Population Problems?

Introduction

Population forecasts have become politically sensitive. Potential "baby-boom" Social Security pressure, increasing senior citizen medical costs, immigration issues, and economic demographics strongly influence many federal policies. Some question whether resources can support our future population, and whether infra-stucture over-loading, pollution, waste, green-house gases, and overall environmental impact loom as increasingly significant problems.

Historically, federal agencies have probably been expected to create objective, unbiased population forecasts and accurate policy models. That is, most hope that these agencies understand the critical objective forecast need, and remain immune to biasing political and business pressures.

But given that key federal agendas, policies, and budget decisions depend on population forecasts and their distribution across age groups, the temptation to bias these sensitive forecasts to suit agendas may be too great. The clearest proof of this is the current raging controversy over whether to apply sampling techniques to the recent census survey to "adjust" for minority undercounting. Undocumented residents pose a potentially huge dilemma, in many ways, as we shall see.

Other potentially biasing forces exist as well. High population forecasts may spur environmentalists and low-growth advocates to influence federal policies toward lower growth rates. Low forecasts may alarm businessmen that depend on growth for increased product demand, and for an adequate labor pool to keep labor costs down. Businessmen also welcome higher immigration rates to increase the available domestic labor supply.

Is there evidence that federal population forecasts and policy models are biased? How do we ensure that our forecasts and associated policy models represent responsible federal efforts? It's important to examine these for biased, slanted results.

An objective population statistics analysis might indicate bias likelihood. This article reports just such an effort, including some suggestion that some publicized federal policy models may be suspect. Hopefully this provides readers with a basis for ferreting out the most accurate future view, and for better evaluating federal policy models.

Summary Findings

Table 1 shows the year 2050 population forecasts generated using this study's various models. In addition, the three Census Bureau series: Low, Middle, High, are shown for comparison purposes. The Half Death Rate Age Segment Model forecast altered the basic Age Segment Model by halving the death rate. The Undocumented Immigration

Model altered the Growth Model to include 5 million undocumented immigrants a year per the Census Bureau 1996 estimate . Both of these were used to estimate forecast sensitivities to changing assumptions that may have some validity. As can be seen, total population is extremely sensitive to undocumented immigration. Further key findings can be found in the respective model sections.

While the year 2050 may seem a long way off, in 2050, today's youth, our children, will be joining the elderly ranks. And their children, our grandchildren, will still be in the work-force. In this light, it does not seem so far off.

Table 1: Year 2050 Population Forecasts

Forecast (Millions)	Source
282	Census Bureau Low Series
394	Census Bureau Middle Series
400	Age Segment Model
440	Half Death Rate Age Segment Model
447	Growth Model
480	Birth Death Immigration Model
519	Census Bureau High Series
828	Undocumented Immigrant Model

The U. S. population is growing exponentially.

As can be seen, the Age Segment Model corresponds fairly well to the Census Bureau Middle Series. But only the High series reflects growth rates observed during the Twentieth Century. But none of the Census Bureau series consider the enormous impact and source for errors caused by undocumented immigrants. The sheer magnitude of forecasts that can be generated by extrapolating federal estimates should be a serious cause for alarm. This may be mitigated some by the births of children of undocumented immigrants, who are citizens and may be counted in the birth rate. But it also yields a source of concern and confusion.

What should be equally alarming is that this population growth will be concentrated in a few metropolitan areas, placing even more strain on infrastructure.

The Age Segment Model Section also provides information on the aging of America as a result of the Baby Boom. While population increases in the older age segments become evident, the significance seems lower than some seem to be implying. According to these models, if federal population forecasts included a continuing death rate reduction, their forecasts should be higher than they are.

As a further check for increasing aging population pressures, the Age Segment model was used to compare the elderly segment (65 and older), the workforce segment (20-64) and the total population through 2050. As a percentage of the Working Age segment, the elderly segment increases slightly from today's 22% to 25%, before dropping to 24%

by 2050, hardly a shocking increase. As a total population percentage, the Working Age segment fluctuates between 57-59%, once again hardly a shocking change.

Depression, inflation, prosperity: what affects the growth rate most? Given the Century's data, depression has the most significant growth impact, perhaps explaining the Census Bureau's Low series.

