2007 Technical Panel on Assumptions and Methods

REPORT TO THE

SOCIAL SECURITY ADVISORY BOARD

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Charter

The Panel of expert actuaries, economists and demographers appointed by the Social Security Advisory Board is charged with providing technical assistance to the Board by reviewing the assumptions specified by the Board of Trustees of the Old-Age and Survivors Insurance Trust Fund and the Disability Insurance Trust Fund and the methods used by the Social Security actuaries to project the future financial status of the funds. Specifically the Panel is asked to:

- Review the assumptions regarding key demographic factors, including mortality, fertility, immigration and disability incidence and termination.
- Review the assumptions regarding key economic factors including productivity, real wage growth, real net rates of return and variations in net rates of return (including equity returns), consumer price increases, labor force participation, and rates of employment and unemployment.
- Review and assess the projection methodology including other methodologies currently in use.
- Review in particular the trends in the earnings to total compensation ratio in light of the changing structure and cost of employee benefits including pensions, health and disability insurance.
- Review and assess the status of the recommendations of the 2003 and 1999 Technical Panel(s).

Introduction

For the third time since 1999, the Social Security Advisory Board has appointed a Technical Advisory Panel to examine the assumptions specified by the Board of Trustees and the methods used by the Office of the Chief Actuary each year to project the future financial status of the Social Security trust funds.

The Advisory Board has invited some of the best actuaries, demographers, economists, and statisticians in the United States to provide an independent review of the very complex and important work that goes into the annual Social Security Trustees Reports. This report is the culmination of more than a year-long effort, begun in August 2006, to offer critical yet constructive recommendations on how to improve policy makers' and the public's understanding of the long-range future of the Social Security programs.

Our report makes some sweeping recommendations on many of the methodologies employed by the Office of the Chief Actuary, as well as suggestions for significant changes of several of the Trustees' assumptions, particularly immigration and mortality. The Panel recommends that more emphasis be placed on explaining the inherent uncertainty of the long-range projections and suggests adopting the use of asymmetrical risk for several of the estimates.

We believe the Trustees and actuaries must place a higher priority on more comprehensive estimation techniques, and greatly expand the use of methods that will help explain behavioral responses to policy changes as well as allow more thorough analysis of outcomes on particular populations.

We also recommend that the documentation of the methods presently used by the Office of the Chief Actuary, begun this year as part of a required audit, be continued and expanded. In addition, data employed in the estimation process needs to be made public (with appropriate safeguards for confidentiality). Ultimately, analysts outside the Social Security Administration should be able to nearly replicate the estimates produced in the annual Trustees Reports. Only then will the larger community of interest be able to contribute to the evolution of techniques to accomplish this very daunting task...producing economic and demographic projections for the next 75 years.

This report reflects the dedicated work and well-considered recommendations of the entire Technical Panel. This report is truly the result of a group effort, and represents a consensus born of mutual respect and patience over the course of many months. Beth Soldo, Eric Stallard, and Shripad Tuljapurkar provided guidance and drafting for the sections on demography. Mary Daly and Deborah Lucas did much of the work on disability, labor force participation, and interest rates, as well as other economic issues, and provided assistance with drafting and editing. Robert Gordon contributed the sections on productivity, real wage growth and inflation. Jeff Passel guided us through the immigration thicket—and some of his work has already been adopted by the Trustees. William Hsiao and Steve Lieberman provided the insight and inspiration for much of our discussion of methodology, with substantial contributions from everyone on the Panel.

Our work would not have been possible without the patient tutoring of the Social Security Administration's Chief Actuary, Stephen Goss, and the many capable people working with him including Deputy Chief Actuaries Alice Wade (long-term) and Eli Donkar (short term), as well as Al Winters and Pat Skirvin. All of the projections in this report were provided by the Office of the Chief Actuary.

We consulted several experts in the use of alternative long-range projection methodologies and would like to thank John Sabelhaus and Noah Meyerson of the Congressional Budget Office's Long-term Modeling Unit; Martin Holmer of the Policy Simulation Group; Howard Iams, David Pattison

and Clark Burdick of the Social Security Administration's Office of Research Evaluation and Statistics for their generous insight and assistance. Joyce Manchester, who was then the director of the Social Security Administration's Division of Economic Research, was especially generous in lending assistance to the Panel on numerous issues including modeling methodology.

The Panel is also grateful for the assistance of Professors Ron Lesthaeghe, Hans-Peter Kohler, and S. Philip Morgan who took time from their busy schedules to conduct a one day symposium on the topic of the long-range future of fertility trends in the United States. Professor Mark Duggan helped the Panel gain a better understanding of trends in disability while Dixie Sommers, an Assistant Commissioner at the Bureau of Labor Statistics briefed the Panel on that agency's methods for projecting labor force participation.

The Panel benefited greatly from frank and spirited conversations with the two Public Trustees of the Social Security Board of Trustees John L. Palmer and Thomas R. Savings. Their liaison from the Social Security Administration, Mike Leonesio, was very helpful in setting up that meeting. The Panel also appreciates the opportunity to brief the numerous public servants who make up the Trustees' working group chaired by Treasury Department Assistant Secretary for Economic Policy Phillip L. Swagel. Jim Duggan, senior economist at the Treasury Department greatly facilitated that meeting.

In an effort such as this, there are always a great many who contribute, but none more so than Joel Feinleib, the Panel's Executive Director, and the Advisory Board's staff economist. We would like to thank the entire staff of the Social Security Advisory Board for their excellent support.

Finally, the Panel acknowledges the work of the 1999 and 2003 Technical Panels. We studied their reports, consulted some of their members, and examined the progress on the recommendations they had made. We have reiterated some of their previous suggestions that have not yet been implemented.

-Dan L. Crippen, Chair

Executive Summary

The Social Security actuaries and the Trustees of the Old Age, Survivors, and Disability Insurance (OASDI) trust funds have perhaps the most difficult analytical task in government—projecting demographic and economic developments over the next 75 years.

The operation of the Social Security system is determined by several key demographic and economic variables including: fertility, mortality, immigration, disability, labor force participation rates, unemployment rate, real wage growth, consumer price index (CPI) growth, and the real interest rate.

In order to project these variables into the future, the Office of the Chief Actuary (OCACT) must have models, implicit or explicit, for each variable, and one or more assumptions must be made to reach ultimate conclusions. As with any analytical exercise, the assumptions, the models, and the methodology to estimate the model parameters are all critical elements of the process.

Methodology

We chose to begin our report with observations on the methods and data used by OCACT and the Trustees, rather than on specific assumptions, for several reasons. The most obvious is that a change in method might have a more lasting impact on future projections than a change in any particular point estimate we could recommend. It is quite easy, in fact, to take narrow issue with any particular estimate, but more difficult to understand and examine the methods used to produce it. Because of the inherent uncertainty in long-range projections, the validity of the estimation process is arguably as important as any specific result.

The methodological challenge is to assess the financial soundness of the Social Security program. The future income and cost of Social Security must be estimated in such a way that allows the Trustees to: (1) examine the likely financial results of the system, including: year-by-year cash flows, the annual balance in the trust fund, and the actuarial balance at the end of the 75-year period; and, (2) describe the uncertainty of the forecasts. In addition, policy makers and the public may also wish to understand the distributional impact of any proposed change to the Social Security program. Technical experts may also wish to evaluate the reasonableness of the variables that are used to forecast the future financial changes, particularly the interaction and consistency between the different economic, social and demographic variables.

The state of actuarial science appears to be rapidly evolving beyond the cell-based models generally employed by the Social Security actuaries, to more explicitly incorporate interactions between economic and demographic variables and to better understand the uncertainty in the projections. The increase in computing power alone makes possible many analyses that were previously impractical, and allows additional data to be incorporated.

New data sources are also emerging. Recent research using longitudinal data such as the Health and Retirement Survey (HRS) and the Survey of Income and Plan Participation (SIPP) linked to micro-level Social Security earnings data have yielded significant insights on disability, health and retirement dynamics. This potent combination—advanced computing, more and better data, and new methods—holds the prospect of significant advances in the analysis required for social programs and their associated trust funds.

Many of this Panel's methodological recommendations—transparency, the use of micro-simulation and stochastic analyses, specifying and estimating interactions, employing additional data—are not new. Previous Technical Panels and other experts have made similar recommendations. What is new, perhaps, is that the actuaries have made some prog-

ress on many of these fronts. There are reasons to be impatient, however. New computing power, new sources of data, and new estimating techniques should allow OCACT to make faster progress in advancing their models and methods. Indeed, others within government, ranging from the Office of Policy within the Social Security Administration (SSA) to non-executive branch agencies such as the Congressional Budget Office (CBO), are exploiting these developments and creating the means to analyze the system and its response to change. Only by aggressively deploying new data and techniques and by making the process more transparent can OCACT and the Trustees remain the definitive source-of-record for this information.

There also appears to be an understandable reluctance by the Trustees to make significant changes to their projections in any given year. Rather, methodological changes that produce significant changes in point estimates are phased in, or offset with changes in other variables. Nonetheless, the Actuarial Standards of Practice, specifically Standard No.32: "Social Insurance"[1], suggests that new information should be incorporated when it is found, even if such information creates some discontinuities in the forecasts: "The actuarial assumptions, both individually and in combination, should reflect the actuary's best judgment, taking into account anticipated future events affecting the related social insurance program."

While OCACT is exploring new ways of augmenting their traditional methods, the adoption appears to us to be slow. Recommendations of previous advisory panels seem to have languished. As a result, important information in the estimating process may be lost. What follows is a series of comments that generally apply across the set of variables for which OCACT makes projections.

A. Transparency

Throughout this report we call for more transparency in the models and data the actuaries use, as well as the assumptions that drive their results. This recommendation is perhaps the most important one we can make. Only with more transparency can other social scientists interested in retirement, Social Security, and the various related issues, bring their intellect to bear on the many complex questions the Trustees and actuaries face. Only by a clear articulation of their assumptions can the actuaries' work be truly examined, and only by a clear understanding of the nature of trust fund accounting can the public be assured of the veracity of statements made about the program.

It is worth noting that all analytical agencies, whether the National Aeronautics and Space Administration (NASA), CBO, or OCACT, must make assumptions about behavior or phenomena that are unobservable or immeasurable. In the process, the assumptions become deeply embedded and the models closely guarded; and these agencies are understandably reluctant to revisit their assumptions or reveal methods. Nonetheless, it is essential to do so. First, accountability requires it—such is the nature of the nascent documentation external auditors recently required of OCACT. Second, and more important, ongoing comprehensive, external review can greatly assist the quality of the analytical exercise.

Transparency of the OCACT models will require several developments: (1) providing more comprehensive documentation, (2) making data from SSA records more available, (3) creating explicit models where none exist, and (4) clearly explaining the processes employed. The ultimate test of transparency is whether the actuaries' results can be essentially replicated.

To this end, we recommend that the Social Security Advisory Board, to whom this Technical Panel reports, should hold semi-annual meetings with OCACT to discuss progress on the various recommendations contained in this report as well as those from previous panels.

B. Uncertainty

The current approach to uncertainty of projections in the Trustees Report, using high-, medium- and low-cost "scenarios" or "variants" to indicate the range of plausible outcomes is a traditional one whose limitations are well-known. The current practice of assuming that all variables could simultaneously move in a low- or high-cost direction produces estimates that lack both an intuitive and a statistical interpretation. The temptation to assign probabilities to the scenarios or to suggest their degree of likelihood should be resisted. Previous Technical Panels have consistently drawn attention to the limitations of the variant approach. For example, the 1999 Technical Panel noted that using high and low alternatives: (1) assumes trajectories are always high or always low; (2) combines trajectories of various assumptions in rigid ways, for example, all are set at their high-cost value simultaneously; (3) ignores that different aspects of

[1] Actuarial Standards Board, "Actuarial Standards of Practice No. 32: Social Insurance," January 1998.

the high and low scenarios have different levels of uncertainty, and (4) does not assign any probability to the forecast ranges.[2] We offer one additional observation: there is no requirement for symmetry of uncertainty—that the forecast be plus-or-minus an equal amount along the projection. Indeed, many key drivers have asymmetrical uncertainty as succeeding chapters will show, and the nature of the uncertainty may well change with the forecast horizon.

Stochastic analysis, on the other hand, produces uncertainty bands that are much easier to interpret. Critically, stochastic analysis can incorporate correlations between variables, and allows ranges to be given a probabilistic interpretation. Although, the actuaries have developed a stochastic model that is used to augment the use of scenarios to analyze uncertainty in the Trustees Report, those results appear more as an addendum than as an integral part of the analysis. The Panel therefore recommends using the results of the stochastic analysis to augment if not supplant the high- and low-cost scenarios, and to communicate the range of uncertainty around the intermediate projections.

In addition to the increased use of stochastic analysis, there are other ways to use scenarios that can be more useful as a way to explore focal alternatives. For example, projecting internally consistent and plausible scenarios (although not necessarily the most likely ones) would make the range of possible outcomes easier to interpret and communicate. In this report we illustrate two new projection scenarios combining (1) relatively high cost demographic assumptions but intermediate cost economic assumptions, and (2) relatively low cost economic but intermediate cost demographic assumptions.

Uncertainty grows as the projection period lengthens. But we find that the practice of discounting summarized balances at a *risk-free* rate inherently over-weights the more uncertain periods of the projection. As a result, the analysis of the "long-run" may well cause critical medium-term policy implications to be overlooked.

C. Modeling—Use of Alternative Approaches to Modeling for Projections—the Case for Micro-Simulation

Models are developed for different purposes; and therefore, any particular model should be judged based on its validity, accuracy and reliability in accomplishing its stated purpose. Also, a model should be flexible enough for changes in assumptions and policies to be explored and evaluated. Since no single model is likely to achieve all of these objectives equally well, we believe it is imperative for OCACT to accelerate its development and incorporation of new models to augment its cell-based approach to projections.

With the advent of increased computing power and better data, micro-simulation models have become important tools for analyzing policy changes and accounting for behavioral relationships. Several research and government agencies currently use such models to evaluate the effects of demographic, economic and policy changes related to the Social Security system. Although not a panacea, these models have proven helpful in examining a wide range of issues of interest to policy makers and analysts.[3] Moreover, by explicitly accounting for interactions across variables, micro-simulation models increase transparency around key assumptions underlying the cell-based projections, encouraging debate and discussion about these assumptions within the research and policy community.

The individual-based nature of these models makes them useful tools to: analyze the distribution of the effects of policy changes (e.g., across income); explicitly model and incorporate interactions between variables; make long-term projections; and, test alternative assumptions. Micro-simulation models are useful for tracing the behavior of individuals and families over time under varying and complex changes in economic and policy variables. Micro-simulation can improve forecast quality when changes in the cross-section over time affect macroeconomic outcomes and thereby system finances.

Micro-simulation is most appropriately used when interactions are important and tractable. While it is relatively easy to gain agreement on the importance of interactions, the tractable test is somewhat more difficult to pass unanimously. Like all models, the behavior embedded in micro-simu-

[2] Technical Panel on Assumptions and Methods (1999), *Report to the Social Security Advisory Board*, November, 1999, p. 7.

[3] These include long-term financing (CBO, *Updated Long-Term Projections for Social Security*, June 2006); the impact of differential mortality improvement on Social Security's progressivity (CBO, "Is Social Security Progressive?" *Economic and Budget Issue Brief*, December 12, 2006); the distributional effects of benefit changes (GAO-08-26, *Social Security Reform: Issues for Disability and Dependent Benefits*, October 26, 2007; Congressional Research Service, *Options to Address Social Security Solvency and Their Impact on Beneficiaries: Results from the Dynasim Microsimulation Model*, Report RL33840, January 29, 2007); and the costs of competing reform proposals (CBO, "Long-Term Analysis of the Liebman-MacGuineas-Samwick Social Security Proposal", February 8, 2006).

lation models requires a set of assumptions about how these interactions arise. Mathematical equations determine which individuals: become disabled in a given year; enter, remain in, or exit the work force; have earnings that rise or fall; immigrate (or emigrate); "marry" (assigning them spouses with certain characteristics); have children; divorce; claim Social Security benefits; and, ultimately, die. Although each of these decisions is typically based on the best available data, research and analysis, the complexity of modeling and the gaps in our understanding and practical limitations create some uncertainty about the reliability and accuracy of micro-simulation projections. Although the same types of decisions are also being made in the cell-based model, they are just not made explicit.

The general advances over the past several decades in social science, computational capability, data, and modeling, coupled with an increased interest in Social Security and its long-range solvency, have created a rich environment for testing the plausibility of modeling decisions and techniques, collaboration with outside experts, and peer review. We favor approaches which rely on explicit, rather than implicit, relationships and assumptions. We believe that the advantages associated with micro-simulation, especially when taken in concert with our other recommendations, strongly argue for increased investment in and reliance on a single (integrated) micro-simulation model as a key tool in OCACT projections for the Trustees. We are not of the view that micro-simulation should be used to replace the cell-based approach, but rather to augment it by increasing the understanding of the interrelationships and impacts of the system on individuals, and to add transparency to the many implicit assumptions made in the cell-based models.

D. Presentation

At the nexus of transparency and clear exposition of uncertainty are a number of recommendations that have more to do with the presentation of the results, which apply regardless of the modeling techniques employed.

Near vs. Long-Term

While it is clearly reassuring to address the long-term (including the impulse to assure the public of "sustainability" for an infinite horizon), it is more important to be straightforward about what is reasonably "knowable" and what remains highly speculative. Although we know (relatively) a lot about beneficiaries and workers for the next 25 years, substantial uncertainty still remains, for example, the rate of immigration. In contrast, 75 years into the future is far more uncertain; the longer the projection period, the more likely uncertainty exists. The single point estimates associated with distant horizons may yield a false sense of precision; and the casual use of these estimates can be misleading.

Despite the fact that Trustees are required to report on system finances over a 75-year horizon, they have the discretion to focus greater attention on longer or shorter time periods. The Panel recognizes that there are pros and cons of emphasizing long-horizon forecasts. On balance we believe that for analysis of the trust funds the disadvantages of very long-range forecasts outweigh the advantages, and we recommend that for the annual Trustees Report emphasis be further shifted toward the intermediate term of 25 years. In addition, more emphasis should be placed on the use of annual cost and income rates, and away from long-term measures including the 75-year summarized balance.

There are circumstances, however, when longer horizons are necessary to understand the dynamics of major policy changes—important effects may not appear until a generation or more in the future. For example, a change from pay-as-you-go funding to something akin to pre-funding would likely require a long transition period and the full effects would not be manifest until well beyond 75 years. For this purpose, a horizon of 150 years or more may be appropriate.

International Comparisons

As will be evident in succeeding chapters, we believe that comparisons with other countries, especially the developed and aging "industrialized" nations, provide valuable insights. Despite the fact that we do not fully understand the cause of many of the disparities, the fact that the consistent experience abroad is quite different from ours suggests the possibility of convergence; perhaps they will all gravitate toward us but the possibility of the opposite deserves consideration.

Forecasting Record

We believe that the accuracy of past projections should be the subject of routine reporting, either in the Trustees Report or in separate supplemen-

tal publications on methodological developments. There should be an analysis of the accuracy of past 10-, 20-, and 30-year projections similar to those periodically done by the Census, Bureau of Labor Statistics (BLS), and the Congressional Budget Office. The report should include a comparison of historical values with projected high-cost and low-cost scenario variants, noting how often each variable exceeded past projected outer bounds.

Use of Graphs and Charts

Advances in computing make it easier to include more graphs and charts that incorporate large amounts of seemingly unrelated data. For example, graphical techniques such as fan charts convey more information than the high-cost and low-cost scenarios. Just as a predicted hurricane track is bounded by a cone of uncertainty, so too can the projections of trust fund components be shown with individual and collective bounds over time.

Nature of Trust Funds

Despite the use of a "trust fund," almost from its inception, the Social Security program has been essentially pay-as-you-go, with payroll tax collections funding current benefits, and not accumulating "savings" for the future. The trust fund does not hold a store of value equal to future obligations. In that sense, it is not "fully-funded" as we think of private retirement plans.

