 and Over 65 per 100 Persons Aged 18–65

Scenario	Year			
	1990	2020	2050	2080
Combined scenarios				
1% mortality progress, TFR = 2, 1–2 million immigrants				
Under 18	41	37	38	38
Over 65	20	28	39	44
Total	62	65	77	82
2% mortality progress, large fertility cycles, 1–2 million immigrants				
Under 18	41	51	48	46
Over 65	20	29	38	48
Total	62	80	86	94
Census Bureau projections				
Middle				
Under 18	41	35	35	34
Over 65	20	29	40	44
Total	62	64	75	78
High				
Under 18	41	42	44	43
Over 65	20	30	39	42
Total	62	72	82	84

through Social Security and Medicare. Hence changes in the composition of the total dependency ratio have important financial and social service implications. Sauvy (1969) and Clark (1976) estimated that the dependency costs of supporting an individual aged 65 or over are higher than the costs of supporting an individual younger than 18 years old. Clark and Spengler (1980, p. 74) estimated that the public transfer costs to the elderly in the United States are three times greater than those for young dependents.

As shown in Table 4, the total dependency ratio increases substantially under all four scenarios considered. Our middle projection runs between the Census Bureau's middle and high projections, and our high projection runs considerably above their high projection. There is a moderate increase in the total dependency ratio from 1990 to 2020 under our middle projection and the Census Bureau's middle projection, but there are much sharper increases under our high projection and the Census Bureau's high projection. The jump in the overall dependency ratio under our high projection is attributable to the combined impact of population aging and the new baby boom.

The youth dependency ratio declines under our middle projection and the Census Bureau's middle projection but increases under our high projection and the Census Bureau's high projection. The elderly dependency ratio more than doubles by 2080 under all four scenarios. Furthermore, all of the projections show similar increases from 1990 to 2020 and 2050: the elderly dependency ratio is 2:10 in 1990, 3:10 in 2020, and 4:10 in 2050.

To the extent that the cost of supporting the oldest-old exceeds that of supporting the younger-old, the projections reported in Table 5 imply that the costs of elderly dependency may increase significantly. Scott and Johnson (1988, p. 16) reported that in Great Britain hospital-care costs for those 75 and older are about 10 times the average for those of working age adults. In Japan the per capita in-patient expenditure for those 70 and older is 5 times that for those aged 15–64. The future dependency costs of the oldest-old, however, are quite uncertain because of uncertainties about the future economic well-being and physical health of the elderly (Kane, Evans, & Macfadyen 1989; Manton 1987). In a recent article Crimmins, Saito, and Ingegneri (1989) concluded that although gains in life expectancy between 1970 and 1980 were largely concentrated in the years with disabling illness, the number of bedridden years increased only slightly. Fries and Crapo (1981) argued that general improvements in living conditions, health behavior, and medical care will significantly improve the future health of the aged, but various studies (e.g., Guralnik & Schneider 1987; Lusky 1986; Verbrugge 1984) have challenged this assumption.

Even if there is no change in morbidity or service-use rates, the statistics in Table 5 imply substantial changes in the social, medical, and economic needs of the elderly because of the aging of the elderly population. Under all four scenarios considered, the proportion of the elderly who are more than 85 years old dramatically increases, until by 2050 a quarter or a third of the old are extremely elderly.

Conclusion

The Census Bureau has released a useful set of projections of the U.S. population. The middle series represents their best guess of the demographic future of the United States, and since the "interpretation of middle-variant projections as forecasts has been nearly universal among users" (Keyfitz 1982, p. 196), it is also the series that policymakers and policy analysts rely on. The Census Bureau also identified high and low projections, which are often interpreted as upper and lower bounds to the likely future path of the U.S. population. We argue, however, that their middle and high projections are too conservative because they discount the possibility of higher fertility levels and future baby boom/bust cycles, underestimate the likely rate of progress that may be made in reducing mortality rates, and underestimate the possible size of future immigration.

Table 5. Percentage of Persons Aged 65 and Over Who Are 85 and Over

Scenario	Year			
	1990	2020	2050	2080
Combined scenarios				
1% mortality progress, TFR = 2, 1–2 million immigrants	10	14	27	29
2% mortality progress, large fertility cycles, 1–2 million immigrants	10	17	34	36
Census Bureau projections				
Middle	10	13	22	24
High	10	15	27	30

Since population forecasting is such an uncertain undertaking (Ahlburg 1987; Ascher 1978; Keyfitz 1981; Murphy 1984; Stoto 1983), we introduced alternative assumptions that we think are possible. The implications of these for population projections are dramatic. We hope they stimulate further discussion of the Census Bureau's projections and some alternatives, a discussion that is of considerable interest to demographers and considerable importance to policymakers. We think that the growth of the U.S. population, especially the elderly population and perhaps the population of children as well, and the uncertainty about the pace of this growth may be substantially greater than the Census Bureau's projections suggest.

The Census Bureau and the broader demographic community should strive to capture and convey population trends and uncertainties better, especially in projections that venture more than two or three decades into the future. More controversy about alternative projections and more discussion about shaky assumptions could lead to better forecasts. As reviewed by Land (1986) and Ahlburg (1987a,b), alternative forecasting methods, such as time series analyses (e.g., Lee & Carter 1990), stochastic methods (e.g., Alho in press; Cohen 1986), and nonlinear models (e.g., Tuljapurkar 1987; Wachter & Lee 1987), could also improve understanding about the range of future demographic trajectories. Long and McMillen (1987) reviewed Census Bureau experiments with some of these approaches.

Population projection is not a bloodless technical task, but a politically charged craft of great interest to policymakers and the public. Consequently, it should not be left to a single agency. A livelier competition of alternative assumptions and innovative methods not only would further the development of demographic analysis but also would serve the public interest.

Notes

[1] There are some private companies who forecast population. Among them are Data Resources Incorporated and Wharton Econometric Forecasting Associates. See Ahlburg (1987b) for a discussion of these models.

[2] A distinction is usually made between projections and forecasts. Projections are merely arithmetic exercises that generate hypothetical future populations given a set of assumptions and a starting population. Forecasts are statements about the future that have some chance of occurring: they reflect the forecaster's beliefs about the future. Because the assumptions the Census Bureau chooses for

projections are those thought most likely to bracket the actual behavior of population components, the distinction between population projections and forecasts loses its force. We consider the Census Bureau's projections, particularly the middle series, to be forecasts.

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