Methods and Models

This study examined the available Twentieth Century population statistics, approximately the last 100 years, from the following sources:

- U. S. Census Bureau, *Statistical Abstract of the United States: 1999*, (119th edition), Washington, D. C., 1999 (primary reference, other editions used also)
- U. S. Census Bureau, *Historical Statistics of the United States, Colonial Times to 1970, Bicentennial Edition, Part I*, Washington, D. C. 1975
- U. S. Immigration and Naturalization Service, *Immigrants, Fiscal Year 1998*, Washington, D. C., 1998

Aggregate population, birth, death and immigration statistics were examined for "strong, persistent signals" that might predict future population. Two forecasts were generated from these statistics: one based on aggregate growth rates, and one based on birth,

death and immigration rates. These population statistics were then examined using age based segments, yielding another population forecast. These forecasts were extended to the year 2050, matching federal population forecasts. The age segment study also looked at the future age segment populations, examining the future "Aging of America".

Simple, non-parametric, graphic-based exploratory data analysis visually displayed the data. This permitted observing changes and significant, constant "signals" (spanning the last thirty years or so) that might reasonably forecast future population statistics. This approach uses the "IOTT: the Intra-Ocular-Trauma-Test". If a "signal" stands out clearly, "hitting you right between the eyes", it is probably significant, worth understanding, and predictive. Such robust signals typically permit generating sound forecasts. If detecting some signals requires more sophisticated statistical analysis, they may not be quite so robust, requiring more validating analysis.

Causality and predictability questions always accompany forecasts: are these signals valid for predicting the future? Will sudden and unpredictable future events invalidate these signals? The forecasts made here assume a continuation of the current national "state of affairs" of the last 20-30 years. The signals used seemed to remain valid during an interval during which the U. S. experienced high inflation, recession and boom, but not a major depression. They should be strong enough to survive similar future conditions. This forecast did not predict altering future events. But there can be no doubt that some past (and future) details can only be explained by more thorough examination of economic, social, and legislative events. This goes beyond the author's intent. Readers

are invited to delve into our economic history and past legislative events where their curiosity is piqued.

The Growth Model

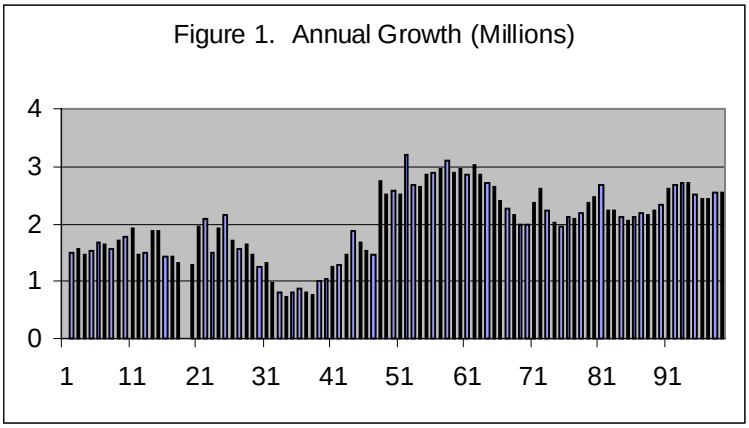


Figure 1 shows the annual Twentieth Century population growth. Annual population growth is the increase in population from the prior year. The most noticeable growth variations were during the Great Depression and the post-World War II baby boom. Since the Seventies, growth has remained above 2 million per year, and appears to show an increasing trend, suggesting exponential population growth. A reasonable conclusion from the Century's data is that population growth increases during prosperous times and decreases during depressed periods.

Over the century, the American population almost quadrupled from 76 million to over 270 million, ranking third among global nations behind only China (1.25B) and India (1B), and

ahead of Indonesia (216M), Brazil (172M), Russia (146M), and Pakistan (138M). Other countries worth noting are Japan (126M), Mexico (100M), and Canada (31M).

According to 1996 statistics, 80% of all Americans live in urban areas. Only 1.7M live in non-urban areas of 100,000 or less. In all, 56% live in 47 cities of 1M or more, and 73% live in cities or 250K or more. Excluding Alaska, the American population density is about 90 people per square mile, and 350 per sq. mi. in urban areas. These densities can be compared to the global density of 118/sq. mi, Australia (6), Germany (188), France (280), UK (634), Brazil (53), China (346), Mexico (135), and Russia (22).