Trust fund balances, and the dates of trust fund "exhaustion," continue to receive prominence in the Trustees Report. Surprisingly little, however, is said in the introductory sections about what the trust funds represent, beyond saying that the securities held are a firm obligation of the U.S. Treasury. Although the broader significance of the trust funds is a difficult issue that the Trustees rightly sidestep, there are basic facts about trust fund accounting that are a prerequisite for understanding the report. It is important to convey, at the beginning of the report, that the trust fund functions as an accounting mechanism and to explain how that mechanism works. The trust fund limits the legal authority to pay benefits. Paying benefits from trust fund "assets" requires increasing taxes, borrowing, or cutting other federal spending, as would be the case if there were no trust fund.

Furthermore, the trust fund is never completely "exhausted" as the usual connotation implies. Even when the balance reaches zero, there will be a flow of revenues that can be used to make payments—about 70 percent of the payments under current projections. The trust fund is more like a checking account and will have "insufficient funds" by mid-century; today's workers are making deposits to cover the checks currently being written to their parents. Our children will do the same for us, except there will be fewer of them to make deposits, and come 2042 or thereabouts, the account will not have enough deposits to cover full payment on all the checks.

Resources for Development

Implementing even some of our recommendations will require more resources for OCACT. However, it is not necessary for the actuaries to accomplish all model development in OCACT. With increased transparency, academic and other research centers can make meaningful contributions from outside government. Similarly, much of the work of the SSA Office of Policy could be incorporated more readily than is the current practice. Other governmental agencies, such as the CBO and the Government Accountability Office (GAO), could assist in evaluating the productivity and efficacy of specific analytical alternatives, even to the point of sharing computer code. The actuaries could use outside developers to replicate or augment their existing models.

E. Specific Assumptions

Table 1 lists our recommendations for the 15 demographic and economic assumptions made by the Trustees and used by OCACT in their projections. For many of the variables, we concluded that the Trustees' current intermediate assumptions are reasonable, but believe that the risk of error is not symmetrical around this "best guess." For several, we found ample evidence to suggest a change at least to the intermediate assumption, and often the high- and low-cost estimates as well. Where we do make suggestions for changes in assumptions in the key variables used to project trust fund finances, we must confess that, like OCACT, we did not have a complete structural model to provide an alternative estimate. However, evidence for a change in immigration, mortality, CPI, and interest rates is compelling. Ultimately, the evidence for the direction of change is more important than the absolute amount. As with the Trustees' estimates, the apparent precision of these assumptions, down to 1/10 of 1 percent of payroll, belies the large underlying numbers and great uncertainty inherent in each.

Table 1: Summary of Assumption Recommendations

Assumptions	Source	Low Cost	Intermediate	High Cost
Total Fertility Rate	Recommended	2.1	no change	1.5
	TR2007	2.3	2.0	1.7
Mortality (Avg. Annual decline) (all ages, both sexes)	Recommended	no change	1.00%	2.00%
	TR2007	0.33%	0.70%	1.21%
Net Immigration	Recommended Starting	1.35mil in 2007	1.35mil in 2007	1.35 mil in 2007 1.1 mil in 2011*
	Recommended Annual growth rate	2.1% 1st 25yrs 0.5% next 50yrs	1.0% 1st 25yrs 0.5% next 50 yrs	2012-2081: 0.25% Legal 0.5% "Other"
	Annual flow in 2081	2,820,000	2,189,000	1,437,000
	Ult. Net Migration Rate	4.6	4.2	3.0
	TR2007 (ultimate)**	1,300,000	900,000	672,500
	Ult. Net Migration Rate	2.5	2.1	1.9
Disability Incidence (per 1000)	Recommended	4.6	no change	6.9
	TR2007	4.4	5.5	6.6
Disability Termination		no change	no change	no change
Labor Force Participation Rate		age-adjusted percentage rates for ages 16 and over		
	Recommended	***M:77 W: 65	no change	no change
	TR2007	M:72.8 W:60.6	M:73.3 W:60.8	M:73.9 W:60.9
Unemployment Rate	Recommended	no change	no change	no change
	TR2007	4.5	5.5	6.5
Components of Real Wage Growth:				
Productivity Growth	Recommended	no change	no change	1.1%
	TR2007	2.0%	1.7%	1.4%
Compensation to GDP ratio	Recommended	no change	no change	no change
	TR2007	0%	0%	0%
Earnings to Compensation ratio		(1st 25yrs, next 50yrs):		
	Recommended	0.0%, 0.1%	-0.1%, 0.0%	-0.2%, -0.1%
	TR2007	-0.1%, -0.1%	-0.2%, -0.2%	-0.3%, -0.3%
Hours worked		(1st 25yrs, next 50yrs):		
	Recommended	0.0%, 0.1%	-0.1%, 0.0%	-0.2%, -0.1%
	TR2007	0.1%, 0.1%	0.0%, 0.0%	-0.1%, -0.1%
GDP deflator-CPI	Recommended	-0.2%	-0.2%	-0.2%
	TR2007	-0.4%	-0.4%	-0.4%
Net Real wage growth		(1st 25yrs, next 50yrs):		
	Recommended	1.8%, 2.0%	1.3%, 1.5%	0.5%, 0.7%
	TR2007	1.6%, 1.6%	1.1%, 1.1%	0.6%, 0.6%
CPI growth	Recommended	1.5%	2.5%	3.5%
	TR2007	1.8%	2.8%	3.8%
Real interest rate (nominal less CPI)	Recommended	3.3%	2.6%	1.8%
	TR2007	3.6%	2.9%	2.1%

* Decline from 1.35 million to 1.1 million over 6 years from fall of 50,000 per year in net "other" immigrants

** Trustees assume immigration levels, not growth rates; they decline in steps to reach ultimate level in 2027 for low and intermediate cost, and 2017 for high cost

*** Panel LOW COST recommends increasing LFPR for each 5-year age group over 55. LFPR of each 5-year age group will reach in 75 years (2081) the current rate (2007) of the next younger 5-year age group e.g. LFPR of 55-59 year old in 2081 will equal LFPR of 50-54 years old in 2007

Demographic assumptions

A. Fertility

The total fertility rate for the United States is considerably higher than for other industrialized nations. We were unable to find in the literature, or from a panel of experts we convened specifically for the purpose, any clear and convincing explanation for the difference. We were not able to make a case for changing the intermediate assumption of 2.0, despite the large difference with most European countries. However, our recommendations for the ultimate high and low cost fertility levels reflect an asymmetry of likely variance. We believe there is greater risk that the U.S. will begin to move toward other countries and experience a reduction in fertility—even if not falling as low as some in the industrialized world—than there is that fertility in the U.S. will increase substantially above our already-high levels.

B. Mortality

Mortality, or more accurately the reduction in mortality, will improve, we believe, more quickly than the Trustees assume. We also believe, based again on international experience, there is a real possibility that mortality will improve much more than even our intermediate assumption. While our suggested change to the intermediate assumption is a significant but modest 0.3 percent per year, we recommend raising the high-cost (i.e., most improvement in longevity) by 0 .8 percent per year.

C. Immigration

Immigration has been greater in the recent past than the Trustees Reports portray and, we believe, will continue to be greater in the future than the Trustees project. We also believe it would be more appropriate to project the rate of change of immigration, rather than the level of immigration, as either are a function of both previous immigration and general population growth. For this report we have utilized the former.

The Trustees have felt constrained by limits contained in current law when making assumptions concerning the number of immigrants entering our country each year. As a result, total immigration is, in reality, considerably greater than the Trustees assume. While "current law" is a useful convention for the development of baselines against which to measure changes in policy, the projection of trust fund finances, especially over very long periods of time, is a fundamentally different exercise. Reality is a better foundation in this case.

We expect that future immigration will depend critically upon the growth in the U.S. economy, the fertility of native-born citizens, and the resultant demand for labor. While immigration from Mexico may eventually slow, there will be ample population in the rest of the world. The Panel strongly recommends that the Trustees pursue research to incorporate the demographic and economic differentials between native and foreign-born populations, by age and sex at a minimum, but also possibly by marital and labor status.

D. Disability

The incidence of disability is particularly difficult to project—it depends more closely than other factors on the interpretation and application of the law to new beneficiaries. Disability incidence assumptions were lowered in the 2007 Report and the Panel believes this revision was reasonable given the data on health and benefit trends. These same data on health and benefit claiming lead the Panel to recommend changes to the low- and high-cost alternative scenarios. We found no compelling evidence to change the Trustees' current intermediate assumptions, but do believe there is more risk of increasing incidence, and less chance of substantial reductions, as reflected in our recommendation.

Economic assumptions

Economic factors are subject to more variation than demographics over short periods, but have exhibited relative stability over at least the medium term of 20-25 years. Some, such as the unemployment rate, do not by themselves materially change the trust fund outlook. Again, asymmetry of risks may apply, but with less regularity than with demographics.

A. Labor Force

With respect to labor force participation (LFPR), the Panel recommends putting more weight on the possibility that greater life expectancy, improved health, unmet demand for workers, low personal savings, changing workplace requirements, and the reduction in defined benefit private retirement plans may increase participation rates at older ages. The Panel believes that allowing for this possibility is important and could ultimately affect both the intermediate- and low-cost scenarios.

B. Unemployment

The Panel recommends no change to the Trustees' assumed rate of unemployment.

C. Real Wage Growth

Productivity Growth

Our recommendation reflects the sharp slowdown in actual productivity growth between mid-2004 and mid-2007 that has reduced the possibility that the American economy entered a new era of rapid high productivity growth after 1995. Instead, it appears that the marked acceleration of productivity growth between 1995 and 2004 can be attributed to special one-time factors that are unlikely to recur. In forecasting future productivity growth, substantial weight must be given to the poor performance of productivity growth in the period 1972-1995. We chose to recommend leaving the intermediate assumption unchanged, but do recommend lowering the high-cost estimate to reflect the greater risk of future substantial declines in productivity.

Earnings to Compensation Ratio

We believe that the decline of earnings relative to total compensation (i.e., the increase in fringe benefits, especially for healthcare) must slow over the next 25 years and abate thereafter. Recent experience suggests that there will be significant resistance to future increases in the health insurance costs borne by employers. The reasons for the growth of defined contribution pension plans are complex, but one important feature of such plans is the ability they give to employers to control the magnitude of their pension liabilities. Employers already have shifted a significant share of health insurance costs to their employees; even more dramatic shifts in this direction should be anticipated, with employers offering their workers a defined contribution to be applied toward health insurance coverage rather than a health insurance plan that offers a defined set of benefits.[4]

Average Hours of Work

We believe hours worked will decline slightly more than the actuaries do over the next 25 years. The Panel feels that the continuing decline in hours in Europe together with the sharp decline in the U. S. between 2000 and 2006 make at least a modest further decline likely. We propose an annual rate of decline of hours per employee of 0.1 percent for the first 25 years of the projections and zero thereafter. After the baby boomers have retired, we assume, as the Trustees do, that hours worked will stabilize.

Inflation Differential

Based on recent evidence that monetary authorities in the industrialized world have developed the means and the will to control inflation, we conclude that the estimates for the CPI should be somewhat lower than the Trustees assume. Because the U.S. economy is driven largely by consumption spending, the difference between the gross domestic product (GDP) deflator and the CPI should diminish more quickly than the Trustees assume.

2007 Technical Panel Growth Rate Recommendations

Real Wage Growth =	(Yr. 0-25) 1.3 pct/yr (Yr. 26-75) 1.5 pct/yr
+ Growth in labor productivity	1.7 pct/yr 1.7 pct/yr
+ Growth in [labor compensation/GDP]	0.0 pct/yr 0.0 pct/yr
+ Growth in [earnings/labor compensation]	-0.1 pct/yr 0.0 pct/yr
+ Growth in [total hours/employment]	-0.1 pct/yr 0.0 pct/yr
+ Growth in [GDP deflator/CPI]	-0.2 pct/yr -0.2 pct/yr

Summary of Real Wage Growth

As a result of these various adjustments, we conclude that real wage growth will exceed the Trustees' estimates over the next 25 years and grow even faster thereafter.

D. Real Interest Rates

Historical data and current financial market results suggest that real interest rates will be lower than the Trustees assumed in their latest report. The Trustees set projected nominal rates to be consistent with their real interest rate and inflation assumptions. The result is an assumed nominal rate in the intermediate case that is inconsistent with the actual nominal Treasury yield curve. CPI inflation also exceeds the medium-term consensus view, and contributes to the discrepancy with market data. The Trustees put greater weight on the past than do financial markets.

[4] U.S. Department of Labor, "The Evolution of Compensation in a Changing Economy," Report on the American Workforce, Washington DC, 2001, pp. 57-94.

The historically low level of long-term yields on financial instruments in the U.S. and abroad suggests that investors expect inflation to remain moderate.

Discounting

Several recent studies have drawn attention to the misrepresentations of liabilities that can occur by inappropriately discounting risky cash flows at a risk-free rate. The risk in Social Security liabilities arises from the indexing of benefits to aggregate wage growth: liabilities will be higher if the economy on average does well over the next 75 years than if it does poorly. This systematic risk implies that the theoretically correct rate is higher than the risk-free Treasury rate. Payroll tax revenues, which also are tied to aggregate economic performance, require similar risk adjustment. For calculations involving discounting such as the actuarial balance, the Panel recommends that the Trustees consider using risk-adjusted rates instead of a risk-free real interest rate.

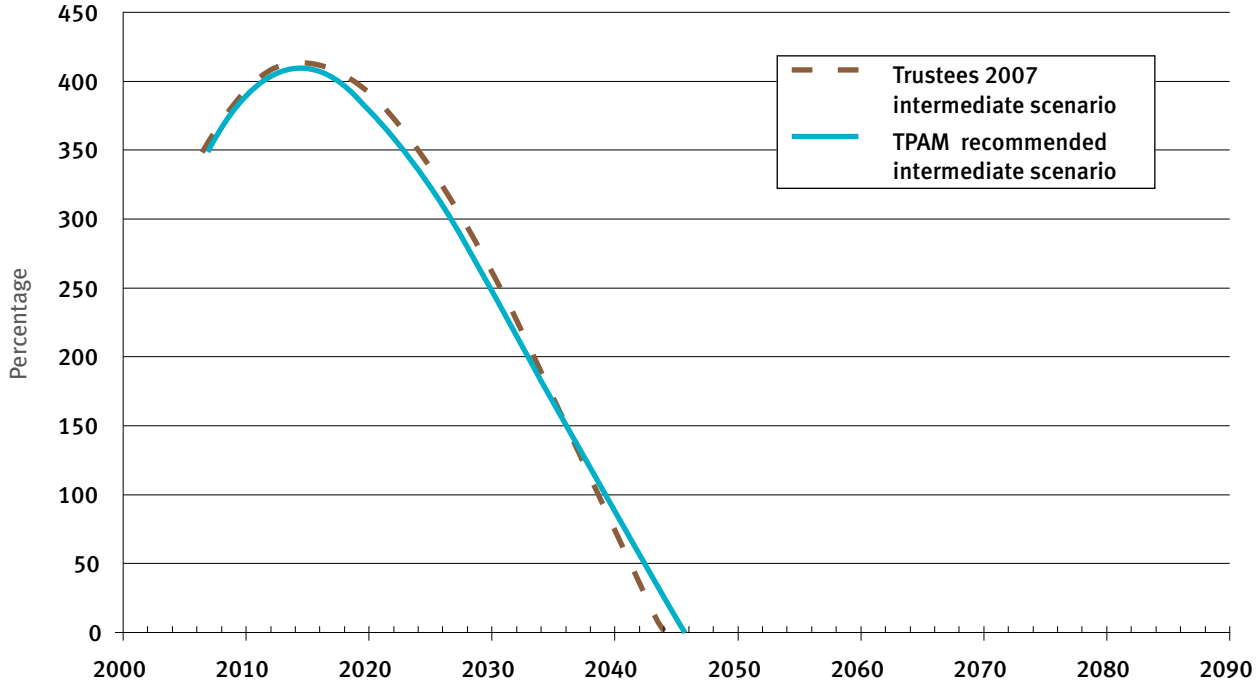
Equity Risk Premium

The equity risk premium—the average return on stocks over the risk-free rate—has no effect on the analysis of system finances under current law. Periodically, however, the actuaries are asked to analyze the effect of legislative changes that include investments in the stock market. We generally agree with the level of risk premiums in recent analyses by the actuaries of proposals involving stock market investments. However, fairly presenting the implications of the equity premium can be a greater challenge than estimating it. The Panel recommends that the actuaries portray risk-adjusted projections as a neutral risk-adjusted case, not as worst case for average returns.

E. Taxable Share of Covered Earnings

There is a growing and significant economic literature on the causes of increasing wage and income dispersion in the United States. The share of total wages has been growing most rapidly for those individuals at the top of the earnings distribution. This trend has been reflected in the falling share of Social Security covered wages that are taxable—from 90 percent in 1983 to 83 percent in 2008. Despite the significance of this trend on the finances of the trust funds, the projections in Trustees Reports since 1983, however, have done a poor job anticipating it. Despite that poor record, those projections also continue to maintain low-cost and high-cost bounds that are unrealistically narrow. The Panel believes the Trustees should conduct additional research into the causes of wage dispersion and focus more attention on providing more reasonable projections of this important influence on overall system finances.

Figure 1: Projected Annual Trust Fund Ratio under Intermediate Assumptions: 2007 Technical Panel vs. Trustees Report 2007



Long-Term Financial Status of the OASDI Trust Funds

Taken together, our recommendations for changes in the Trustees' assumptions yield a modest improvement in the finances of the system by all the usual measures. Generally, income is reduced by a small amount, which is more than offset by a reduction in system costs. The 75-year actuarial deficit would be -1.74 percent of taxable payroll under the Panel's recommended intermediate assumptions compared to -1.95 percent under the current Trustees' assumptions. While the 75-year effect reflects a notable improvement, it is important to remember that while the direction of the change is reasonable, the exact magnitude is very uncertain. Some of the suggested changes, such as immigration, reduce the deficit, but by an uncertain amount. Others, such as the decline in mortality, increase costs by a similarly uncertain amount.

As depicted on Figure 1, the trust fund balance remains positive for only one additional year under the Panel's recommended intermediate assumptions compared to those in the 2007 Trustees Report, with the balance reaching zero in 2042 rather than 2041.

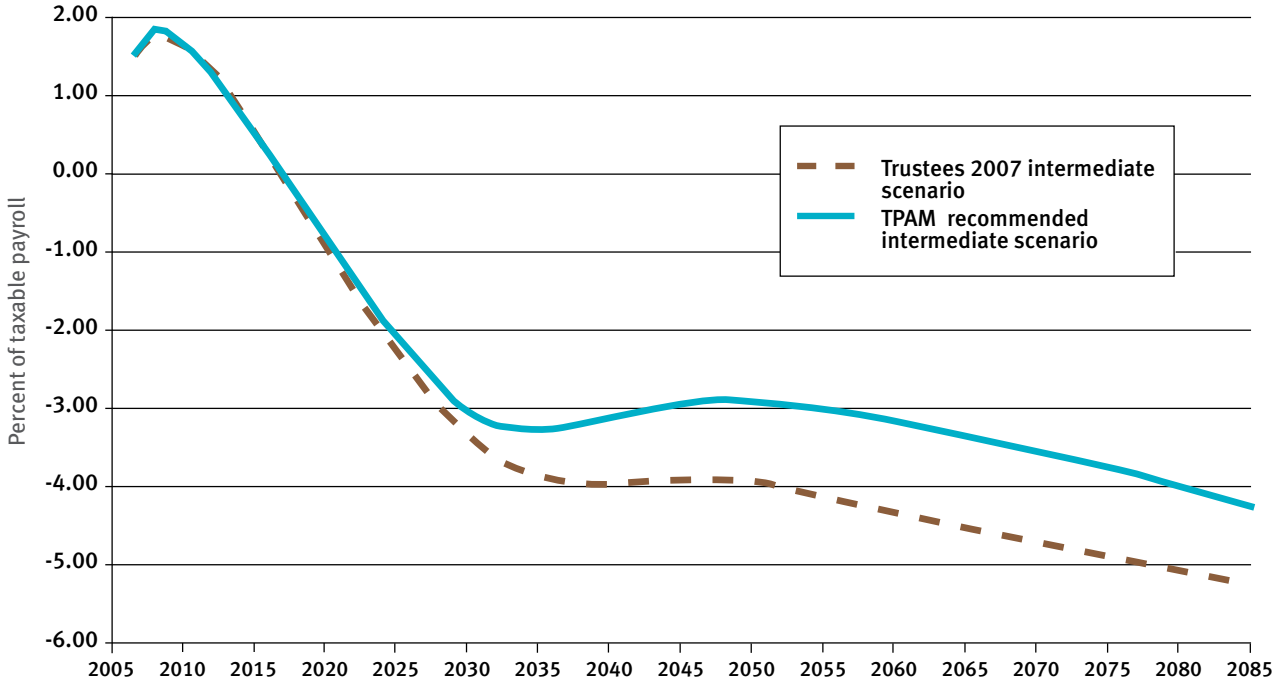
Despite the improvement, annual costs exceed income (excluding interest) starting in 2017 (the same year as projected in the Trustees Report) and never turn around, growing to a deficit of 4 percent of payroll in the 75th year of the projection period. Even after the boomers are no longer a factor, the system's finances continue to erode as far as the crystal ball can see, and well beyond. Put another way, we cannot "assume" our way out of the financial hole—see Figure 2.

Our assumption of a more rapid improvement in mortality, all else equal, raises system costs, especially in the longer forecasts, as retirees collect benefits for longer periods.

Increased immigration helps the outlook for the trust fund by lowering the cost rate over the entire period. Immigration adds to the gross payroll taxes and benefits paid, but the effect on rates arises mostly through costs due to immigrants entering the workforce very soon after arrival and adding to taxable payroll faster than collecting additional benefits. Undocumented immigrants who do not have proper Social Security numbers also contribute approximately $5 billion a year to the trust funds without ever claiming benefits for those contributions.[5]

Our recommendation to slow the decline in the earnings-to-compensation ratio improves the trust

Figure 2: Projected Annual Balances under Intermediate Assumptions: 2007 Technical Panel vs. Trustees Report 2007



[5] Porter, Eduardo, "Illegal Immigrants are Bolstering Social Security with Billions," New York Times, April 5, 2005.

Figure 3: Incremental Effect of Individual Technical Panel Recommended Intermediate Assumptions on 2007 Trustees Projection of Annual Balances

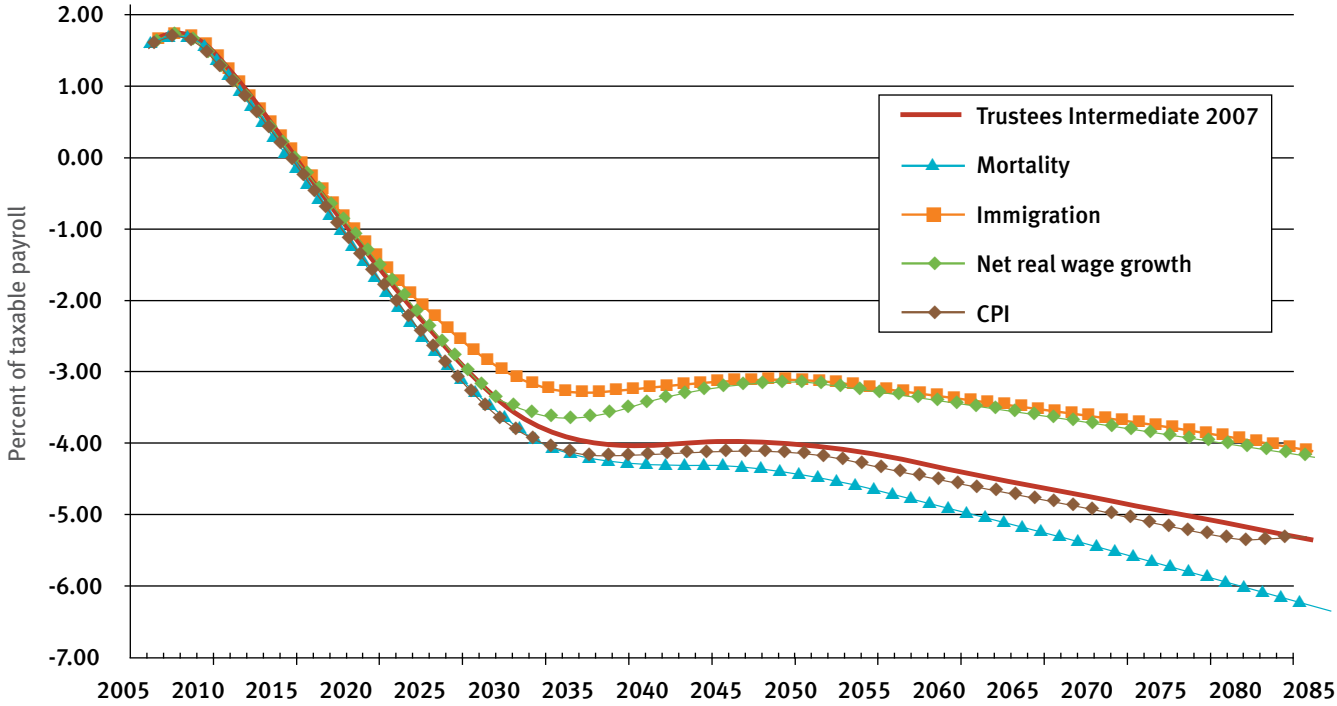


Table 2: Summary of Effects of Individual Assumptions on System Finances

	75 year summarized balance	*Change from TR*	25th year balance (2031)	*Change from TR*	50th year balance (2056)	*Change from TR*	75th year balance (2081)	*Change from TR*	Year cost exceeds income*	Year Trust Fund ratio <0
2007 Trustees Report	-1.95		-3.56		-4.20		-5.20		2017	2041
Mortality	-2.20	*-0.25*	-3.64	*-0.08*	-4.64	*-0.44*	-6.02	*-0.82*	2017	2040
Immigration	-1.50	*0.45*	-3.00	*0.56*	-3.24	*0.96*	-3.98	*1.22*	2018	2044
Real wage growth	-1.63	*0.32*	-3.46	*0.10*	-3.26	*0.94*	-4.06	*1.14*	2017	2042
CPI growth	-2.02	*-0.07*	-3.64	*-0.08*	-4.31	*-0.11*	-5.31	*-0.11*	2017	2040
Interest rates	-2.15	*-0.20*	-3.56	*0.00*	-4.20	*0.00*	-5.20	*0.00*	2017	2040
TPAM intermediate:	-1.74	*0.21*	-3.14	*0.42*	-2.98	*1.22*	-3.95	*1.25*	2017	2042

* excluding interest
Source: OCACT projections of Technical Panel asssumptions

fund outlook slightly in the first years and a small amount over 75 years. The changes in hours worked and GDP-CPI differential also improves the long-term outlook by a small amount.

The recommended CPI change has a negligible effect in the short- and long-run. The change in the real interest rate adds very slightly to the trust fund deficit by reducing the interest income in the early years. Values summarized over 75 years in present value calculations would appear larger with a lower interest rate. These marginal effects are depicted graphically in Figure 3 (interest rate effects are not shown) and numerically in Table 2.

Chapter 1: Methodology

We begin our report with observations on the methods and data used by the Office of the Chief Actuary (OCACT) and the Trustees, rather than on specific assumptions, since we would expect a more lasting impact from a change in method than a change in any particular point estimate we could suggest. It is quite easy, in fact, to take narrow issue with any particular estimate, but more difficult to understand and examine the methods used to produce it. Because of the inherent uncertainty in long-range projections, the validity of the estimation process is arguably as important as any specific result.

The methodological challenge is to assess the financial soundness of the Social Security program. The future income and cost of Social Security must be estimated in such a way that allows the Trustees to: (1) examine the likely financial results of the system, including year-by-year cash flows, the annual balance in the trust fund, and the actuarial balance at the end of the 75-year period; and, (2) describe the uncertainty of the forecasts. In addition, policy makers and the public may also wish to understand the distributional impact of any proposed change to the Social Security program. Technical experts may also wish to evaluate the reasonableness of the variables that are used to forecast the future financial changes, particularly the interaction and consistency between the different economic, social, and demographic variables.

The state of actuarial science appears to be rapidly evolving beyond the cell-based models generally employed by the actuaries, to more explicitly incorporate interactions between economic and demographic variables and to better understand the uncertainty in the projections. The increase in computing power alone makes possible many analyses heretofore impractical, and allows additional data to be incorporated.

New data sources are also emerging. Recent research using longitudinal data such as the Health and Retirement Survey (HRS) and the Survey of Income and Plan Participation (SIPP) linked to micro-level Social Security earnings data have yielded significant insights on disability, health, and retirement dynamics. This potent combination—advanced computing, more and better data, and new methods—holds the prospect of significant advances in the analysis required for social programs and their associated trust funds.

Many of this Panel's recommendations on methods—transparency, the use of micro-simulation and stochastic analyses, specifying and estimating interactions, employing additional data—are not new. Previous Technical Panels and other experts have made similar recommendations. What is new, perhaps, is that the actuaries have made some progress on many of these fronts. There are reasons to be impatient, however. New computing power, new sources of data, and new estimating techniques should allow OCACT to make faster progress in advancing their models and methods. Indeed, others within government, ranging from the Office of Policy within SSA to non-executive branch agencies such as the Congressional Budget Office, are exploiting these developments and creating the means to analyze the system and its response to change. Only by aggressively deploying new data and techniques and by making the process more transparent can OCACT and the Trustees remain the definitive source-of-record for this information.

There also appears to be an understandable reluctance by the Trustees to make significant changes to their projections in any given year. Rather, methodological changes that produce significant changes in point estimates are phased in, or offset with changes in other variables. Nonetheless, the Actuarial Standards of Practice, specifically

Standard No.32: "Social Insurance," suggests that new information should be incorporated when it is found, even if such information creates some discontinuities in the forecasts: "The actuarial assumptions, both individually and in combination, should reflect the actuary's best judgment, taking into account anticipated future events affecting the related social insurance program."[6]

While OCACT is exploring new ways of augmenting their traditional methods, the adoption appears to us to be slow and sometimes grudging. Recommendations of previous advisory panels seem to have languished. As a result, important information in the estimating process may be lost. What follows is a series of comments that generally apply across the set of variables for which OCACT creates projections. Their specific applicability and methodological comments unique to each variable appear in the appropriate chapters.

A. Transparency

Throughout this report, we call for more transparency in the models and data the actuaries use, as well as the assumptions that drive their results. This recommendation is perhaps the most important one we can make. Only with more transparency can other social scientists interested in retirement, Social Security, and the various related issues, bring their intellect to bear on the many complex questions the actuaries face. Only by a clear articulation of their assumptions can the actuaries' work be truly examined. Only by a clear understanding of the nature of trust fund accounting can the public be assured of the outlook for the program and the veracity of statements made about it.

Method Recommendation M-1: **Further document all models to the extent necessary for others to replicate forecasts. Make available sufficient data for non-government analysts to replicate forecasts, and conduct research to improve forecasting techniques. Include in the analysis an explicit discussion of the historical time periods, and the associated rationale, used for each variable.**

Method Recommendation M-2: **Explicitly model and document relevant interactions.**

Method Recommendation M-3: **The Social Security Advisory Board, to whom this Technical Panel reports, should hold semi-annual meetings with OCACT to discuss progress on the recommendations contained in this report as well as those from previous panels.**

All analytical agencies, whether NASA, CBO, or OCACT, must make assumptions about behavior or phenomenon that are unobservable or immeasurable. In the process, the assumptions become deeply embedded and the models closely guarded. These agencies are understandably reluctant to revisit assumptions or reveal methods. Nonetheless it is essential to do so. First, accountability requires it—such is the nature of the nascent documentation external auditors recently required of OCACT. Second and more important, ongoing comprehensive, external review can greatly assist the quality of the analytical exercise.

Transparency of the OCACT models will require several developments:

- providing more comprehensive documentation
- making data from SSA records more available
- creating explicit models where none exist and
- clearly explaining the processes employed

The ultimate test of transparency is whether the actuaries' results can be replicated. For example, interactions between the variables that drive the projections are not made explicit in the cell-based models used by the actuaries, and it is not clear how these relationships are incorporated in the final projections. As a start, it would be helpful for OCACT to publish any calculations, spreadsheets, models or even rules-of-thumb that are currently used to assess interactions. The professionals of OCACT are aware of virtually every potential interaction we raised along the way, every additional technique that might be brought to bear, and almost every piece of relevant literature we cited. Although they "test" their assumptions and the resultant estimates it is often in ways that are not explicit, formal or replicable.

Another area of necessary transparency is an explanation of the data used and the time-periods employed in the trend analysis, as well as the rationale for those choices. The heavy reliance on historical trends in long-term projections makes it particularly important to choose the "correct" reference period from which to draw inferences—a period that will vary depending upon the phenomenon being examined. Some retrospectives are limited by

[6] Actuarial Standards Board, "Actuarial Standards of Practice No. 32: Social Insurance," January 1998.

the availability of data, or at least comparable data, and it is unwise to place too much weight on history when evidence is limited. Nor should we employ data from a longer but less relevant time period simply because we can. Current projections rightly use different time horizons as relevant reference points for different assumptions: to project mortality the focus is on the past 50 years; to project immigration the focus is the past 100 years; for fertility the focus is the past 20 years; and for disability incidence the emphasis is on more recent history. While these choices may be reasonable ones, the rationale behind them is not always transparent.

Further, these data must be or become publicly available to allow replication and modification of the techniques. To the extent private data on individuals is used, minimal aggregation should be employed to protect identity, and the aggregated data made public.

B. Uncertainty

Method Recommendation M-4: **Incorporate asymmetrical risk in the projections.**

Method Recommendation M-5: **Further develop stochastic modeling capabilities, and make much greater use of stochastic analysis to examine uncertainty, especially the effects interactions have on uncertainty.**

Method Recommendation M-6: **Consider risk-adjusting discount rates for summarized balances. Using the risk-free interest rate to discount uncertain future cash flows is inconsistent with valuation principles, and over-weights the outcomes that are most uncertain.**

The exercise undertaken by OCACT and the Trustees is equivalent to asking someone in 1932, during the depths of the Great Depression when the Dow Jones Industrial Average reached an all-time low of 41, to predict the size of the population and the state of the economy in the year 2007 and essentially everything in between—World War II, baby boom generation, nuclear power, Cold War, space travel, Vietnam War, improvements in healthcare, industrialization, computers, or the Dow Jones Industrial Average (DJIA) breaking 14,000. And looking forward from the perspective of 1932, it would have been virtually impossible to predict the economic and demographic changes for the succeeding ten years (which included the enactment of Social Security), let alone 75. Yet the actuaries and Trustees must have a sense of how uncertain the future may be to understand the validity of their work. The further the gaze into the future, the less certain the outlook. This is not a reason for futility, but it does require that explanations of uncertainty in the projections need to be expanded.

The current approach to uncertainty in the Trustees Report, using high-, medium-, and low- cost "scenarios" or "variants" to indicate the range of plausible outcomes is a traditional one whose limitations are well known; it produces estimates that lack both an intuitive and a statistical interpretation. In addition, the temptation to assign probabilities to the scenarios or to suggest their degree of likelihood should be resisted.

Previous Technical Panels have consistently drawn attention to the limitations of the variant approach. For example, the 1999 Technical Panel noted that using high and low alternatives: (1) assumes trajectories are always high or always low; (2) combines trajectories of various assumptions in rigid ways, for example, all are set at their high-cost value simultaneously; (3) ignores that different aspects of the high and low scenarios have different levels of uncertainty; and (4) does not assign any probability to the forecast ranges.[7] We offer one additional observation: there is no requirement for symmetry of uncertainty—that the forecast be plus-or-minus an equal amount along the projection. Indeed, many key drivers have asymmetrical uncertainty as succeeding chapters will show, and the nature of the uncertainty may change with the forecast horizon.

Stochastic analysis, on the other hand, produces uncertainty bands that are much easier to interpret by incorporating correlations between variables and allowing ranges to be given a probabilistic interpretation. The Panel therefore recommends using the results of the stochastic analysis to augment if not supplant the high- and low-cost scenarios, and to communicate the range of uncertainty around the intermediate projections.

The actuaries have also developed a stochastic model to augment their use of scenarios to analyze uncertainty, but those results appear more as an addendum in the Trustees Report than as an integral part of the analysis. There are at least two aspects of uncertainty that the actuaries should analyze and integrate into the main analysis. First, the scenario presentation in the Trustees Report is focused on the intermediate projection—a point

[7] Technical Panel on Assumptions and Methods (1999), *Report to the Social Security Advisory Board*, November, 1999, p7.

forecast favored as the "best guess." As the forecast horizon lengthens there is a substantively important decrease in the usefulness of any point forecast, whereas probabilistic statements about different outcomes remain useful to policy analysis.

To illustrate, suppose that over a 5-year horizon we make a point forecast, and that a small interval around that forecast covers a prediction interval with 90 percent probability. We can reasonably use the point forecast as a basis for decisions over the 5 years. But the 90 percent probability interval will be more than twice as wide at a 25-year horizon, and nearly four times as wide at a 75-year horizon. (This scaling is robust for any class of models that uses multiplicative or additive random shocks.)

Such a large increase in the uncertainty of, say, the dependency ratio or the summarized actuarial balance needs to be confronted realistically. For example, a statement that under the intermediate scenario a tax increase of 2 percent will balance the fund over 75 years would be replaced by a statement that there is a probability of 50 percent that a tax increase of 2 percent will balance the fund, or there is a probability of 75 percent that a tax increase of 4 percent will balance the fund. Policy makers can then decide on the level of insurance, if any, they want to buy with a tax increase.

Second, while the Trustees Report focuses on the important question of the sensitivity of the intermediate forecast, it should spend some effort examining the sensitivity of the projection intervals in the corresponding stochastic forecasts. Research shows economic uncertainty is a major factor in the short-term (25 years) while demographic uncertainty dominates in the long-term (50 years).[8] The inclusion of behavioral responses may influence these patterns in ways that the present analyses do not capture.

In addition to the increased use of stochastic analysis, there are other ways to use scenarios that can be more useful as a way to explore focal alternatives. To illustrate how scenarios could be constructed to provide more useful and interpretable information, we asked the actuaries to calculate the implications of several "integrated" scenarios. The scenarios represent plausible, internally consistent alternatives, albeit not the most likely, outcomes. The first demonstrates what would happen if demographic forces (but not immigration) lead to the high-cost outcomes, holding economic assumptions to their intermediate assumed values. Specifically, the total fertility rate is assumed to fall from 2.0 to 1.5 over 25 years, and mortality improvement is 2 percent per year, assumptions that are close to recent experience in some European countries. Immigration policy is assumed to ease in response to the lower fertility rate: starting at 1.35 million, growing at 2.1 percent for 25 years, and then at 0.5 percent thereafter—what amounts to the Panel's recommended low-cost immigration assumption. Other assumptions are as in the Panel's recommended intermediate case. This results in a 75-year actuarial balance of -3.39 percent of payroll, an estimate that lies between the Trustees' traditional intermediate- and high-cost scenarios.

We also looked at an alternative economic scenario reflecting more optimistic assumptions about future economic conditions, by assuming real wage growth and real interest rates would be at the Panel's recommended low-cost values, while all other variables remain at the intermediate. Specifically, the real wage growth is assumed to be 1.8 percent for the first 25 years, and 2 percent for the last 50 years of long-range period (see Table 1); the ultimate real interest rate is assumed to be 3.3 percent, and the share of covered earnings that are taxable is assumed to be 83.8 percent (equal to the Trustees' low-cost assumption). This produces a 75-year actuarial balance of -.66 percent of payroll, which lies between the Trustees' traditional intermediate- and low-cost scenarios. The experiment indicates that even an improbably high rate of economic growth is not likely to be enough to bring the system into balance (see Figure 4).

Uncertainty grows as the projection period lengthens. But we find that the practice of discounting summarized balances at a risk-free rate inherently over-weights the more uncertain periods of the projection. In the process, the analysis of the "long-run" may well cause critical medium-term policy implications to be overlooked.