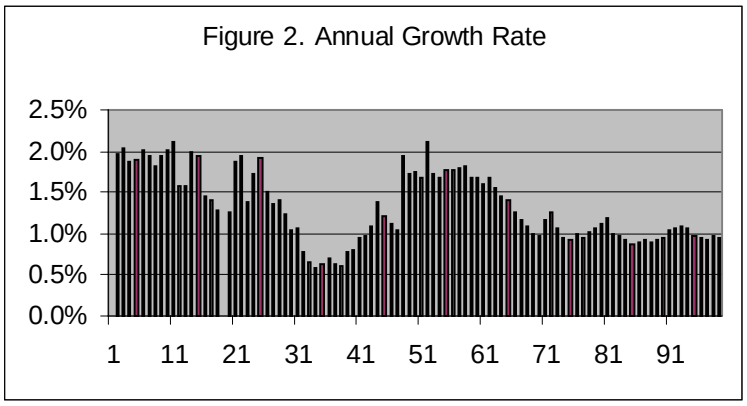
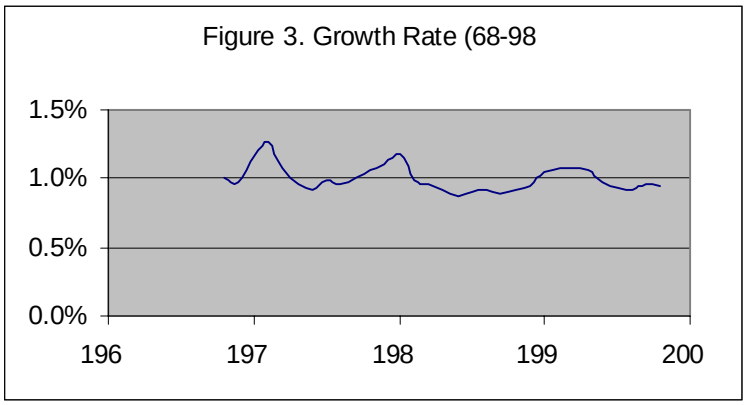


Figure 2 shows annual growth rates. The annual growth rate is the population increase as a percentage of the prior year's population. No trend for the entire century seems evident. The most significant interval was the growth rate decline during the Depression, representing the century's lowest growth rates and a sharp decline from pre-Depression rates. The other obvious feature was the "baby boom" era from the late Forties through the early Sixties. But this era seems more of a return to pre-Depression growth than an

unusual post-war growth rate. Actually, the growth rate increased during World War II to well above Depression levels before the post-war “baby-boom”. After the baby boom, growth rates seem relatively constant, with short, small cyclic increases. These cycles occurred on roughly a twenty year cycle, which may reflect a baby boom generational ripple occurring every consecutive generation. One reasonable question is why the growth rate declined from baby boom levels in the late Sixties? One answer may be the declining child-bearing capacity of the post World War II population. Another may be the advent of the birth control pill. And another is the increased transition from a rural agrarian society to an industrialized urban one, where large families became less economically advantageous.

As can be seen in Figure 3, growth rates for the last 30 years seem relatively constant, with a slight upward trend since the mid Eighties. If this trend continues, it will be very significant.

The growth rate has not been below .9% since the Depression, the last 60 years, and was well above that in prior years. Over the last twenty years, the annual growth rate has fluctuated between roughly .9% to well over 1%. The recent constant growth rate suggests exponential population growth. This does not bode well for those concerned that our population is growing too fast, or that our population growth will remain within reasonably stable, sustainable levels.



If the approximate .97% growth rate is used to forecast Year 2050 population, the population will be 447M, about a 60% increase. An .8% growth rate yields a 410M population, and .9% yields 430M.

There were an estimated 5M 1996 undocumented immigrants, apparently reflecting levels during the entire period of 1982-1996. If this annual undocumented immigrant rate is added to this model, the result is an 828M population, more than a tripling of the official population and density in only 50 years.

In this light, the Census Bureau forecasts seem conservative.

The Birth, Death, Immigration Model

Aggregate population changes result from births plus immigration minus deaths. Americans immigrating to other countries represent a negligible population fraction.

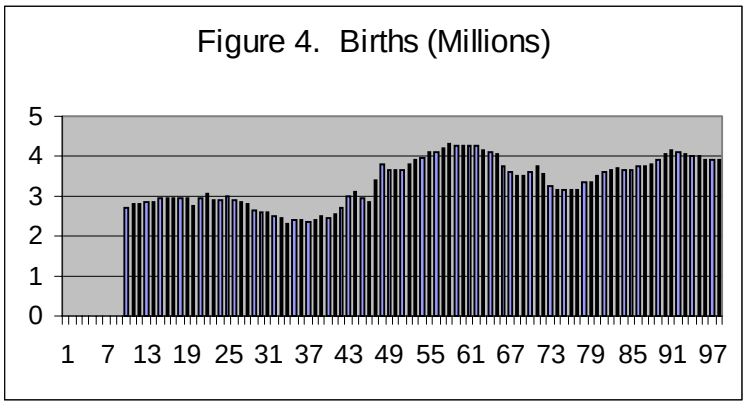


Figure 4 shows the available data for annual births. The steadily increasing trend indicates exponential growth. Key eras to note, once again, were the Depression and the Baby Boom.

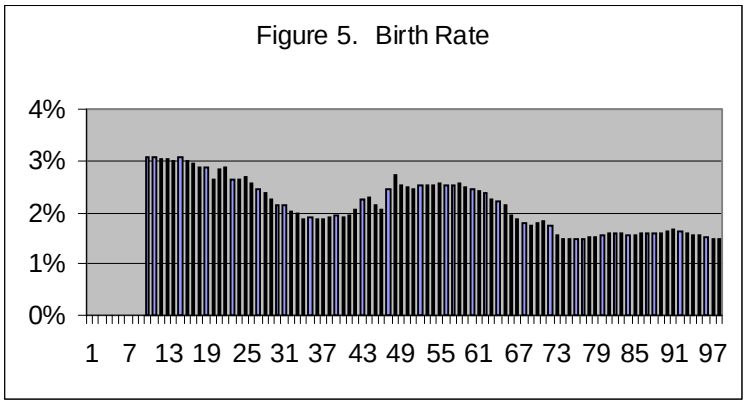


Figure 5 shows the annual birth rate, and shows a noticeably different story than the previous figure. The birth rate dropped markedly during the Depression. During the Baby Boom era the birth rate rose from Depression levels, but did not reach the pre-Depression rates. The key point for our purposes is that the birth rate has remained relatively

constant for the last 30 years, between 1.5% and 2% for most of the years, as Figure 6 shows.

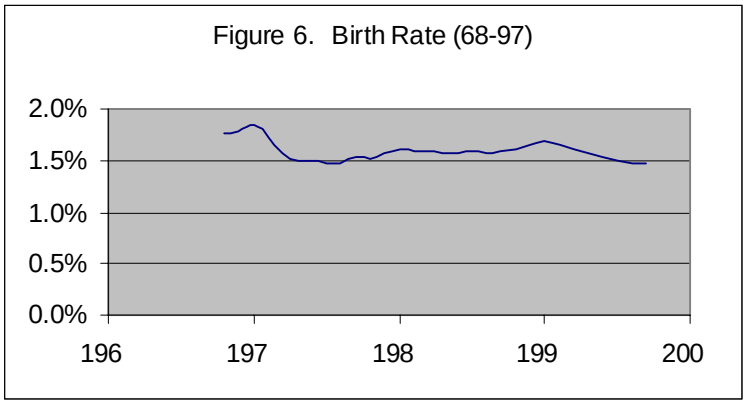


Figure 7 shows annual deaths according to the available data. As can be seen, deaths have been steadily increasing.