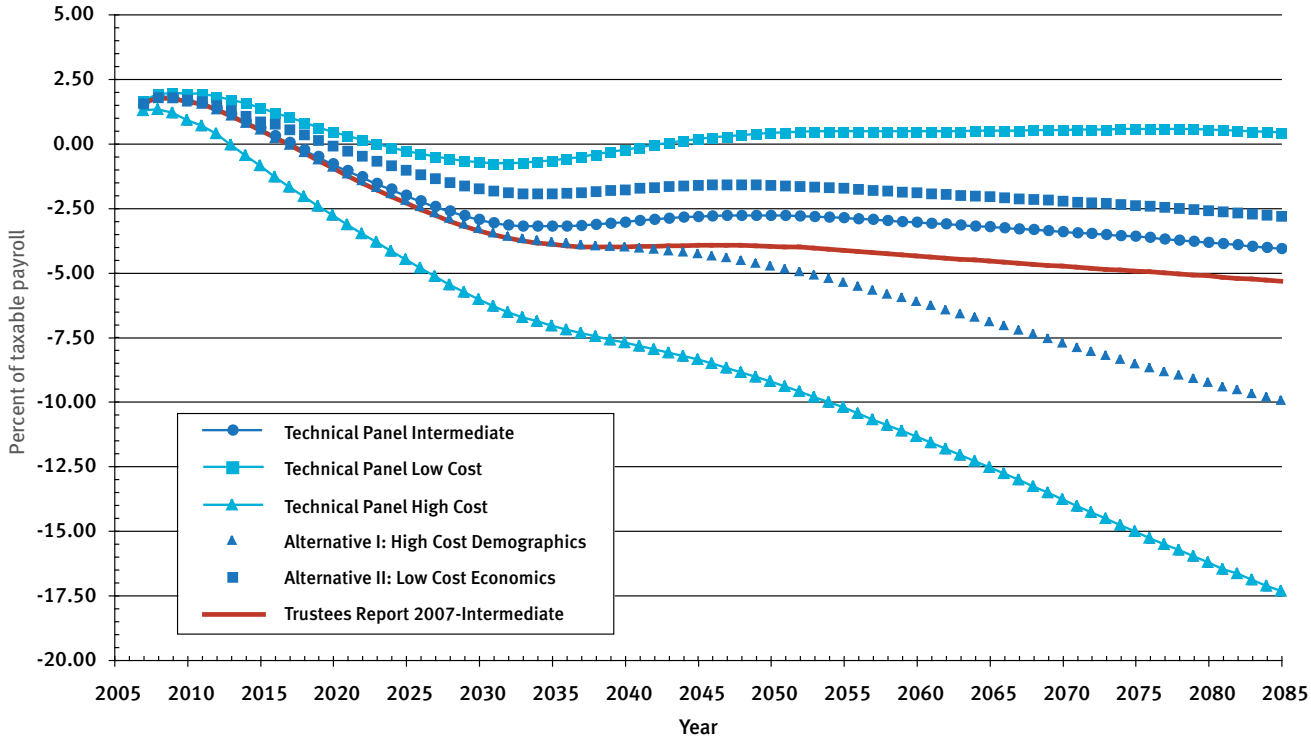
C. Modeling: Use Of Alternative Approaches To Modeling For Projections—The Case For Micro-Simulation

Method Recommendation M-7: **Increase the use of micro-simulation to analyze and display interaction effects and distributional outcomes of policy changes.**

Models are developed for different purposes. A model should be judged based on its validity, accuracy, and reliability in accomplishing its stated

[8] Tuljapurkar, Shripad and Ronald Lee, "Stochastic Forecasts for Social Security," in David Wise (ed.), *Frontiers in the Economics of Aging*, Chicago: University of Chicago Press, 1989, pp.393-420.

Figure 4: Comparison of Alternative Scenarios: Projected Annual Balances



purpose, and it should also be flexible enough for changes in assumptions and policies to be explored and evaluated. For example, for financial purposes, a model should be judged based on its accuracy and reliability in predicting future revenues, costs and financial balances. For distributional analysis, a model should be judged based on its ability to analyze impacts by socioeconomic classes and intergenerational groups. Since no single model is likely to achieve all of these objectives equally well, we believe it is imperative for OCACT to accelerate its development and incorporation of new models to augment its cell-based approach to projections.

With the advent of increased computing power and better data, micro-simulation models have become important tools for analyzing policy changes and accounting for behavioral relationships. Several research and government agencies currently use such models to evaluate the effects of demographic, economic, and policy changes related to the Social Security system including the Congressional Budget Office (CBOLT), Social Security Administration's Office of Policy (MINT), the Urban Institute (DYNASIM3), and the Policy Simulation Group (SSASIM/PENSIM/GEMINI). Although not a panacea, these models have proven helpful in examining a wide range of issues of interest to policy makers and analysts.[9] Moreover, by explicitly accounting for interactions across variables, micro-simulation models increase transparency around key assumptions underlying the cell-based projections, encouraging debate and discussion about these assumptions within the research and policy community. For these reasons, the Panel believes it is imperative that OCACT increase its investment in and utilization of micro-simulation models as augmentations to cell-based projections.

While advocating an increased reliance on micro-simulation, the Panel recognizes that there are also advantages of the cell-based methods employed by OCACT. Cell-based models can be more tractable, and the results more predictable than micro-simulation models. It can be easier to impose aggregate constraints on variables, such as the rate of real wage growth, which reflect de-

[9] These include long-term financing (CBO, *Updated Long-Term Projections for Social Security*, June 2006); the impact of differential mortality improvement on Social Security's progressivity (CBO, "Is Social Security Progressive?" *Economic and Budget Issue Brief*, December 12, 2006); the distributional effects of benefit changes (GAO-08-26, *Social Security Reform: Issues for Disability and Dependent Benefits*, October 26, 2007; Congressional Research Service, *Options to Address Social Security Solvency and Their Impact on Beneficiaries: Results from the Dynasim Microsimulation Model*, Report RL33840, January 29, 2007); and the costs of competing reform proposals (CBO, "Long-Term Analysis of the Liebman-MacGuineas-Samwick Social Security Proposal", February 8, 2006).

velopments in a broad range of underlying social and economic trends but are less dependent, in a tractable way, on the interactions captured in a micro-simulation. Also, the cell-based approach may avoid unintended consequences that can arise from explicit modeling of individual behavior. To avoid such problems, it is standard to constrain behavior in micro-simulation models so as to impose consistency with certain aggregate quantities. Similar aggregation restrictions also must be applied to cell-based models, but it is generally more straightforward to do so in that context.

The return to investing in a full blown micro-simulation model is that it can provide new insights and possibly improve accuracy when interactions among variables affect outcomes. This is especially true when the nature of these interactions is expected to change over time, or differentially across the population. Micro-simulation models use information on individuals from large-scale surveys to build a "virtual" population. This population is aged over time by applying demographic and economic processes (e.g., births, deaths, marriages, divorces, employment, and retirement) estimated from survey data. Individuals in the population "behave" in ways consistent with history. Policy changes can be applied to this virtual population and the results of these changes can be analyzed over time and compared to the outcomes under no policy changes. By starting with and maintaining a representative sample of the population, micro-simulation creates a potentially more flexible and detailed model, one that incorporates interactions as the base population evolves over time. Individual observations can be aggregated and analyzed in almost any grouping, or along any dimension that has been used within the data. Importantly, micro-simulations impose an "adding up" constraint, ensuring that economic aggregates and population counts remain internally consistent.

The individual-based nature of these models makes them useful tools for a variety of inquiries: to analyze the distribution (e.g., across income) of the effects of policy changes; to explicitly model and incorporate interactions between variables; to make long-term projections; and, to test alternative assumptions. Micro-simulation models are useful at tracing the behavior of individuals and families over time under varying and complex changes in economic and policy variables. Micro-simulation can improve forecast quality when changes in the cross-section over time affect macroeconomic outcomes and thereby system finances.

Conditions where micro-simulation models are preferred to cell-based methods are best demonstrated by examples. A demographic example arises from mortality improvement differentials. Data show that improvements in mortality have been distributed unevenly across the population, with greater gains to higher income individuals. Such differentials are hard to overlay on a cell-based model since the effects on an age-sex group can change in a complicated way over time. In a micro-simulation, such differentials are straightforward to implement, since mortality rates can be assigned to individuals. In the case of mortality improvements, changes in the cross-section significantly affect system finances. To demonstrate this point, we asked the CBO to do a simple experiment where projected annual declines in overall death rates are distributed across the population according to the historical differential in mortality by earnings observed in the data. Relative to the baseline projection, where a reduction in mortality is distributed uniformly across earnings quintiles, the change increased life expectancy for the 1940s to 2000 cohorts in the expected way. In the bottom quintile, the increase in life expectancy was about 66 percent of the baseline, while at the top it was 138 percent of the base case, or 3.5 versus 7 years, respectively. The changes in system finances are predictable. Incorporating differential mortality worsens the actuarial balance by 0.12. The change in 2080 is more dramatic, the cost-income gap as a share of taxable payroll worsens by 0.25 percentage points, which is roughly 5 percent of the baseline projected imbalance.

Micro-simulation can also be useful in capturing transitional changes in mortality patterns. For example, this same approach could incorporate and examine the effects of temporary changes in mortality patterns across men and women owing to sharp increases in female smoking rates in certain cohorts. To incorporate such temporary changes into a cell-based model would require altering the time period for evaluating trends or adjusting male-female differentials in an ad hoc way as the cohorts move through the age distribution.

An economic example where micro-simulation provides macroeconomic insights is for the analysis of differential labor force participation rates. It seems likely that economic and demographic forces will change retirement behavior toward longer labor force participation. Life expectancy is increasing, defined benefit based incentives for fixed retirement dates are declining, and jobs are becoming less structured allowing for potentially better matches between older workers and employers. Data suggest that these factors are distributed differentially across the population, thus, as with mortality rates, differ-

entially affecting the forecast for increased participation at older ages across important variables such as wages, income, education, and gender. The complexity of these decisions, the interrelationships between the many variables both within and outside the Social Security system, and the fact that the retirement and work decisions change over time, would make it difficult to overlay these factors on a cell-based model.

A second economic example is analysis of the effect of income inequality. As wage inequality has steadily climbed, the size and composition of the population under the taxable maximum, and the distribution of replacement rates, has changed. It is difficult to predict the effect of a further widening of the income distribution with a cell-based model, but with a micro-simulation the implications can be examined by increasing the assumed volatility of shocks to wage income. Since, as we have seen, changes in the earnings distribution also affect variables such as labor force participation and mortality, being able to systematically incorporate these changes into a model is important.

Each of these examples highlights the fact that micro-simulation is most appropriately used when interactions are important and tractable. While it is relatively easy to gain agreement on the importance of interactions, the tractable test is somewhat more difficult to pass unanimously. Like all models, the behavior embedded in micro-simulation models requires a set of assumptions about how these interactions arise. Mathematical equations determine which individuals become disabled in a given year; enter, remain in or exit the work force and how much they earn; immigrate (or emigrate); "marry" (assigning them spouses with certain characteristics), have children, divorce, claim Social Security benefits, and, ultimately, die. Even though each of these decisions is typically based on the best available data, research and analysis, the complexity of the modeling and the gaps in our understanding and practical limitations create uncertainty about the reliability and accuracy of micro-simulation projections. That said, it is important to recognize that the same types of decisions are also being made in the cell-based model, they are just not made explicit. Bringing these best guesses into a micro-simulation model has the advantage that they are more exposed to scrutiny.

As noted earlier, the general advances over the past several decades in social science, computational capability, data, and modeling, coupled with an increased interest in Social Security and its long-range solvency, have created a rich environment for testing the plausibility of modeling decisions and techniques, collaboration with outside experts, and peer review. We favor approaches that rely on explicit, rather than implicit, relationships and assumptions. We believe that the advantages associated with micro-simulation, especially when taken in concert with our other recommendations, strongly argue for increased investment in and reliance on a single (integrated) micro-simulation model as a key tool in OCACT projections for the Trustees.

D. Presentation

At the nexus of transparency and clear exposition of uncertainty are a number of recommendations that have more to do with the presentation of the results, which apply regardless of the modeling techniques used.

Presentation Recommendation P-1: **Shift the emphasis toward the intermediate-term and away from very long-term measures such as the infinite horizon forecasts. Shift emphasis toward the use of annual cost and income rates, and away from summarized 75-year balances.**

Presentation Recommendation P-2: **Include in the analysis an explicit comparison of the U.S. experience with other countries.**

Presentation Recommendation P-3: **Report annually the accuracy of previous estimates and projections.**

Presentation Recommendation P-4: **Increase the use of graphical representations of uncertainty.**

Presentation Recommendation P-5: **Improve the explanation of trust fund accounting and its implications.**

Near vs. Long-Term

While it is clearly reassuring to address the long-term (including the impulse to assure the public of "sustainability" for an infinite horizon), it is more important to be straightforward about what is reasonably "knowable" and what remains highly speculative. We know (relatively) a lot about beneficiaries and workers for the next 25 years—even then, substantial uncertainty still remains, such as the future rates of immigration.

In contrast, 75 years into the future is far more uncertain. The longer the projection period, the more uncertainty exists. The single point estimates associated with distant horizons may yield a false sense of precision; and the casual use of these estimates is often misleading.

Despite the fact that the Trustees are required to report on system finances over a 75-year horizon, they have the discretion to focus greater attention

on longer or shorter time periods. The Panel recognizes that there are pros and cons of emphasizing long-horizon forecasts. Advantages include that they allow the full effect of policy changes to be played out, and that they reveal long-term imbalances, perhaps thereby encouraging more comprehensive reform. Conversely, there are also serious disadvantages. The great uncertainty about economic, demographic, and other policy conditions at long horizons decreases the credibility of long-range estimates. Small errors in assumed growth rates can lead to big mistakes, and smaller but meaningful reforms can appear insignificant when compared to enormous but distant deficits. Emphasis on long horizons can invite policies that balance system finances but only by including deferred and unrealistically high tax increases or benefit cuts.

To illustrate the sensitivity of the infinite horizon actuarial balance to relatively small changes in assumptions, consider a reduction in the real interest rate from 2.9 percent to 2.6 percent, consistent with our recommendation in this report. A back-of-the-envelope calculation shows that the actuarial balance increases by about 60 percent. In general, the calculation is enormously sensitive to small changes in the growth rate of the Gross Domestic Product (GDP) or interest rates.[10]

On balance we believe that for analysis of the trust funds the disadvantages of very long-range forecasts outweigh the advantages, and we recommend that for the annual Trustees Report emphasis be further shifted toward the intermediate term of 25 years and the use of annual cost and income rates, and away from long-term measures including the 75-year summarized balance.[11]

International Comparisons

As will be evident in succeeding chapters, we believe comparisons with other countries, especially the developed and aging "industrialized" nations provides valuable insights. Although we do not fully understand the cause of many of the disparities, the fact that the consistent experience abroad is quite different from ours suggests the possibility of convergence; perhaps they will all gravitate toward us or perhaps we will gravitate toward them.

Forecasting Record

We believe that the accuracy of past projections should be the subject of routine reporting, either in the Trustees Report or in separate supplemental publications on methodological developments. There should be an analysis of the accuracy of past 10-, 20-, and 30-year projections similar to those periodically done by the Census, Bureau of Labor Statistics, and Congressional Budget Office. The report should include a comparison of the high-cost and low-cost scenario variants and how often past outer bounds have been exceeded for each variable.

Use of Graphs and Charts

Advances in computing make it much easier to include more graphs and charts that incorporate large amounts of seemingly unrelated data. For example, graphical techniques such as fan charts convey more information than the high-cost and low-cost scenarios. Just as a predicted hurricane track is bounded by a cone of uncertainty, so too can the projections of trust fund components be shown with individual and collective bounds over time.

Nature of Trust Funds

Among the developments likely not foreseeable in 1932 was the passage of the Social Security Act in 1935. Modeled in part on European retirement systems, this centerpiece of President Franklin D. Roosevelt's signature New Deal program included an accounting device euphemistically called a "trust fund." The program was described as "insurance" even though it was more "assurance" of a generational promise to provide a modicum of income to those who were disabled or retired. Initially, with 35 workers for every beneficiary, it was relatively easy to fund the program. The projection of ample trust fund balances over long periods was used to justify periodic increases in benefits. However, almost from its inception, the Social Security program has been essentially pay-as-you-go, with payroll tax collections funding current benefits, and not accumulating "savings" for the future. The trust fund does not hold a store of value equal to future obligations. In that sense, it is not "fully-funded" as we think of private retirement plans.

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[10] The calculation assumes a cost rate in excess of the revenue rate of 2 percent of GDP starting in 2040, and a long-run GDP growth rate of 1.9 percent. The 2 percent gap is discounted to the present, using either 2.6 percent or 2.9 percent as the discount rate.

[11] There are circumstances, however, when longer horizons are necessary to understand the dynamics of major policy changes—important effects may not appear until a generation or more in the future. For example, a change from pay-as-you-go funding to something akin to pre-funding would likely require a long transition period and the full effects would not be manifest until well beyond 75 years. For this purpose, a horizon of 150 years or more may be appropriate.

Trust fund balances, and the dates of trust fund "exhaustion," continue to receive prominence in the Trustees Report. Surprisingly little, however, is said in the introductory sections about what the trust funds represent, beyond saying that the securities held are a firm obligation of the U.S. Treasury.

It is important to convey, at the beginning of the report, that the trust fund functions as an accounting mechanism and to explain how that mechanism works. The trust fund limits the legal authority to pay benefits. Paying benefits from trust fund "assets" requires increasing taxes, borrowing, or cutting other federal spending, as would be the case if there were no trust fund. These points are made in the body of the report, but that material should be drawn upon to provide guidance right at the beginning.

With regard to the date of trust fund exhaustion there are two issues. The first is that the date receives more prominence than seems warranted—it seems to suggest that we are simply spending down accumulated assets until that date and that no benefits could be paid after that date. Neither is accurate. A more minor issue is that what is assumed about cash flows following an exhaustion date is not always clear. This is particularly true of the Disability Insurance (DI) fund where the exhaustion date does not seem to affect benefit payments, even in presentations where Old Age and Survivors Insurance (OASI) fund exhaustion does.

As noted above, paying benefits from trust fund "assets" requires increasing taxes, borrowing, or cutting other federal spending, as would be the case if there were no trust fund. The fact that trust fund balances are positive should not be viewed with great comfort. Nor is the trust fund ever completely "exhausted" as the usual connotation implies. Even when the balance reaches zero, there will be a flow of revenues that can be used to make payments—about 70 percent of the payments under current projections. The trust fund is more like a checking account and will have "insufficient funds" by mid-century; today's workers are making deposits to cover the checks being written to their parents. Our children will do the same for us, except there will be fewer of them to make deposits. Come 2042 or thereabouts, the account will not have enough deposits to cover full payment on all the checks.

Resources for Development

We have no doubt that implementing even some of our recommendations will require more resources for OCACT. However, it is not necessary for the actuaries to accomplish all model development in OCACT. With increased transparency, academic and other research centers can make meaningful contributions from outside government. Similarly, much of the work of Social Security Administration's Office of Policy could be incorporated more readily than is apparently the current practice. Other governmental agencies, such as CBO and GAO, could assist in evaluating the productivity and efficacy of specific analytical alternatives, even to the point of sharing code. The actuaries could use outside developers to replicate or augment their existing code.

Chapter 2: Demographic Assumptions and Methods

Demographic models and assumptions that provide estimates of the future population size and age structure are central to projecting future Social Security revenues and expenditures. The estimates of future population growth are generated from the initial population and assumptions concerning the total fertility rate, legal and other-than-legal immigration, and trends in mortality improvement. These estimates ultimately are used to determine the number of workers covered by Social Security and the number of beneficiaries in each year.

A. Fertility

Assumption Recommendation A-1: **The Panel believes that there is greater risk (and cost) to the trust funds associated with overestimating the total fertility rate over the next 75 years than underestimating it. We therefore recommend retaining the intermediate assumption of 2.0 from the 2007 Trustees Report, but we assume a high-cost total fertility rate of 1.5, 0.2 lower than that of the Trustees, and a low-cost rate of 2.1, rather than 2.3. In Chapter 1, the Panel recommended that the Trustees adopt asymmetric high-cost and low-cost assumptions relative to their intermediate assumption. We made this recommendation because policy makers and future retirees should be able to understand the direction of our uncertainty in evaluating alternative assumptions for the deterministic projections prepared by Trustees. It should be noted here that the intermediate series is not the "average" or "most likely" assumption, nor are the low- and high-cost alternatives brackets with known sampling distributions, such as a 95 percent confidence interval about the mean.**

Overview

The fertility assumption is expressed in terms of the total fertility rate (TFR), the average number of births per woman over her lifetime, assuming she survives to the end of her reproductive period and is exposed to the same age-specific schedule of fertility as observed in a given year. As a summary measure of fertility, the total fertility rate is a composite of the changes in the tempo, or timing, of childbearing and the level, or quantum. We address both components of the TFR in our discussion and recommendations.