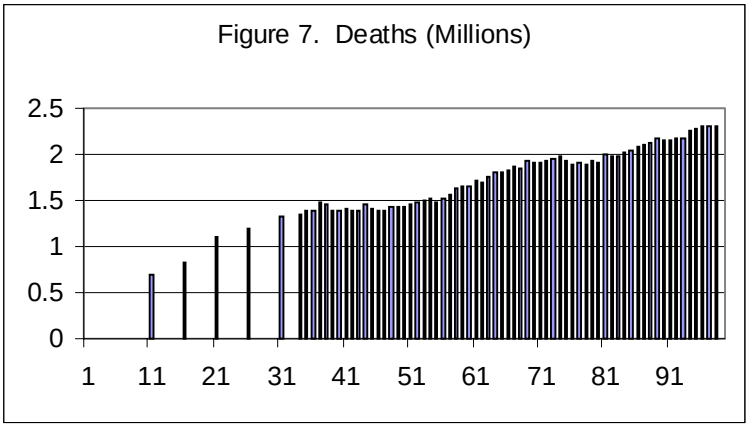
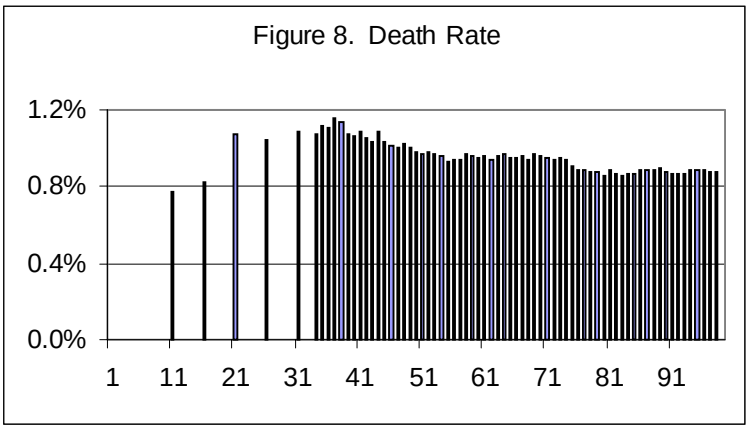


Figure 8 shows the annual death rate. As can be seen, the death rate has decreased over the last sixty years, but has remained relatively constant over the last twenty-five years.



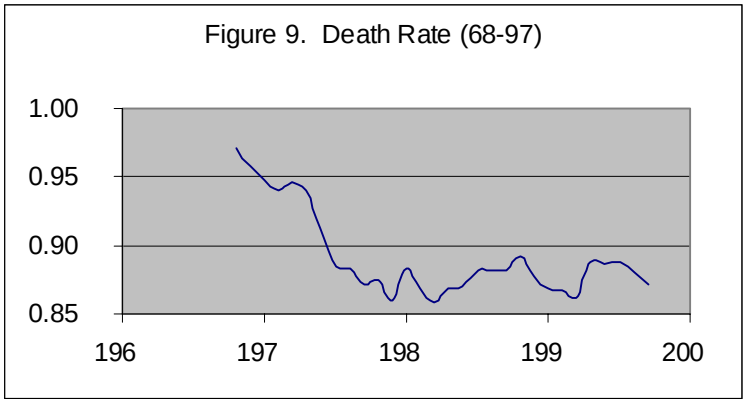


Figure 9 shows the death rates for the last thirty years, confirming the relative constancy for the last twenty-five years. This scale shows a seemingly sharp death rate decrease in the early Seventies, which may reflect the Vietnam War's end.

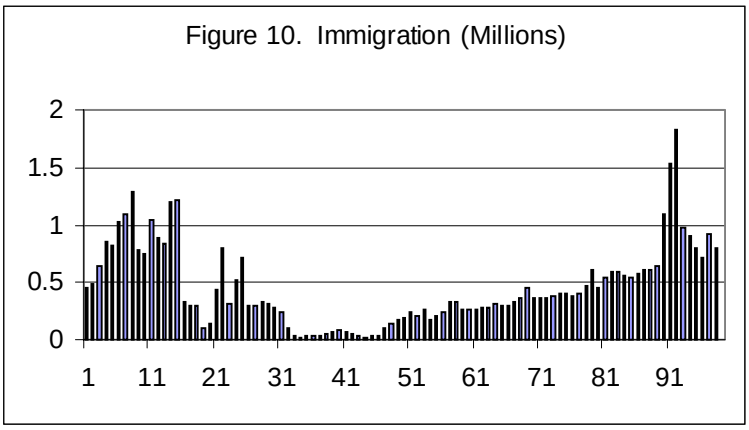


Figure 10 shows annual immigration. High during the century's beginning, it dropped precipitously during World War I, the Depression and World War II, and has been steadily rising ever since, approximating or exceeding the early century rate. The large, short-term early 90's increase probably reflects immigration legislative changes.

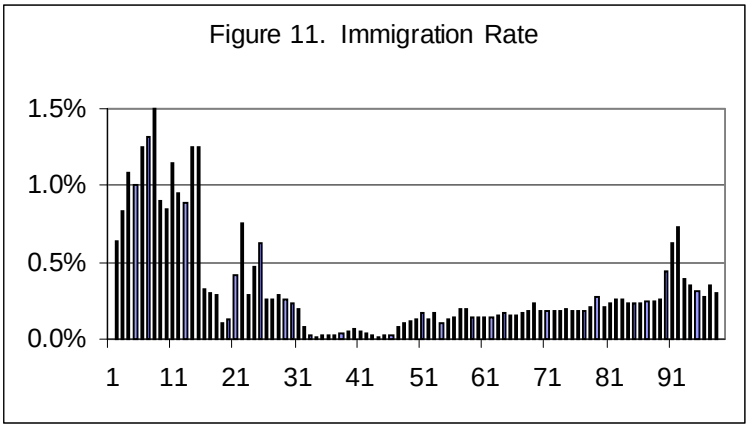


Figure 11 shows annual immigration rates. This chart shows that while recent immigration rates have not approached those during the Century's early years, they have been steadily increasing since WWII.

When a birth rate of 1.57%, a death rate of .87% and an immigration rate of .3% are used to forecast population, the population is projected to reach 480 million by 2050, a number that compares reasonably well with the growth model forecast.

Undocumented 1996 immigration has been estimated at 5 million. There has been little indication that number has dropped since then. If undocumented immigration is estimated to add an additional 3 million a year to the population, the forecast for 2050 increases to just under 700 million. If 5 million a year is assumed, the 2050 population 2050 jumps to 828 million, roughly triple today's population. This shows the dramatic impact that undocumented immigration can have if continued at recent estimated levels.

The Age Segment Model

Figure 12 shows the annual population breakdown by age segments. These categories were chosen because they most clearly demonstrate distinct age segments for study purposes. The available data provided more, smaller age segments, that were too "noisy" and too detailed to reflect clear, distinct "signals" as with these segments. The segments used resulted from grouping smaller segments exhibiting similar characteristics. This figure shows the rippling effects of the reduced birth rate during the Depression and the increased birth rate during the baby-boom era. The baby-boom impact can be seen rippling through the age segments, first with the young, then the young adults, and then the middle-aged adults. The senior category can be seen to be steadily

increasing, with the baby-boom impact yet to arrive. Interestingly, the youth bracket can be seen to be returning to baby-boom levels.

Figure 12. Age Segments (Millions)

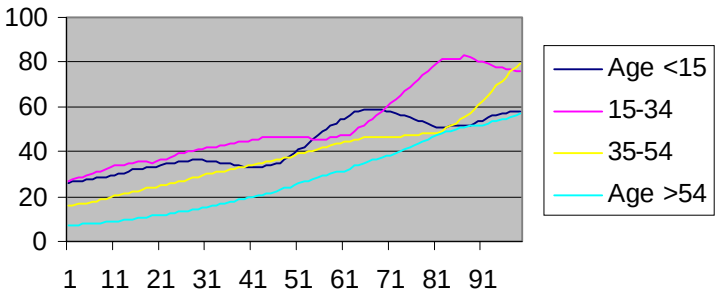


Figure 13. Age Segment Percentages

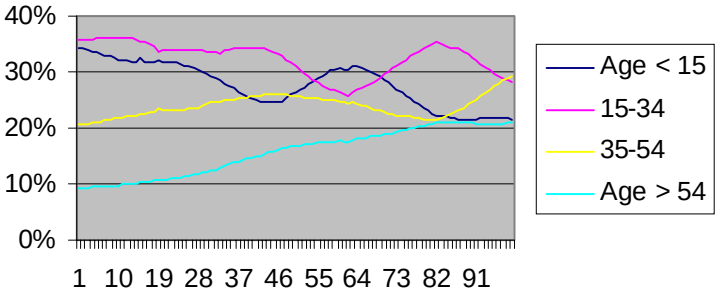


Figure 13 shows the age segments as percentages of the total population. The same rippling affects can be seen here, but the senior segment seems to be the most stabile and least volatile, so far. Most striking is the crossover between young adults and middle-aged adults. They are now fairly comparable. The young segment has remained a steady population percentage since the early Eighties.