In order to inform short and longer term perspectives on fertility, it is useful to look at historical patterns. It was suggested to the Panel that the previous 10-25 years are the most relevant period for our analysis.[12] And as a review of the empirical evidence from this recent period demonstrates, these findings are consistent with inferences supported by a much longer time series. When the data from the past 20 years is analyzed along with comparable date from the last 200 years, two conclusions emerge: (1) U.S. fertility is likely to continue to decline or plateau at current levels (i.e., not increase) and, (2) the baby boom of the 1950s is an aberration rather than a precursor of the immediate future. Although there have been numerous changes in women's employment, age at marriage, wage rates, and family-friendly work place policies, the total fertility rate in the United States has remained relatively stable since the 1970s.

The Trustees interpret their long-run scenarios of the fertility rate as a statement about the aver-

[12] The Panel convened a one-day meeting on "The future of U.S. fertility trends" on November 27, 2006. Outside experts who participated were Hans-Peter Kohler, Ph.D., Professor of Sociology, University of Pennsylvania; Ronald Lesthaeghe, Ph.D. Professor Emeritus of Demography and Social Sciences, Free University of Brussels (VSB); and S. Philip Morgan, Ph.D., Professor of Sociology, Duke University. Lowest-low fertility is largely a European Union phenomena not observed until after 1990 (see Kohler, H-P, F.C. Billari, and J.A. Ortega, "Low Fertility in Europe: Causes, Implications and Policy Options," in F. R. Harris (Ed.), *The Baby Bust: Who will do the Work? Who Will Pay the Taxes?*, Lanham, MD, Rowman & Littlefield Publishers, 2006, pp.48-109.).

age level of fertility. This is reasonable; however, changes in fertility across much of the industrialized world strongly supports three key observations: (1) the traditional methods (historical analysis, expert opinion) are poor at predicting changes in fertility level; (2) the traditional view about replacement fertility as a natural floor is being proved incorrect; and, (3) feedback loops that link demographic processes are usually overlooked.[13] Adding another 100 million people to the U.S. population in the next 50 years, for example, may have a depressing effect on fertility if growth is highly concentrated geographically. Several economists have suggested that increases in public pensions, and particularly PAYGO pension schema, suppress subsequent fertility.[14] Current models relating fertility to public policy treat fertility as exogenous to the pension system, rather than as a lagged endogenous input into the solvency of the system. Such an effect on a public pension system could operate through increasing income and payroll taxes, or the consumer price index.

Historical Background

The total fertility rate (TFR) for the U.S. has been marked by temporary downturns and upswings, but overall fertility has charted a remarkably steady downward trend over the last 200 years.[15] Because whites are the largest racial/ethnic group in the population, the fertility rate for the population as a whole closely tracks that of white females. As can be seen in Figure 5, fertility rates for white women fell steadily in the 1800s and in the early part of the last century. Fertility increased during the early years of the Great Depression in the 1930s[16] and nearly doubled at the end World War II, reaching its peak in 1956, before resuming its historic decline to the current level of 2.05.

A closer examination of fertility rates by race/ethnicity shows this same downward trend for blacks and Hispanics. (See Figure 6.) Since 1980 the total fertility rate, weighted by the relative size of its racial/ethnic components, has hovered at or around the replacement level of 2.11, with a narrow 25-year range of 1.80 (1983) to 2.08 (1990). While the rate for Hispanic women is higher overall than for white or black women, it, too, has been declining. In 2005, there was eight-tenths of a child difference between the higher TFR of Hispanics and either the white or overall TFR. For Mexican-origin mothers, the comparable TFR was greater by slightly more than one child.[17]

In Figure 7, historical trend lines allow comparison of the total fertility rate, the weighted average of age-specific birth rates for women defined to be in their child-bearing years at a point in time,[18] and cohort fertility (CFR), which is fertility of the same women at successive ages.[19] The TFR is sensitive both to the level and stability of age-specific fertility, as well as the timing of child-bearing. Although the cohort fertility rate smoothes out temporal fluctuations in the period TFR and yields a more straightforward interpretation, it can only be estimated after cohort reproduction is complete. As a result, its usefulness as a projection tool is limited.[20]

Reflecting on the historical data presented here, the Panel anticipates a historically low total fertility rate over the course of the next 25 years, with a narrow range of 1.5 to 2.1, and an ultimate TFR that may well be below replacement levels. However, it is important to note that a negative growth rate for the U.S. is not inevitable, depending on the sheer number of immigrants and their level of fertility.

Uncertainty

There are several reasons for asserting that there is more uncertainty on the low side rather than

[13] Note we do not discuss rates of childlessness in this section. While as much as 18-20 percent of cohorts who have completed their childbearing years never bore children, the effect on the actuarial balance is likely to be trivial because of longer work lives of childless women. For data on childlessness in the U.S., see Abma, J.C. and G.M. Martinez, "Childlessness among Older Women in the United States: Trends and Profiles," Journal of Marriage and Family, 68: 1045-1056, 2006.

[14] Boldrin, M., M. De Nardi, and L.E. Jones, "Fertility and Social Security," NBER Working Paper 11146, 2005; and Ehrlich, Isaac and Jinyoung Kim, "Has Social Security Influenced Family Formation and Fertility in OECD Countries? An Economic and Econometric Analysis," Journal of Pharmaceuticals Policy and Law, Vol. 9, 2007 pp. 99-120.

[15] Although Hacker, 2004, dates the long term decline in white fertility to the 1840s and the drop in white marital fertility to after the Civil War.

[16] Greenwood, J., A. Seshadri, and G. Vandenbroucke, "The Baby Boom and Baby Bust," The American Economic Review 95(1), 2005, pp. 183-207.

[17] Martin, J.A., B.E. Hamilton, P.D. Sutton, et al., "Births: Final Data for 2004", National Vital Statistics Reports, 55(1), Hyattsville, MD, National Center for Health Statistics, 2006.

[18] Typically this is considered to be within the age range 15-44, but in light of increasing age at child-bearing the National Center for Health Statistics now reports the number of births to women aged 45-49 and 50+. See Hamilton B.E., J.A. Martin, S.J. Ventura, Births: Preliminary Data for 2005. Health E-Stats, Released November 21, 2006.

[19] Data is from the National Center for Health Statistics and published by Schoen, 2006, and Preston and Sten, 2007.

[20] Schoen, R., *Dynamic Population Models*, Dordrecht: Springer, 2007.

on the high side of fertility in preparing 25-year and 75-year projections. Among these are: timing of births by parity (the total number of live births ever had by a woman); tempo vs. quantum differences; international comparisons with other highly developed countries; and new insights into the relationship between migrant fertility, especially births to Mexican-born mothers, and the overall fertility rate in the United States.

Timing of Births, Parity, and Levels of Fertility

Most demographers attribute the decline in fertility in the United States and in the European Union to delayed childbearing patterns and to changes in

Figure 5: Total Fertility Rate: White Women, 1800-1998

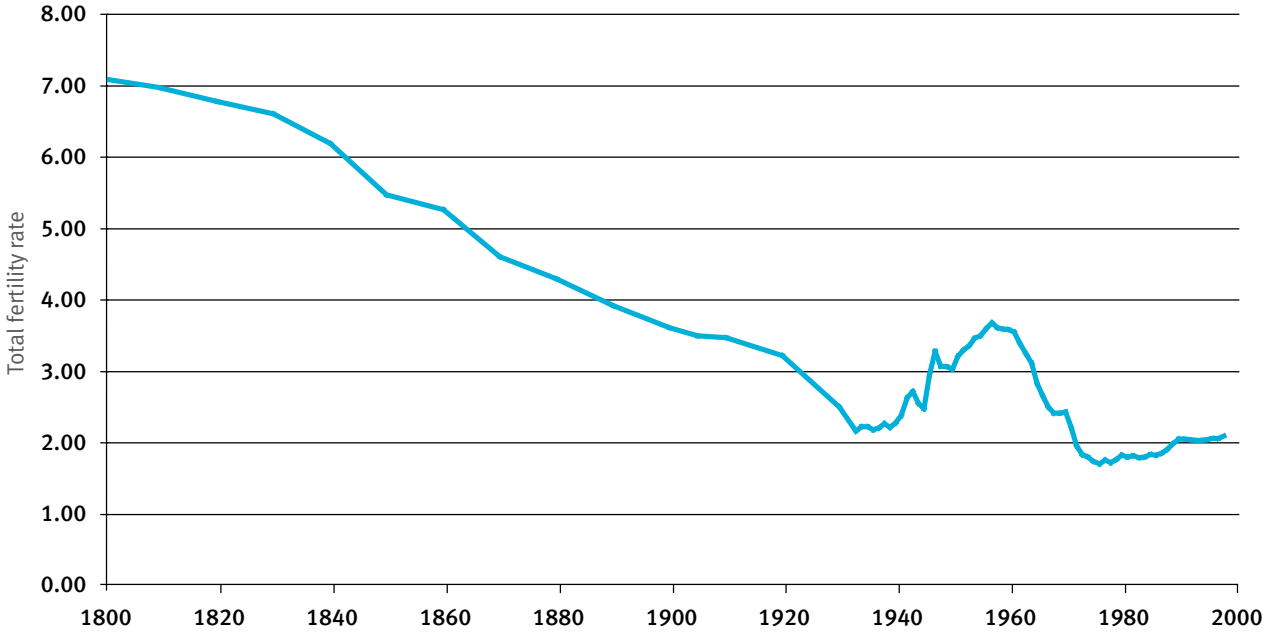


Figure 6: Total Fertility Rate by Race/Ethnicity: 1980-2004

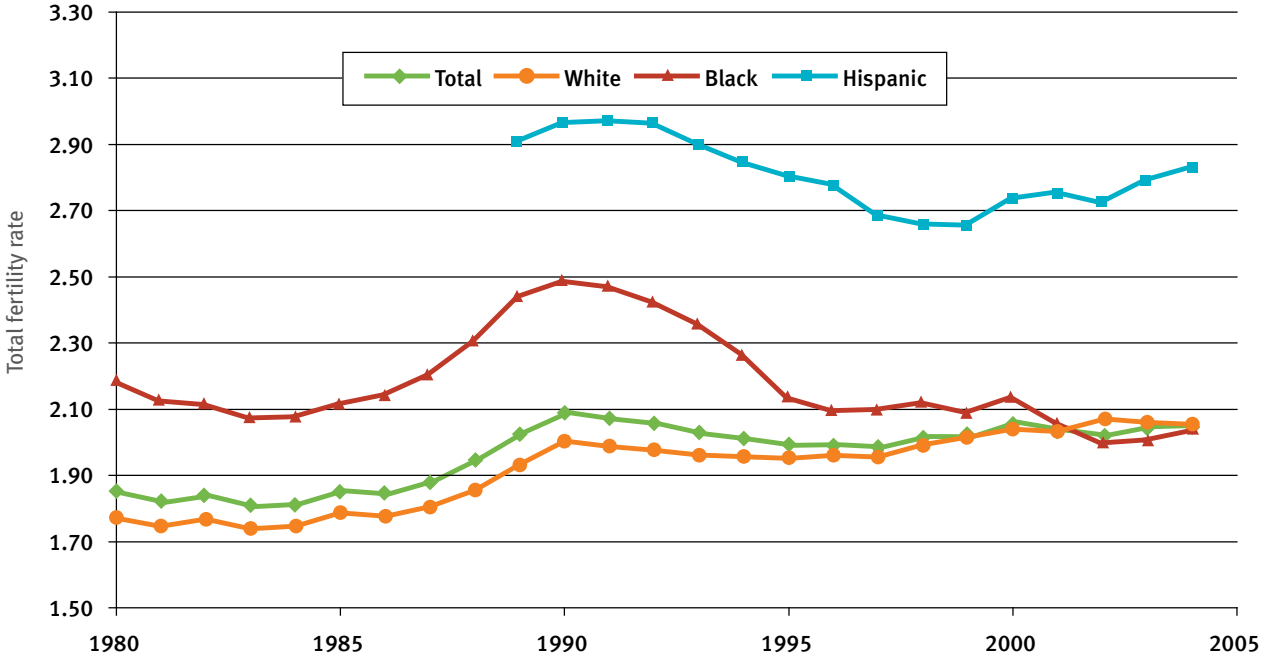
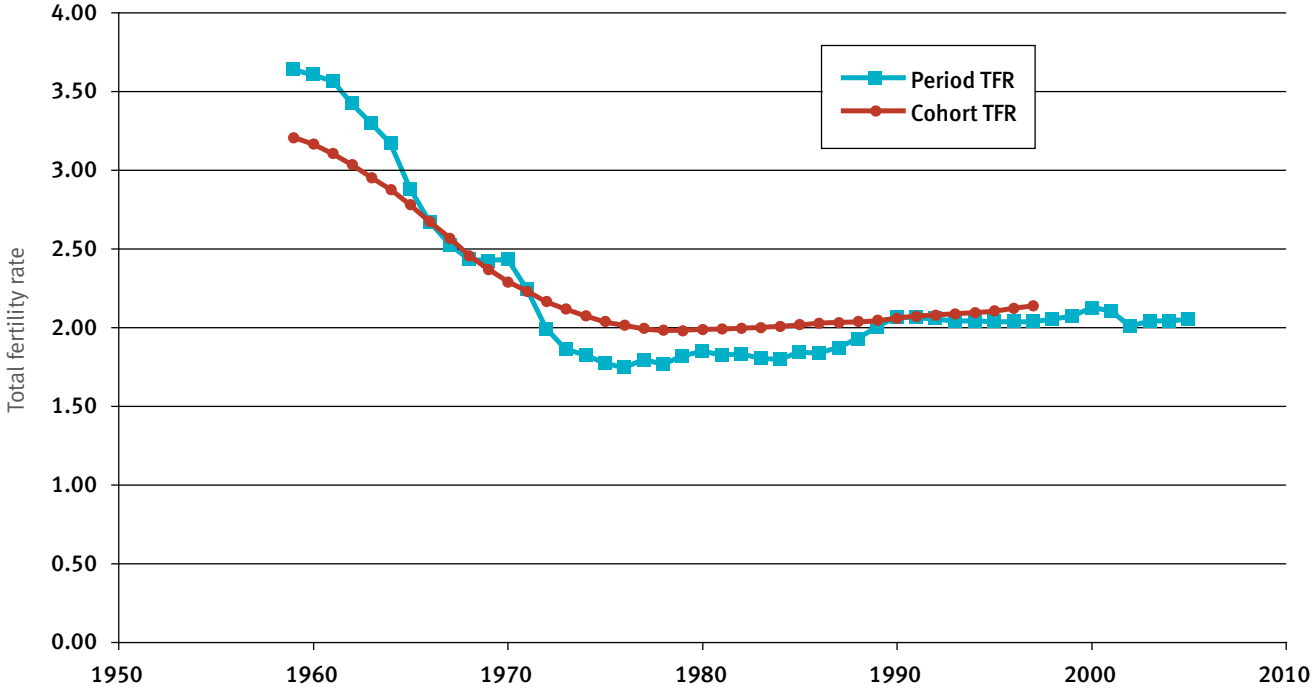


Figure 7: Period Total Fertility Rate and Cohort Total Fertility Rate: 1959-2005



the distribution of parity.[21] Research done on the 1960-61 birth cohort by Shkolnikov et al.[22] demonstrated that the decline in fertility is related to more women having two or fewer births. We recommend that the Trustees carefully monitor birth rates and the timing of childbearing for the population as a whole, by race, ethnicity and nativity.

For most of the last century, births to older women have been associated with high fertility and high parity but this is no longer the case. As shown in Figure 8, birth rates for women 30 years of age and younger have been declining while births to mothers aged 40-44, and especially to women aged 45-49, have been rising. Traditionally, late fertility has been interpreted as the opportunity cost of highly educated women who postpone childbearing. Preston and Sten,[23] however, suggest that the effect of education on the timing of childbearing is overstated. To an unknown extent, the increasing fertility of women in their 40s may reflect increased availability and use of assisted reproductive technologies that can extend childbearing years, as well as minimize the consequences of infertility and subfecundity.

Regardless of the age of the mother, nearly three-quarters of all births have been first or second-born children. From 1990 to 2004, nearly one-half (49.8 percent) of all births to women aged 45 and over were first or second live births; only 15.3 percent were to women with six or more births. Consistent with these trends, the overall mean age of childbearing has been steadily rising from 25.0 in 1980, to 26.4 in 1990, to 27.5 in 2004. These same trends, of lesser magnitude, are evident in other racial and ethnic groups. In 2004, for example, when the mean age-at-first-birth was 25.4 for whites, it was 25.2 for all Hispanics. In contrast, the average age of first birth for Mexican-origin mothers was 22.5, only 0.2 of a year lower than the average age at first birth for black mothers.

Table 3 presents estimates of the period total fertility rate (TFR) and the mean age at first birth (MAFB) for the U.S. and select countries whose current fertility rates are considered to be at the "lowest-low" level. In addition to the U.S., Greece, Italy, Spain, and Japan, all experienced fertility rates at 2.0 or less in the 1970s-1980s and reached lowest-low levels (TFR of 1.3 or less) in the 1990s.[24]

[21] Kohler, et al., 2006, pp. 48-109, op. cit.

[22] Shkolnikov, V.M., E.M. Andreev, R. Houle, and J.W. Vaupel, "The Concentration of Reproduction in Cohorts of Women in Europe and the United States," *Population and Development Review*, 33(1), March 2007.

[23] Preston, S.H. and S.R. Sten, "The Future of American Fertility," Paper presented at the 9th Annual Joint Conference of the Retirement Research Consortium, Washington, D.C., August 9-10, 2007.

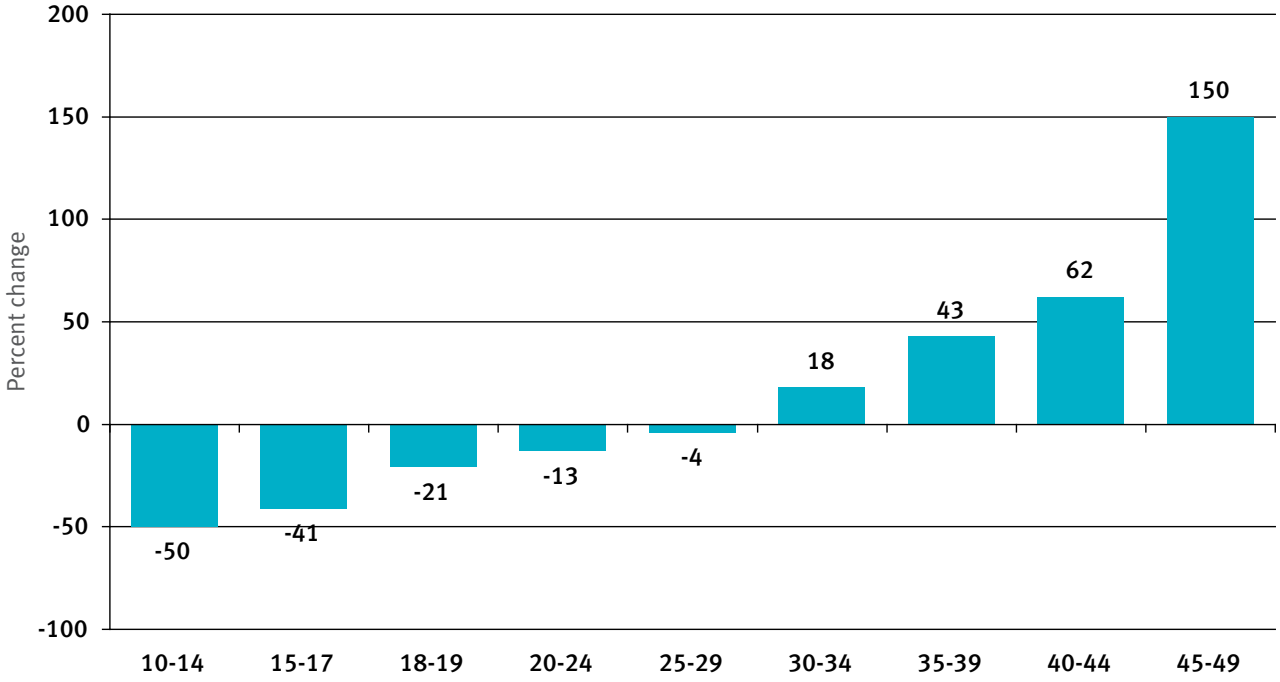
[24] The TFR in Japan did not fall below 1.3 until 2003.

Table 3: U.S. vs. Select Lowest-low Fertility Countries: Mean Age at First Birth (MAFB), and Total Fertility Rate, 1980 – 2002, and Annual Rate of Increase in MAFB (1990-2000)

Country	1980		1990		2000		2002		Annual rate of Increase in MAFB 1990-2002
	MAFB	TFR	MAFB	TFR	MAFB	TFR	MAFB	TFR	
Greece	24.1	2.23	25.5	1.39	27.3[a]	1.29	--	1.25	0.2
Italy	25	1.64	26.9	1.33	28.7[b]	1.24	--	1.27	0.26
Spain	25	2.2	26.8	1.36	29.1	1.24	--	1.25	0.23
Japan	26.4	--	27	--	28	--	28.3	1.29	0.1
U.S.	22.7	1.81	24.2	2.08	24.9	2.06	25.2[c]	2.04[c]	0.07

a = 1997; b = 1999; c = 2004
SOURCE: Kohler, et al. 2006: Tables 1 and 2; and Martin, et al. 2006: Table 14

Figure 8: Percentage Change in U.S. Birth Rates by Age of Mother: 1990-2004



In 1980 the MAFB in the U.S. was 22.7, while in Italy and Spain the mean age was in excess of 25.0 and 26.4 years of age in Japan. The annual rate of increase in the mean age-at-first-birth in all of the countries, except Japan, was in the range of 0.14-0.19 from 1980-1990. But during the period 1990-2000, the annual rate of increase in the mean age accelerated in Greece, Italy and Spain by an average of 0.23, while the annual rate of increase fell to 0.10 in Japan and to 0.07 in the U.S., a drop of nearly 50 percent relative to the average annual rate for the preceding decade. An average annual rate of increase in the MAFB of 0.20 is considered rapid,[25] signaling a change in the timing of fertility.

Quantum Change and Shifts in Composition

While the Panel believes that lower levels of fertility are likely, we recognize that it is important to understand the factors that have led to a fertility level in the U.S. that is substantially above the experience of most other high-income nations. One might argue that the U.S. simply trails behind Europe and Japan, and that fertility will fall to historically low levels in future years,

[25] Kohler, et al., 2006, op. cit.

as has occurred in other wealthy countries. The 2003 Technical Panel observed that the high fertility rate of U.S. women may be the result of a greater ability to combine work and childbearing. Flexible work hours, access to a range of public and private child support services, and the relative ease of leaving and re-entering the work force make this a more viable lifestyle option. However, if the real or opportunity costs of childrearing increase, the fertility rate may well decline. This scenario is in part determined by wage growth, productivity, and employment rates. The Panel suggests that the Trustees commission a detailed study of macroeconomic effects on childbearing in the U.S. in a model that allows for recursive linkages.

Rather than extend the work of the 2003 Technical Panel, this Panel focused on the compositional differences between our population and those of the lowest-low fertility countries. As pointed out in Figure 6 some of the largest immigrant and minority groups within the U.S. have fertility levels that are well above the national average. In 2005, the total fertility rate (2.045) rose slightly from the previous year but was still below replacement levels of fertility. In contrast, the TFR for Hispanics in 2005 was above replacement (2.877) and 41 percent higher than the national average. The rate for Mexican mothers was 3.021 in 2004, the last year for which the TFR is available by country of origin. Whether or not the fertility of Mexican-origin women will continue to exceed that of non-Hispanic white women by an average of one child in the short-term, remains to be seen. It is further unknown whether or not the fertility of Mexican-born women will be sufficient to rejuvenate the size and age structure of the U.S. population over the next 25 or 50 years.

Fertility Behaviors of Mexican-Born and Mexican-American Women

Conventional wisdom is that the fertility behavior of migrants and their immediate descendents quickly approaches similar levels as the fertility of non-migrant, native-born white women. There are numerous reasons why migrants might adjust their fertility downward over time and across several generations of descendents, including cultural assimilation of U.S. fertility norms, adaptation to new economic opportunities, and the higher relative cost of child bearing in the U.S.[26] These theories lead us to expect a decline in migrant fertility.

Immigrants from Mexico have the potential to have a large effect on the fertility rates in the U.S. If we look closely at fertility trends in Mexico, we see that the total fertility rates in that country are falling and, as of 2000, were almost on a par with the U.S. In fact, over the next 30 years the TFR in Mexico is expected to fall to 1.86. Much of this has been attributed to a rapid decline in larger families, a rapid uptake in contraception, and increases in age at first birth.[27] Even in the context of declining fertility trends in their country of origin, the fertility rate of Mexican immigrants has exceeded Mexican national levels since 1994.[28] However, what may be even more surprising is that third or higher generation Mexican-Americans, overall, have more children than Mexican migrants or first-generation Mexican-American women.[29] Research has shown that cohort differences in the timing of childbearing account for this anomaly and it is not anticipated that these generational differences will persist.[30] Parrado and Morgan further show that when cohorts and migrant generations are arrayed on a more realistic generational time line, fertility differentials largely converge between whites and Mexican-born migrants, as well as with second and third generation Mexican-Americans. [31]

While immigration will continue to impact the increase in the U.S. resident population in proportion to the size of migration streams, at this time neither the number of new additions, nor the fer-

[26] Lindstrom, David P. and Silvia G. Saucedo, "The Short- and Long-Term Effects of U.S. Migration Experience on Mexican Women's Fertility", *Social Forces*, Vol. 80, No. 4, June 2002, pp. 1341-1368.

[27] Tuiran, R., V. Partida, O. Morjarro, and E. Zuniga, "Fertility in Mexico: Trends and Forecast", Completing the Fertility Transition, Department of Economic and Social Affairs, Population Division, United Nations, 2002, pp. 483-506.

[28] This cross-over was not observed in 1997, however.

[29] Using pooled data from the June Fertility Supplements to the 1984-1986 Current Population Surveys (CPS), Bean et al., 1984, first noted the inverse correlation between fertility and generational status of Mexican-Americans in cross-section. Using the 1986-88 CPS Fertility Supplements, Bean et al., 2000, reached similar conclusions.

[30] Frank, R. and P. Hauveline, "A Crossover in Mexican and Mexican-American Fertility Rates: Evidence and Explanations of an Emerging Paradox," Demographic Research, Vol. 12:78-101, 2005.

[31] Parrado, E. A. and S. P. Morgan, "Intergenerational Fertility among Hispanic Women: New Evidence of Immigrant Assimilation", unpublished manuscript, 2007. Earlier studies based on cross-sectional data alone compare the fertility of same-aged women who differ by self-reported generational status, especially second- and third-generation Mexican-American women. This comparison involves descendents of different Mexican birth cohorts, born 25-30 years apart. Parrado and Morgan, on the other hand, index their comparisons to first generation migrant birth cohorts. The completed fertility estimates for the 2nd and 3rd generation Mexican-Americans are offset by a 25-year lag between adjacent generations. Their approach allows for pseudo inter-generational estimates that more realistically mimic migrant family progress in adapting to the U.S.

tility of their descendents three generations out, is of a magnitude to offset the momentum of near-replacement fertility over the next 25-50 years.

B. Mortality

Assumption Recommendation A-2: **For the intermediate-cost scenario, the Panel recommends that assumed ultimate rates of mortality decline by age and sex be increased to an average of 1.00 percent per year to be consistent with those observed during 1953–2003 for the total population. Assumed ultimate rates of mortality decline for the low-cost projections should be held at their current levels (averaging 0.33 percent per year). Assumed ultimate rates of mortality decline for the high-cost projections should be increased to an average of 2.00 percent to reflect the potential for the U.S. to reach rates of mortality reduction seen in international data.**

Method Recommendation M-8: **The Panel recommends that the mortality projection model be simplified by dropping separate projections by cause of death and stating assumptions in terms of age-specific rates of decline for all-cause mortality.**

Method Recommendation M-9: **The Panel recommends that the infinite horizon mortality projection model be dropped.**

Overview

The Panel recommends that the Trustees increase the assumed rates of mortality decline for the intermediate-cost and high-cost projections, while also simplifying the projection model by eliminating the breakdown by causes of death. This recommendation can be justified by an analysis of historical trends for the U.S. alone, but it is also supported by the recent mortality experience of other high-income countries.[32] The 1.00 percent per year ultimate rate of decline recommended by the Panel for the intermediate-cost projection is consistent with levels recommended by the 1999 and 2003 Technical Panels and represents a reaffirmation of the view of a substantial number of independent experts that the Trustees should increase this parameter. The last significant increase in this parameter was made in 2000, but to a level substantially below the level recommended by the 1999 Panel.

The Trustees currently project rates of mortality decline separately for each of seven causes of death. These projections are based on cause-specific mortality data for 1983–2003 for five age groups, two sexes, and seven causes, for a total of 70 parameters. Consideration of the low-cost and high-cost projections increases the total number of parameters to 210. Such detail should be dropped from the projection process; it is unlikely to produce more accurate results and there is little empirical basis for current assumptions. Moreover, the Panel believes that the use of the 21-year period 1983–2003 as the basis of a 75-year projection is too short; a better basis would be the 51-year period 1953–2003.

The Panel believes that there is substantial uncertainty in the 75-year projection and that the uncertainty is asymmetric with greater risk on the high side. The Panel recommends that the ultimate rates of mortality decline for the low-cost projection be held at their current level of 0.33 percent per year. The ultimate rates of mortality decline for the high-cost projection, however, should be increased substantially to 2.00 percent to reflect intrinsic uncertainty inherent in projections based solely on experience data from the U.S., as well as additional uncertainty arising from the potential for the U.S. to reach rates of mortality decline seen in international data for 33 high-income countries with higher life expectancies.

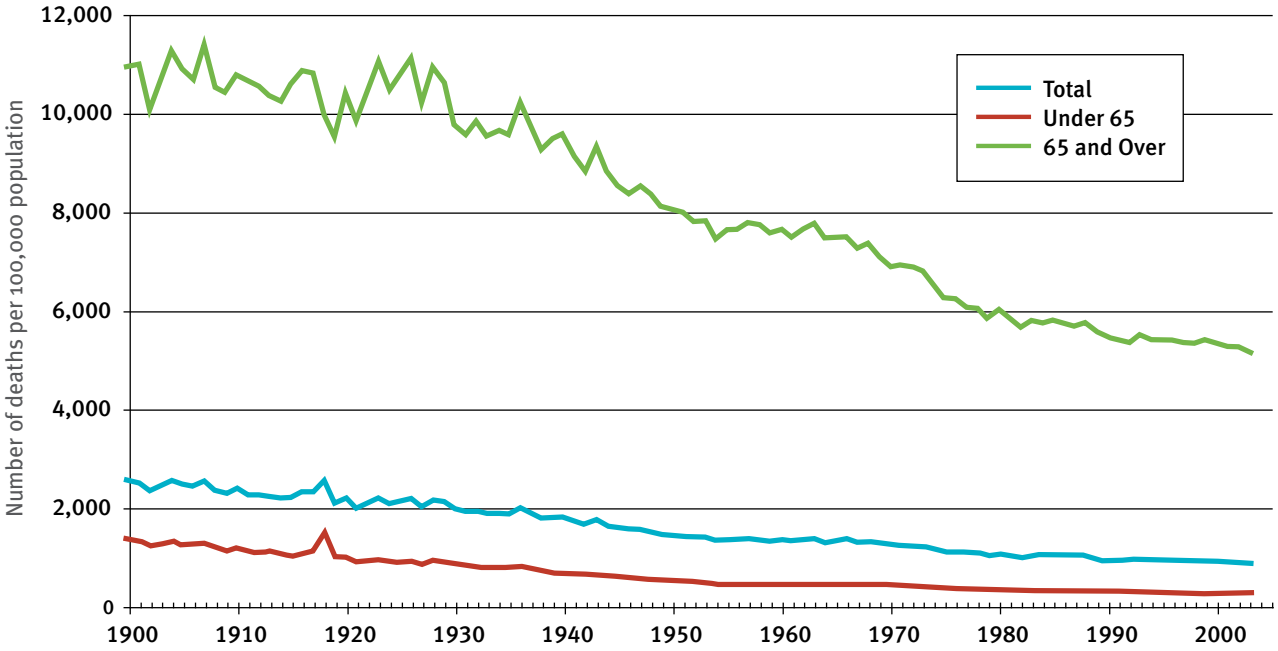
The uncertainty of the future mortality projection increases as the interval from the base year to the targeted future year of the projection increases. Given that existing projections of mortality 75 years into the future are already highly uncertain, projections of mortality even further into the future (including over the "infinite horizon") will be even more uncertain, making it impossible to select any one set of assumptions as a best estimate or to quantify the uncertainty in a meaningful way. The 2003 Panel[33] recommended "assuming a cessation of mortality decline at all ages beginning in 2200 following a linear reduction in rates of decline (toward zero) beginning at the end of the ultimate period (i.e., 2077)." The stated basis for this assumption was that "one should not assume positive rates of mortality decline farther into the future than has been observed in the past."[34] The current Panel rejects this notion and believes there is no credible reason to expect that mortality declines will

[32] U.S. Census Bureau, National Population Estimates, July 1, 2006, Population Division, Washington, D.C., 2007.

[33] Technical Panel on Assumptions and Methods (2003), Report to the Social Security Advisory Board, October 2003, p. 40.

[34] Ibid

Figure 9: Age-Adjusted Central Death Rates by Age and Calendar Year, 1900-2003



cease in 2200. Given the range of scientific breakthroughs in our understanding of the fundamental mechanisms of disease and aging that may occur over the next 200 years, the Panel considered the possibility that mortality declines in 2200 may be substantially larger than the current declines, with life expectancy increasing one to two years or more per decade. Carnes and Olshansky[35] argue that major breakthroughs will be essential if continued mortality reductions are to occur after life expectancy at birth reaches about 85 years.

Historical Background

Mortality risks across the age range fell dramatically during the 20th century (see Figure 9), leading to a large rise in life expectancy at birth (and at all ages) for both men and women in the U.S.

For the total population, life expectancy at birth rose from 47.7 years in 1900 to 76.6 years in 2000, a 61 percent increase over the century. However, most of this increase (71 percent) occurred before 1950. Life expectancy at older ages exhibited much smaller increases, with major differences in the timing. At age 65, for example, life expectancy rose from 11.7 years in 1900 to 17.6 years in 2000, a 28 percent increase. However, most of this increase (66 percent) occurred after 1950. These timing differences are fundamental to our choice of the specific historical period 1953–2003 as the basis of the 75-year projections.

Part of the slowdown in the rise of life expectancy at birth was due to the disproportionate influence of infant and child survival on this measure of average lifespan. Once childhood mortality became rare, there were few deaths left to eliminate in early life, making it more difficult to raise life expectancy at birth.[36] In addition, there was a substantial reduction between the first and second halves of the 20th century in rates of mortality decline among both children (ages 0–14) and adults of working age (15–64); see Figure 10.

On the other hand, at ages 65 and above, the pace of mortality decline generally accelerated over the century, thanks to an unprecedented reduction in certain forms of old-age mortality (especially cardiovascular disease) beginning in the late 1960s; see Figure 11.

Figures 9–11 demonstrate clearly that mortality declines varied considerably from decade to decade, and by sex. The 1940s and 1970s stand out as periods of very rapid improvement, while the last 20 years have been less favorable, especially for fe-

[35] Carnes, Bruce A. and Jay S. Olshansky, "A Realist View of Aging, Mortality, and Future Longevity,", Population and Development Review, 33(2):367–381, 2007.

[36] Keyfitz, Nathan, *Applied Mathematical Demography*, 2nd Edition, New York: Springer-Verlag, 1985; and Wilmoth, John R., "The Future of Human Longevity: A Demographer's Perspective," *Science*, 280: 395-97, 1998.

Figure 10: Age-Adjusted Central Death Rates at Age 0-64 by Sex and Calendar Year, 1900-2003

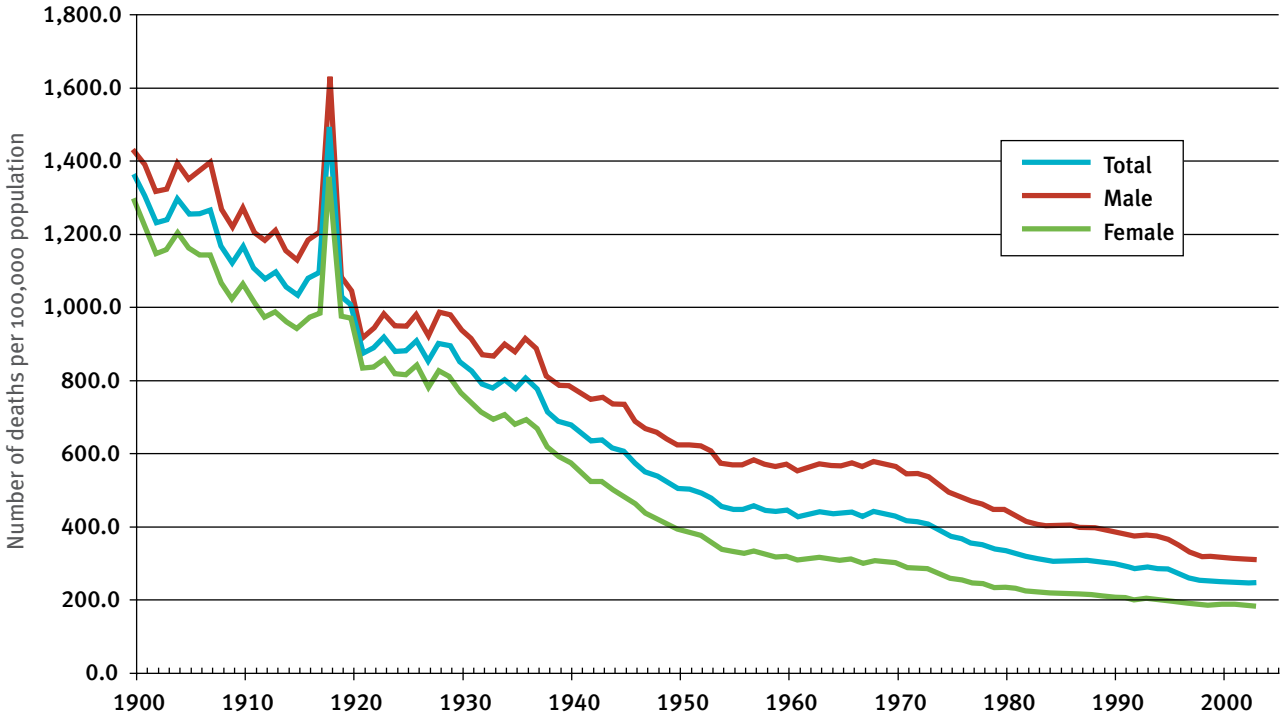
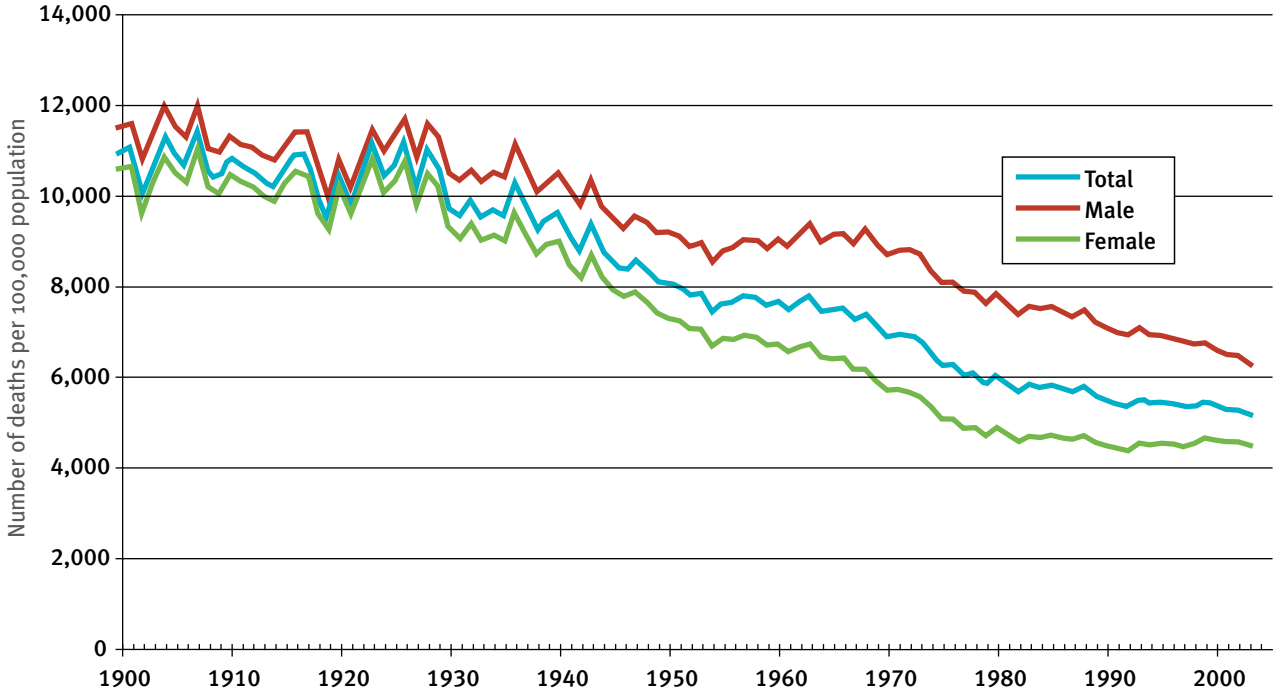


Figure 11: Age-Adjusted Central Death Rates at Age 65 and Over by Sex and Calendar Year, 1900-2003



males. The period 1982–1999 represented a period of stagnation for females, but not males, while the period 1954–1968 represented a period of stagnation for males, but not females.