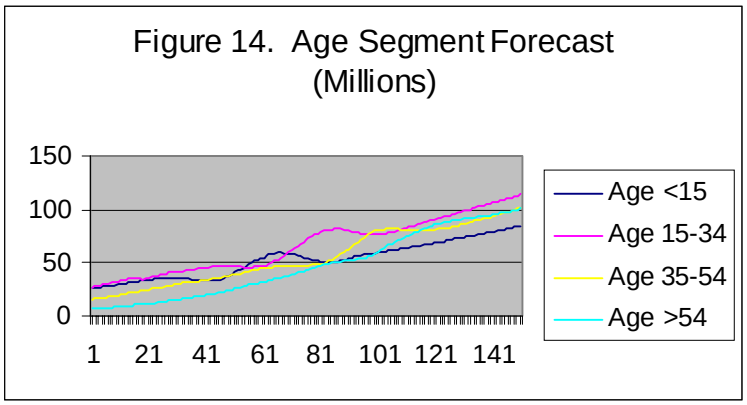


Figure 14 shows the age segments forecast out to the year 2050. This chart shows how the baby-boom ripple will play out by roughly 2030, and then the age segments remain fairly constant in proportion to the total population.

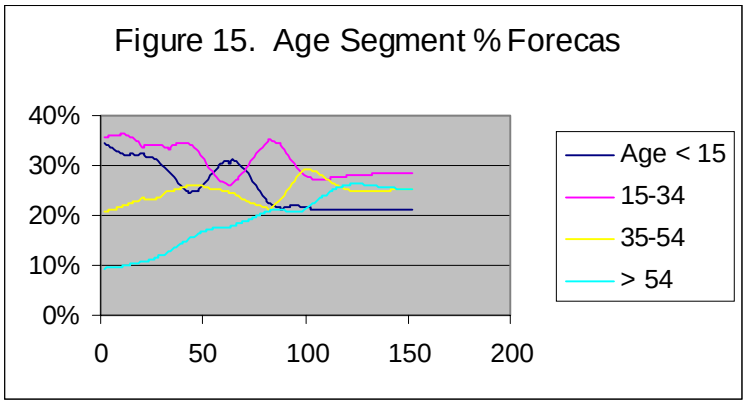
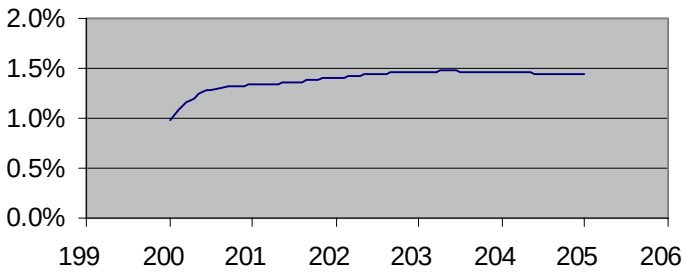


Figure 15 shows the age segment population percentages through 2050. As can be see, the relative segment percentages stabilize by 2050.

When these age segments are used to forecast 2050 population, using immigration and death statistics available for each segment , the 2050 population is forecast to be 400 million, which is very close to the Census Bureau Middle Series forecast. This raises the obvious question of why this forecast is lower than the previous ones. The answer lies in the fact that the aggregate death rate increases as the population ages and more older Americans experience a much higher death rate, as shown in Figure 16. The death rate increases sharply during the next 10-15 years, and then increases further to roughly a 50% higher rate by the year 2025, at which point it becomes more constant.

Figure 16. Death Rate 2000-2050



If the death rate is cut by half, the population forecast increases to 440 million.

Aging America Impacts?

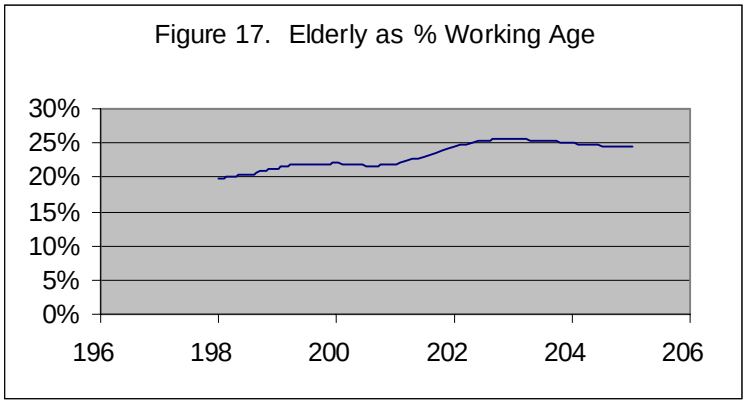
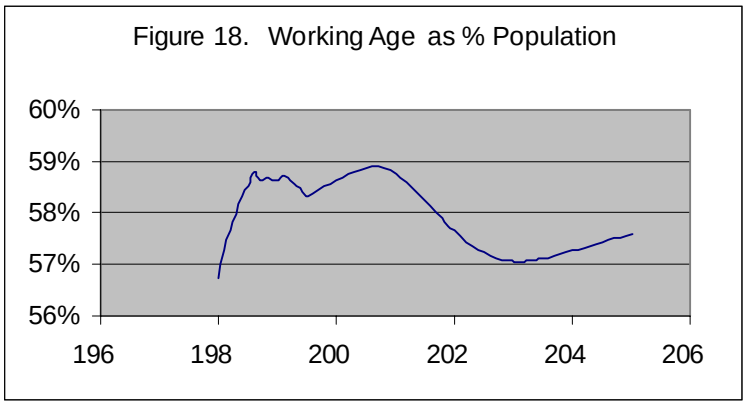


Figure 17 shows the elderly (65 or older) as a percentage of the total workforce age segment (20-64). As can be seen, the percentage rises during the next thirty years, but only slightly more that it rose during the last twenty years, and then shows some decline. While this may represent an increased burden on the workforce, it hardly seems the catastrophic outcome some portray for Social Security pressures. It's hard to imagine today's Trust Fund balance depleted by such a marginal rise, but this requires another study. What will happen is increased pressure on the Federal government to spend within current receipts excluding Social Security.



To check this sensitivity, Figure 18 shows the workforce segment population percentage through 2050. While the scale suggests wild swings, the total range is within 2% (57-59%). Interestingly, after a rise due to “baby-boomers”, there is almost a 2% decline, but this is short lived as the percentage begins steadily increasing beginning about 2030. This hardly portrays an alarming shift. Besides, as long as salary and income exceed the CPI Index, and healthier seniors remain in the workforce longer, increased Social Security receipts could increase more than payouts.

According to these models, if federal population forecasts included a continuing death rate reduction, their forecasts should be higher than they are.

With an assumption that the death rate suddenly becomes reduced by half across all age segments, which impacts older age segments far more than younger ones, the elderly segment only increases to about 30% of the workforce, which is still below what some

might consider cause for alarm. Besides such an assumption seems an extreme test of future conditions.

Conclusion

These population forecast models provide some alternative data points for evaluating the forecasts and policy statements issuing from the Federal government. As a check point, they should provide useful data for questioning and challenging future Federal forecasts and policy predictions. In addition, they may inspire some to take a closer look at expected growth rates and significant factors, and compare them to sustainable growth rates.

About the Author

Wayne Bowen has over thirty years in Information Technology, and has been involved in numerous strategy, planning and forecasting studies. For a number of years, he was in the commercial insurance industry, where he pioneered new techniques for data acquisition, data analysis, and forecasting. In addition, he briefly resided in Washington, D. C. as a telecommunications consultant. He holds a B. S. in Math from the University of Kentucky, an M. S. from the University of Chicago in Information Science, and an MBA from the University of Chicago in Finance, Management Science, and Behavior Science.