The Panel's recommendation that the projections be based on the 51-year period 1953–2003 ensures that the calibration data include sub-intervals of rapid improvement as well as stagnation. This recom-

Table 4: Assumed Ultimate Average Annual Percentage Reductions in Central Death Rates, 2007 Trustees Report

Alternative	Low Cost	Intermediate Cost	High Cost	Low Cost	Intermediate Cost	High Cost
	Male			Female		
Under Age 15						
Heart Disease	0.5	1.0	2.0	0.5	1.0	2.0
Cancer	0.8	2.0	5.2	0.8	2.0	5.2
Vascular Disease	0.3	0.6	0.7	0.3	0.6	0.7
Violence	0.6	0.9	1.2	0.6	0.9	1.2
Respiratory Disease	1.5	2.5	3.0	1.5	2.5	3.0
Diabetes Mellitus	1.1	1.8	2.3	1.1	1.8	2.3
Other	2.0	1.8	1.5	2.0	1.8	1.5
Resulting Total *	**1.43**	**1.54**	**1.48**	**1.46**	**1.57**	**1.49**
Ages 15 - 49						
Heart Disease	1.1	2.3	3.1	1.1	2.2	3.0
Cancer	0.2	0.5	1.9	0.2	0.5	2.0
Vascular Disease	1.0	1.8	2.1	1.0	1.8	2.1
Violence	0.5	0.8	1.6	0.5	0.8	1.6
Respiratory Disease	0.3	0.5	0.8	0.3	0.5	0.8
Diabetes Mellitus	0.2	0.3	0.4	0.2	0.3	0.4
Other	0.5	0.8	1.2	0.3	0.6	1.0
Resulting Total *	**0.52**	**0.86**	**1.54**	**0.41**	**0.73**	**1.45**
Ages 50 - 64						
Heart Disease	1.1	2.0	2.9	1.1	2.2	3.1
Cancer	0.1	0.4	1.2	0.1	0.4	1.3
Vascular Disease	1.0	1.5	2.1	1.0	1.6	2.3
Violence	0.5	0.8	1.6	0.5	0.8	1.6
Respiratory Disease	0.3	0.6	0.9	0.3	0.7	0.9
Diabetes Mellitus	0.2	0.3	0.6	0.2	0.3	0.6
Other	0.5	0.9	1.5	0.4	0.8	1.4
Resulting Total *	**0.46**	**0.82**	**1.48**	**0.36**	**0.72**	**1.41**
Ages 65 - 84						
Heart Disease	0.7	1.7	2.3	0.8	1.8	2.4
Cancer	0.1	0.5	1.8	0.1	0.5	1.8
Vascular Disease	1.3	2.5	3.1	1.3	2.6	3.1
Violence	0.5	1.2	1.7	0.5	1.2	1.7
Respiratory Disease	0.0	0.2	0.4	0.0	0.2	0.4
Diabetes Mellitus	0.3	0.6	0.9	0.3	0.6	0.9
Other	0.1	0.3	0.6	0.1	0.3	0.6
Resulting Total *	**0.31**	**0.72**	**1.30**	**0.30**	**0.68**	**1.23**
Ages 85 and older						
Heart Disease	0.6	1.2	1.7	0.6	1.2	1.7
Cancer	0.0	0.4	1.2	0.0	0.3	1.2
Vascular Disease	0.8	1.9	2.5	0.8	1.8	2.4
Violence	0.4	0.9	1.2	0.4	0.9	1.2
Respiratory Disease	0.0	0.2	0.4	0.0	0.2	0.4
Diabetes Mellitus	0.3	0.6	0.9	0.3	0.5	0.8
Other	0.0	0.2	0.5	0.0	0.2	0.5
Resulting Total *	**0.25**	**0.62**	**1.03**	**0.26**	**0.61**	**1.01**

* Resulting total represents average annual percent reduction in age-adjusted death rates for the last 50 years of the 75-year projection period.
Source: Social Security Administration, Office of the Chief Actuary, August 16, 2007.

mendation gives appropriate weight to the arrested decline above age 80 beginning in the 1980s, as well as mortality reversals above age 85 during the 1990s. The 1999 and 2003 Panels suggested that unfavorable trends in old-age mortality during the 1980s and 1990s may reflect the delayed effects of increased levels of smoking among women; recent articles offer empirical support for this explanation.[37]

Current Trustees' Assumptions

In recent years, the Trustees have specified their mortality assumptions in terms of ultimate rates of mortality decline by age, sex, and cause of death. For their 2007 Report, the complete set of assumptions consists of 70 numbers (5 age groups × 2 sexes × 7 cause categories). Consideration of the low-cost and high-cost projections increases the total number of parameters to 210; see Table 4 (unchanged since 2002). Technically, these ultimate rates are the fundamental assumptions of the model, and all other summary statistics are results of the projection exercise. However, these values are not included in the Trustees Report, nor are they otherwise publicly available. The Panel included them here to make them publicly available and recommends that the Trustees make them available in future reports or in supplementary online tables (unless the Trustees adopt our Method Recommendation M-8 to drop the cause of death detail from the projection process).

In lieu of the detailed tables, the Trustees summarize these assumptions by reporting the implied ultimate rates of decline (i.e., during the last 50 years of the 75-year projection horizon) for all-cause mortality and for a limited number of broad age groups (e.g., 0–14, 15–64, and over 65), adjusted to remove the effects of changes in the distribution of the population by age and sex. For example, the 2007 Trustees Report contains the following description:

"After adjustment for changes in the age-sex distribution of the population, the resulting total death rates are projected to decline at ultimate average annual rates of about 0.33 percent, 0.70 percent, and 1.21 percent between 2031 and 2081 for alternatives I, II, and III, respectively. In keeping with the patterns observed in the historical data, future rates of decline are assumed to be greater for younger ages than for older ages, but to a substantially lesser degree than in the past. Accordingly, age-sex-adjusted death rates for ages 65 and over are projected to decline at average annual rates of about 0.28 percent, 0.66 percent, and 1.15 percent between 2031 and 2081 for alternatives I, II, and III, respectively."[38]

The Panel agrees that summarization of the assumptions in Table 4 over all ages or for broad age ranges is reasonable and provides appropriate transparency. Indeed, this is precisely the mode the Panel selected in formulating its recommendations to the Trustees with respect to their assumptions:

Assumption Set	Low Cost	Intermediate Cost	High Cost
Trustees' Assumptions	0.33	0.70	1.21
Panel's Recommendations	0.33	1.00	2.00

Nonetheless, the Panel believes that it will not be apparent to the general reader that these assumptions imply a gradual deceleration in the pace of mortality decline throughout the projection interval. During the ultimate period and beyond, this deceleration is driven by the cause-of-death methodology: over time, categories that are assumed to decline the most slowly account for an increasing portion of deaths.[39]

In addition to this built-in deceleration, there is also an explicit assumption of a pronounced slowdown in mortality decline below age 65 during the first 25 years of the projection period. Below age 15 this deceleration is roughly twice as large as the historical slowdown that occurred between the first and second halves of the 20th century; for ages 15-64 it is about 1.5 times as large. For ages 65 and above, the Trustees' assumptions imply rates of mortality decline throughout the projection interval (0.66 percent per year) and for the sub-interval 2031–2081 (also 0.66 percent per year, as noted above) that lie below the historical average both for the 20th century as a

[37] Pampel, Fred C, "Cigarette Use and the Narrowing Sex Differential in Mortality," *Population and Development Review*, 28(1), 2002, pp. 77–104; and Wang, Haidong, and Samuel H. Preston, "Forecasting U.S. Mortality Using Cohort Smoking Index," *Demography*, 43(4):631–646, 2006.

[38] 2007 *Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds*, U.S. Government Printing Office: Washington, D.C., 2007, p. 74.

[39] Wilmoth, John R., "Are Mortality Projections Always More Pessimistic When Disaggregated by Cause of Death?" *Mathematical Population Studies*, 5(4), 1995, pp. 293–319.

whole (0.78 percent) and for the period 1950–2000 (0.82 percent). The overall rates of decline for the overlapping periods 1950–2000 and 1953–2003 were 0.98 percent and 0.97 percent, respectively, both of which were rounded to 1.00 percent in forming our recommendation for the intermediate-cost projection based on analysis of long-term historical trends for the United States.

Explanation of Panel's Recommendations

Mortality projection involves a series of choices about how to extrapolate historical trends in death rates by age. Five of the most important choices concern the following: (1) method(s) for computing historical rates of change in age-specific death rates; (2) whether to consider various components of mortality separately (i.e., causes of death); (3) whether to perform separate projections for subpopulations (by sex, race, etc.); (4) historical period(s) from which assumed rates of future mortality decline are derived; and (5) whether to accelerate or decelerate rates of decline compared to the historical baseline. More detail about various aspects of these topics is contained in Wilmoth.[40]

Rates of Change

The first issue is methodological, concerning the formulas used to compute rates of mortality decline by age. The 2003 Panel considered two methods—the "slope" and "endpoint" methods. Briefly, the slope method consists of using a simple statistical technique to find the line that best fits the historical mortality trend for a given age group. On the other hand, the endpoint method considers only the decline between the beginning and the end of the time period, ignoring intermediate data. Differences between the two methods can be quite significant in certain cases, affecting assumed rates of mortality decline that are derived from historical experience. Nevertheless, each method possesses certain advantages from a methodological point of view.[41] The 2003 Panel used an average value based on both methods for analyzing historical trends and setting assumptions. The current Panel used a modified form of the endpoint method that provided an alternative approach to dealing with the limitations of the simple form of the endpoint method (see below).

Parsimony

The second and third issues exemplify the need for a balance between simplicity and complexity. In both cases, the current Panel agreed with the 2003 Panel that the projection methods should favor simplicity. This Panel noted, however, that the principle of parsimony should apply only to the projection methods and not to the analysis of historical trends used to support the projections. Thus, the Panel applauds the Trustees and the Office of the Chief Actuary for investigating past mortality trends separately by cause of death and for men and women. (Other breakdowns could be useful as well, for example, by race, ethnicity, income class or nativity.) However, making separate assumptions about future rates of mortality decline by cause of death or for sub-populations adds complexity to the projection model without evidence of improved accuracy in forecasting.

A model based on separate projections by cause of death over a long time horizon is both implausible and inconsistent with historical experience. Historically, rates of decline for specific causes of death (or broad categories of causes) have tended to vary much more than for all-cause mortality, as populations often focus on combating those causes of death that dominate mortality patterns at a given moment. In the most successful cases, breakthroughs against specific diseases lead to rapid reductions in deaths from that cause. For example, antibiotic therapies sharply reduced infectious disease in the 1940s, and various factors decreased cardiovascular disease in the 1970s.

Methodologically, implementation of the cause of death assumptions implicitly assumes that the selected list of causes is the correct list and that the causes are functionally independent. Neither of these conditions holds. For example, in reviewing the list of diseases in Table 4, the Panel noted that diabetes is a risk factor for heart and vascular disease so that changes in any one of these "causes" cannot be independent of changes in any other. All three are related to diet and nutrition which may be treated as more fundamental in the causal chain.[42] Similarly, cancer and respiratory disease are related to cigarette smoking which may also be treated as more fundamental in the causal chain. Violence is related to alcohol use (murder) and depression (suicide), both of which are components of the "other" cause category.

[40] Wilmoth, John R., "Overview and Discussion of the Social Security Mortality Projections," *Social Security Advisory Board Working Paper*, 2005.
[41] Ibid.

[42] Stallard, Eric, "Demographic Issues in Longevity Risk Analysis,", Journal of Risk and Insurance, Vol. 73(4):), 575–609, 2006, pp. 575–609.

Furthermore, the empirical basis for the Trustees' current cause-specific assumptions seems to be weak. In general, it is very difficult to construct consistent time series of mortality data by cause of death over long historical periods (for any country, not just the U.S.) due both to a lack of data for earlier periods and to changes in cause-of-death coding practices over time. The Trustees' current projections are based on mortality data by cause for the U.S. beginning with 1979. Cause-specific mortality data are available electronically for the period 1968–1978, but are coded using a prior version of the International Classification of Diseases and are not used by the Trustees.

Thus, on the basis of trends over little more than two decades, the Trustees derive rates of mortality decline for seven hypothetically independent cause-of-death categories over a time horizon extending from 75 years to infinity. However, the connection between data and assumptions is not always clear. For example, the assumed ultimate rate of decline for cancer mortality in the 65–84 age range is 0.50 percent per year for both sexes, although observed values were 0.23 percent for men and -0.69 percent for women during 1981–2001.[43] There is little written explanation of how these assumptions were developed; the Panel recommends that this information be made more readily available if the current method is retained.

Bell and Miller[44] explain the assumptions as follows:

> "Ultimate annual percentage reductions in central death rates by sex, age group, and cause of death were postulated for years after 2029. The broad age groups for which specific rates of reduction were selected are: under age 15, ages 15–49, ages 50–64, ages 65–84, and age 85 and older."
>
> "Even though ultimate annual percentage reductions in central death rates are postulated for the seven causes ..., the resulting percentage reduction in age-adjusted central death rates for all causes combined are carefully reviewed, analyzed, and adjusted to assure consistency with the overall assumed rates of reduction. For each age and sex group, the decomposition of the percentage reduction by causes also provides a useful tool to test the reasonableness of the overall reduction."

Material presented to the Panel by OCACT[45] indicated that:

> "Ultimate annual percentage reductions in central death rates are assumed to apply for years starting with 2030. The percentages were determined based on historical trends and consideration of many factors ... which affect mortality. Expected rates of improvement in mortality by cause of death have long played a role in selection of ultimate mortality improvement assumptions for the Trustees Reports. While these rates by cause of death have not effectively "controlled" the outcome for assumptions reflecting all causes combined, they serve as an important basis for analysis relative to past trends and for assessment of reasonableness of future assumptions."
>
> "Because reductions in mortality have differed widely by age in the past, the ultimate reductions in death rates have been selected to vary by age group. Historically, reductions have been very rapid at the youngest ages. However reductions at the highest ages, 85 and over, have been very slow. [The Trustees'] assumptions have reflected for many years the belief that neither of these extremes will persist indefinitely into the future. The Trustees assumptions have reflected slower improvement at the youngest ages than evidenced over the past century and faster improvement at the highest ages (85 and over) than experienced historically. While this "compression" of rates of mortality improvement is in conflict with a literal interpretation of the Lee and Carter method, it was nevertheless endorsed explicitly by the 1999 Technical Panel, where Ron Lee was the principal demographer on the panel."

These descriptions indicate that a substantial amount of professional judgment is involved in setting the ultimate rates of mortality decline used by the Trustees. One critical component of

[43] See Table 3 in Bell, Felicitie C., and Michael L. Miller, Life Tables for the United States Social Security Area 1900–2100, Actuarial Study No. 120, Social Security Administration, Publication No. 11-11536, 2005.

[44] Ibid, p. 8.

[45] Documents presented by the Office of the Chief Actuary to the Technical Panel, December 2, 2006.

this process appears to be an evaluation of the implications for all-cause mortality of the selected set of ultimate rates.

The Panel's recommendation takes this approach one step further and shifts the focus solely to all-cause mortality without explicit consideration of the cause specific components. This is feasible given that there is no aspect of the actuarial calculations that depends on cause specific mortality projections. Moreover, once the cause-specific mortality projections are dropped, much longer historical periods can be used as the basis of the projections. Regarding sub-populations, separate mortality projections based on different historical rates of decline lead either to continual divergence between groups, or to convergence and eventual crossover (i.e., where groups change their relative positions). Both situations seem rather unlikely, at least for long-term projections. Although recent differential trends by sex could plausibly continue for another 10–20 years, the Panel recommends that ultimate rates of mortality decline be equal for men and women, derived from trends for the total population.

International comparisons can also be helpful as a guide to future mortality trends despite differences in levels. The U.S. differs from other wealthy countries in ways that affect the overall level of mortality (e.g., more inequality, a less extensive social safety net), and the current gap in levels could remain for many years. However, it seems much less likely that the pace of mortality decline will be vastly different over the long term amongst this close-knit group of nations. The post-1980 slowdown in mortality reduction for the U.S. was not typical; most high income countries have enjoyed an accelerated mortality decline at older ages during the last two decades, sometimes starting from lower levels than the U.S. in 1980.[46] These experiences support the Panel's recommendation for a projected recovery from the recent period of slow mortality decline in the U.S.

Use of Historical Experience

The fourth and fifth issues concern the subjective application of historical experience to choices about assumed rates of future mortality decline. A comparison of 20th century trends before and after 1950 is informative for these choices. Figure 10 shows that there was a pronounced deceleration in rates of mortality decline at younger ages between 1900–1950 and 1950–2000, although the trend was quite variable from decade to decade. On the other hand, Figure 11 shows that the rate of mortality decline above age 65 increased from the first to the second half of the 20th century. This change might be taken as evidence that the historical peak rate of mortality decline at older ages has not yet arrived. Indeed, the possibility of major breakthroughs in our understanding of the fundamental mechanisms of disease and aging might be used to justify an assumption of a continued acceleration of mortality decline at older ages. However, the Panel believes that this argument would be too speculative to serve as a "best estimate".

Although it is generally accepted that long-term mortality projections should not be based on short historical intervals, the Panel believes that half a century is long enough to avoid giving undue weight to atypical, short-term trends. Figure 12 displays the changes that would occur in the calculated annual rates of decline as one shifted the start year of the historical base period throughout the interval 1940–2002, using the "endpoint method" identified above. The calculations in Figure 12 are based on the data displayed in Figure 9 and clearly indicate that the estimated rate of decline depends on the selection of the base period. For example, the 0.97 percent decline for 1953–2003 would change to 1.19 percent if the base period were 1968–2003 and to 0.65 percent if the base period were 1982–2003. The variability in the estimated rate of decline is smallest for base periods prior to 1963 where the recommended value of 1.00 percent is reasonably representative for all-age mortality.

Further insight into the recommendations can be obtained by considering the sex-specific rates of decline displayed in Figure 13, based on stratification of the data displayed in Figure 9.

The differences between the sexes in Figure 13 reflect the different impacts of the respective stagnation periods, 1954–1968 for males and 1982–1999 for females. Given the Panel's recommendation that the ultimate rates of mortality decline be equal for men and women, as derived from trends for the total population, it is apparent from Figure 13 that this will be most reasonably accomplished if the selected base period starts in 1963 or earlier, in which case the rates of decline for both males and females would close to 1.00 percent, the Panel's recommendation.

[46] Wilmoth, 2005, op. cit.; and Bongaarts, John, "How Long Will We Live?" Population and Development Review, 32(4):605–628, 2006.

Figure 12: Alternative Calculations of the Average Annual Rate of Decline in Age-Sex-Adjusted Death Rates, Starting at Each Calendar Year in the Interval 1940-2002 and Ending in 2003, All Ages and by Age Groups 0-64 and 65+

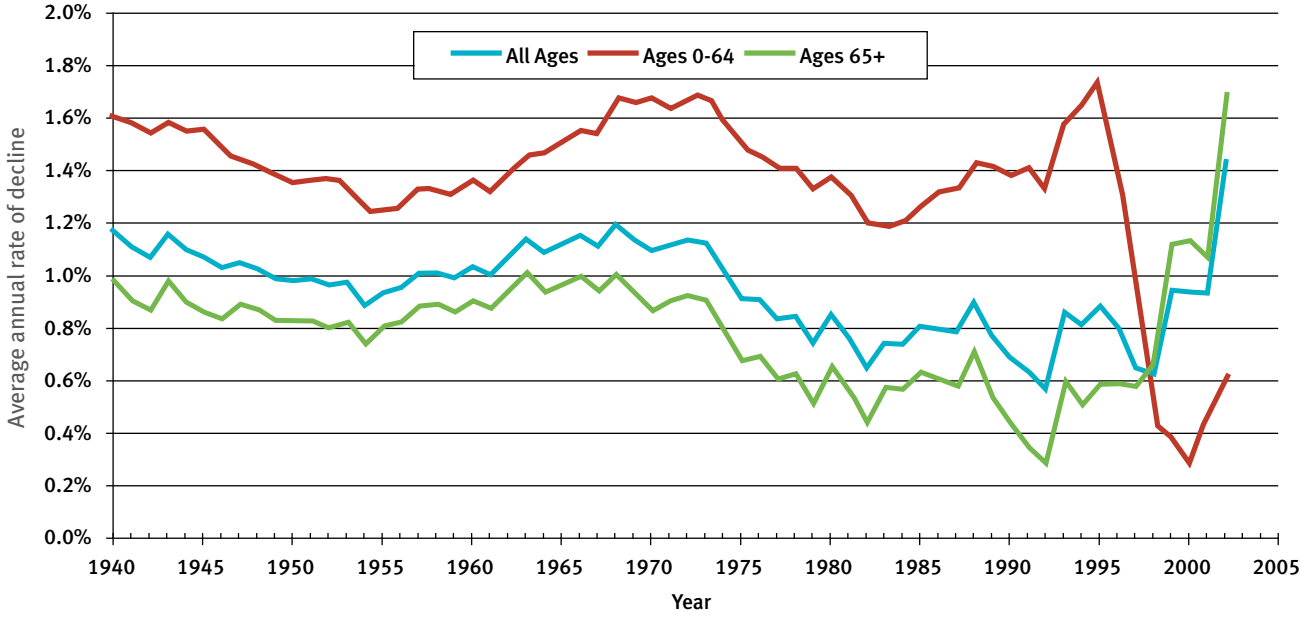
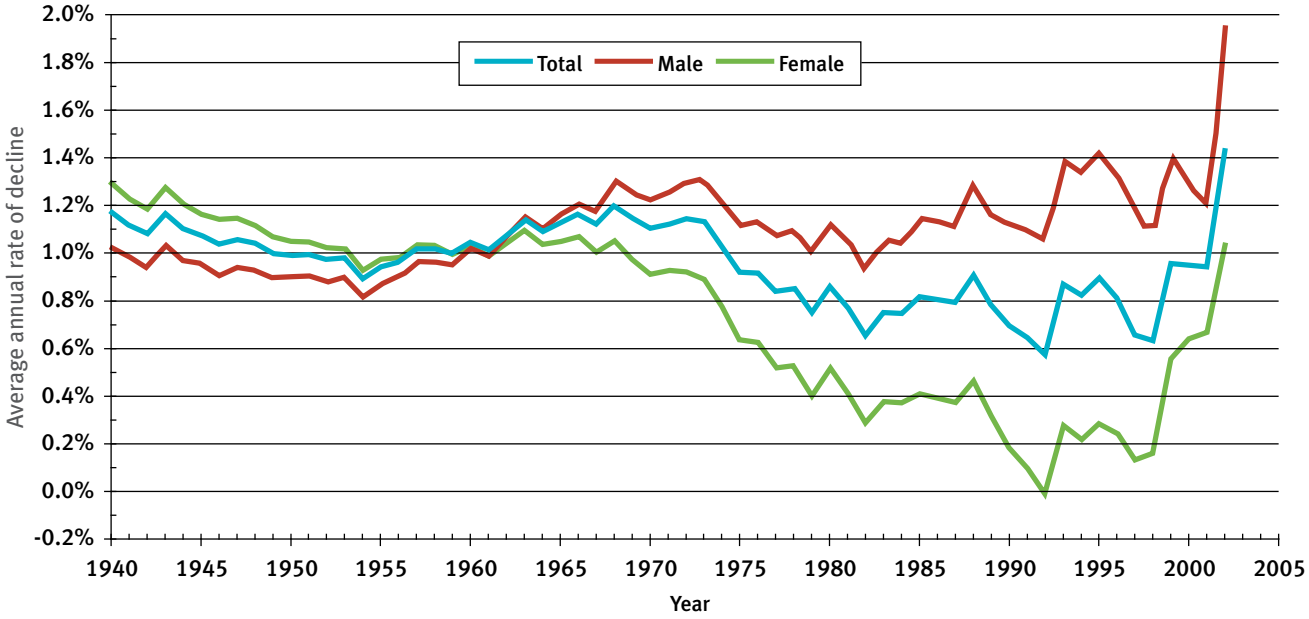


Figure 13: Alternative Calculations of the Average Annual Rate of Decline in Age-Sex-Adjusted Death Rates Starting at Each Calendar Year in the Interval 1940-2002 and Ending in 2003, All Ages, by Sex



The factors that may plausibly contribute to future mortality reductions may be best represented by a baseline that goes back 50–70 years. During this period, the medical treatment of sick persons became, for the first time in history, one of the major forces propelling mortality downward. This trend began in the 1930s with the introduction of an early generation of anti-bacterial drugs.[47] Other factors, broadly characterized as improvements in living standards and public health, drove earlier mortality declines. All of these factors played a role in the mortality reductions observed since 1950 in the U.S., and all of them are likely to influence

[47] McKeown, Thomas, The Role of Medicine: Dream, Mirage, or Nemesis, Oxford, U.K., Basil Blackwell, 1979.

future trends as well. These mortality reductions occurred despite the negative health effects of cigarette smoking and the more recent onset of the "obesity epidemic" and it is reasonable to expect that they will continue even in the face of these and other negative factors.

Wang and Preston demonstrated that the sex differences in mortality over the period 1948–2003 occurred on a cohort basis with increasing relative mortality for males born during or prior to 1903–1907 and decreasing relative mortality for males born during or after 1908–1913 at least through the cohort born in 1948–1953.[48] These differences were shown to be associated with sex differences in cigarette smoking by cohort with males attaining their peak smoking rates one generation earlier than females (i.e., about 25 years). An important outcome of their analysis was the prediction that "men's mortality will benefit enormously from reductions in smoking that have already occurred."[49] These changes were predicted to lead to a substantial narrowing of the sex differences in mortality over the next several decades.

The Panel is skeptical about the quality of mortality data from the first half of the 20th century, especially the accuracy of age reporting at older ages, and is unwilling to recommend using such data. This position effectively limits the starting year of the recommended baseline periods to the range 1950–1963, with a preference for periods of 50 years. Thus, the Panel recommends that assumed ultimate rates of mortality decline at older ages be based directly on the experience of 1953–2003, with neither the slowdown implied in the Trustees' current assumptions nor the uptick implied by models that assume major breakthroughs.

Conclusion

The Panel recommends using 1953–2003 as the historical baseline. Using the full 20th century for this purpose would be another possibility, but then the assumed pace of mortality decline at older ages would be slightly slower (see Figures 9–11). In contrast, the mortality decline at younger ages was much slower on average during the second half of the 20th century; therefore, the assumed rates of decline would be much higher with a baseline of 1900–2003 instead of 1953–2003. The most compelling reason to prefer the baseline of 1953–2003 over 1900-2003 is that the second half of the century was characterized by a more even pace of mortality decline across the age range, and it is reasonable to assume that this pattern will prevail in the future as well.

The 1999 and 2003 Panels differed with respect to their opinions regarding the use of the 25-year phase-in period during which the baseline rates of decline were linearly blended with the ultimate rates of decline, with the 2003 Panel recommending a more rapid transition over a 10-year phase-in. The current Panel is satisfied with the 25-year phase-in period and believes that it represents a reasonable method of transitioning to the ultimate rates of decline in Assumption Recommendation A-2.

C. Immigration

Assumption Recommendation A-3: **The Panel recommends that immigration scenarios should tie the level of net immigration to the size and growth of the U.S. population rather than decreasing or increasing constant numbers of immigrants. The Panel recommends that the Trustees move toward expressing their ultimate net migration assumptions as rates (annual number of net migrants divided by population size).**

Assumption Recommendation A-4: **The Panel strongly recommends that the Trustees increase significantly their assumptions regarding future levels of net international migration; at a minimum, projections of future migration should be brought into line with current measured levels of net international migration.**

- **In the intermediate scenario, net international migration should increase from 1,350,000 in 2007 by 1.0 percent per year through 2030; thereafter, net international migration should increase at 0.5 percent per year. At this level, immigration as a percent of population (the "net migration rate" or NMR)[50] remains within the range of both recent and historical experience. With the other demographic assumptions recommended by the Panel, this immigration scenario represents a net migration rate of 4.4 per 1,000 population at the beginning of the projections, gradually rises to 4.6 and then declines to 4.2 after 75 years. With this assumption, the average**

[48] Wang and Preston, 2006, op. cit.

[49] Ibid, p. 643

[50] Strictly speaking, the specified measure (immigration divided by population) is not a true demographic "rate" because the population in the denominator is not exposed to the risk of occurrences counted in the numerator. Nonetheless, the NMR measures the rate of growth of the population attributable to immigration and remains a useful term.

NMR over 2005–2080 is equal to the average over the 1980–2005 period or 4.4 per 1,000.

- **Our high-cost (lower immigration) scenario recommendation is to assume that net "other" immigration drops by 50,000 per year from the initial value of 500,000 to 200,000 and that net legal immigration is held constant during this period. Then, beginning from 1.1 million in 2012, legal immigration would increase by 0.25 percent per year and net other immigration at 0.5 percent per year. With these assumptions, the NMR[51] declines from approximately 4.3 per 1,000 at the beginning of the scenario, then drops quickly to 3.0 after 25 years where it remains constant throughout the rest of the 75-year projection. The Panel bases the high-cost scenario on assumptions that unauthorized migration might be brought under control and that the growth rate of legal immigration would be slower than population growth (i.e., a declining NMR).**
- **The low-cost (higher immigration) scenario assumes that annual immigration will have reached 2.8 million by 2080, a value consistent with an annual immigration increase of 1.0 percent. For the period from 2030 to 2080, immigration is assumed to increase by 0.5 percent per year, implying an increase of 2.1 percent per year for the period leading up to 2030. This scenario assumes a relatively rapid rate of increase in the short term, but a slow down for the long run. The NMR in this scenario peaks at 5.7 per 1,000 population for 2030–2035, equal to the 1995–2000 peak. The average NMR is 5.1, or slightly higher than the last 20 years, but less than the average over the long period of relatively high immigration to the U.S. in the second half of the 19th century and the early 20th. The Panel's recommendations for the low-cost and high-cost scenarios are designed to give a greater spread between high and low in the short-term than might be otherwise obtained from basic extrapolation models.**

Method Recommendation M-10: **The Panel recommends that the Trustees make fundamental changes in their approach for deriving net migration assumptions and for implementing the assumptions.**

Method Recommendation M-11: **The Trustees' net migration assumptions should not be based on the provisions of current immigration law, which are consistent with widely varying levels of net migration, and which can reasonably be expected to change in the future; but rather on an analysis of historical trends augmented by on-going and future research on behavioral, demographic and economic determinants of migration.**

Method Recommendation M-12: **The Trustees should disaggregate the demographic projection model by nativity (i.e., into native and foreign-born populations). Such a model would facilitate incorporation of significant known differentials into the projections, including: emigration (largely limited to former immigrants), fertility (higher for immigrants than natives), and labor force participation (higher for foreign-born males and lower for foreign-born females than for the corresponding native groups). Such a disaggregation can be implemented with the current cell-based projection model or micro-simulation models that might be adopted in the future.**

Method Recommendation M-13: **The age-sex distributions of net international migration components should accurately reflect the demographic logic of the model. Specifically, the age distribution of net "other" immigration should encompass both positive and negative values rather than simply reflecting the age distribution of the migrant population.**

In making these recommendations, this Panel strongly supports the concept of the principal immigration recommendation of the 2003 Panel while making some adjustments in level and method to reflect more recent measures of immigration. If the methodological changes recommended by the Panel are adopted, further adjustments are recommended to the assumptions. Specifically, rates of increase in net immigration recommended would be applied to the assumed levels of legal immigration and to assumptions regarding net "other." Emigration rates would be applied to the foreign-born population each year. With this type of assumption, net international migration might grow more slowly as emigration numbers could increase in line with growth of the foreign-born population, not the total population.[52]

[51] The NMRs reported for Panel scenarios other than the intermediate cost scenario are approximations based on projections carried out by the Panel with fertility and mortality assumptions approximating the Panel's recommendations, but varying only the immigration assumption. The precise values would differ slightly when implemented with other demographic assumptions.

[52] For applications of emigration rates see Passel, Jeffrey S. and D'Vera Cohn "U.S. Population Projections, 2005–2050," Pew Hispanic Center, Washington, D.C., February 2008; and Hollmann, Frederick W., Tammany J. Mulder, and Jeffrey E. Kallan, *Methodology and Assumptions for the Population Projections of the United States: 1999 to 2100*, U.S. Census Bureau, Washington, D.C., January, 2000.

Overview

International migration has proved to be the most difficult component to forecast of the three major demographic factors (fertility, mortality and international migration). In addition to social and economic determinants, the level of international migration is directly affected by specific national policies in ways that the other demographic components are not. Further, although many of the factors underlying migration trends are reasonably well-known, they have proved difficult to apply in a forecasting framework.

International migration is a particularly critical factor in the Trustees' projections. In the near-term future (the first 25 years of the projections), virtually all of the variability in the projected labor force ages (roughly ages 18–64) can be traced to the immigration assumption. The fertility assumptions affect only ages up through 25 (i.e., those cohorts not yet born); the mortality assumptions are extremely relevant for Social Security, but they mainly affect the older ages during this time. Indeed, virtually all of the projected growth in labor force ages for at least the next 50 years can be traced to immigrants and their U.S.-born offspring (Passel 2007).

Historical data on international migration show a steady upward trend in immigration levels since the 1930s. This steady growth shows up regardless of whether the backward look covers 25, 50, or 75 years. Annual immigration has grown at an average rate of around 4 percent since the early 1950s with net annual immigration averaging more than 1.3 million since 1995. This recent high level of immigration has been maintained in spite of a significant drop during 2002–2004 due to an economic slowdown and security concerns.[53] The growth rate in the number of immigrants is about the same when measured from the early 1930s and a bit less (just over 2 percent annually) when measured from the late 1970s. Legal immigration and net immigration show quite similar growth patterns.

During this most recent 75-year period, the volume of immigration, including both legal and unauthorized, grew faster than the overall rate of population growth (about 1.1–1.4 percent). As a result, the NMR increased steadily. For 1930–1945, the NMR was only 0.1 net immigrants per 1,000 population; by 1990–2005, it had reached 4.9.

The rapid growth of annual immigration reflects a steady increase in both legal and unauthorized immigration. The legal immigration changes are traceable to several major modifications in immigration law since 1952. Unauthorized or illegal immigration emerged on a large-scale basis only in the 1970s and was followed by significant expansion beginning in the late 1990s. The current legal immigration regime can be traced to major legislative changes in 1965, 1976, 1980, 1986, and 1990 followed by adjustments in 1996 and 2001.[54] These changes greatly increased the level of legal immigration and opened up the U.S. economy to larger numbers of legal temporary migrants ("legal nonimmigrants" in immigration lingo).

In the 1970s, large and increasing numbers of unauthorized migrants began to settle permanently in the U.S with their families. Notwithstanding laws against the knowing hire of illegal immigrants, the growth of this population accelerated in the 1990s until the unauthorized migrant population reached about 12 million by 2006.[55] With globalization of the U.S. economy, ever larger numbers of foreigners entered the U.S. as tourists, business persons, and as temporary workers. Even though only a small fraction of the visitors end up settling in the U.S. as unauthorized migrants (i.e., "overstayers"), the numbers eventually reached significant levels—about 4–5.5 million by 2005.[56] In addition, relatively inexpensive international travel and easy, inexpensive communication facilitated the settlement of both legal and unauthorized migrants in the U.S. Most of these trends have their roots within the last 25 to 35 years and point to the study of this period as a basis for projecting immigration into the future.

In contrast to these observed trends over the last 25, 50 or 75 years, the immigration assumptions adopted by the Trustees for projecting the OASDI trust fund display a stark discontinuity. The Trustees' projections start from a much lower

[53] For estimates see Passel and Cohn, 2008, op. cit.; and Passel, Jeffrey S. and Roberto Suro, "Rise, Peak, and Decline: Trends in U.S. Immigration 1992–2004," Pew Hispanic Center, Washington, D.C. September, 2005.

[54] Fix, Michael and Jeffrey S. Passel, *Immigration and Immigrants: Setting the Record Straight*, The Urban Institute Press, Washington, D.C., 1994; and U.S. Immigration and Naturalization Service, Statistical Yearbook of the Immigration and Naturalization Service, 1998, Washington, D.C., U.S. Government Printing Office, 2000, Appendix 1.

[55] Passel, Jeffrey S., "Size and Characteristics of the Unauthorized Migrant Population in the U.S.: Estimates Based on the March 2005 Current Population Survey," Pew Hispanic Center, Washington, D.C., March, 2006.

[56] Passel, Jeffrey S., "Modes of Entry for the Unauthorized Migrant Population," Pew Hispanic Center Fact Sheet, Washington, D.C., May 22, 2006.

level of immigration than the base year, project a near-term decrease in net immigration from this low level, and then reach a constant (and much lower) level after 20 years. In the intermediate scenario, the Trustees start with net immigration of 1,075,000 in 2007 or roughly 15 percent below the current level of net immigration. Net immigration is then assumed to decrease by about 0.9 percent per year to reach 900,000 by 2026 and then remain at that level for the remaining years of the projection. The Trustees' intermediate assumption also represents a marked break with NMR trends. The assumed pattern of net immigration implies a steady decrease from its current level to approximately 2.1 net migrants per 1,000 population. The NMR trend has been steadily upward since the 1930s. Further, the NMR was last as low as 2.1 in the late 1960s, before the U.S. opening of immigration to the world had taken effect.

The Trustees' high-cost scenario assumes lower ultimate levels of net immigration not seen since the 1970s; even the higher levels of immigration assumed in the Trustees' low-cost scenario just barely reach the levels attained in the last 10 years. The Panel finds these assumptions totally at odds with historical experience and highly implausible. Since a higher immigration assumption results in a larger and younger population, as well as a larger labor force in the near term, the impact of such an erroneous (and low) assumption on the system's finances is a major concern.

Although measurement of current and historic levels of immigration remains somewhat problematic (especially with regard to unauthorized migration, emigration, and year-to-year changes in the level of immigration), there have been a number of advances in recent years to support the Panel's recommendations. The bulk of legal immigration has been well-measured for more than a century, but estimates of the magnitude of illegal migration were very limited prior to the last two decades. Knowledge has improved thanks to demographic analysis of 2000 Census data, information about annual flows of migrants during the 1990s, historical analysis of the series of censuses during the 20th century, and improved measures from surveys such as the Current Population Survey (1994 and later) and the American Community Survey (2000–2004, with full annual implementation beginning with 2005).

The Panel recommends increasing the levels of immigration in the entire range of the assumptions used for projecting the OASDI trust funds. The Panel arrived at this conclusion only after agreeing on two fundamental changes in the way such assumptions are derived. First, current immigration law does not provide a sound basis for deriving plausible net migration assumptions, especially over the long-term horizon required for trust fund projections. Second, the most plausible, yet simple, manner of specifying an ultimate net migration assumption is in terms of the net migration rate (relative to the size of the U.S. population), rather than as a fixed number of migrants per year.

Historical Background

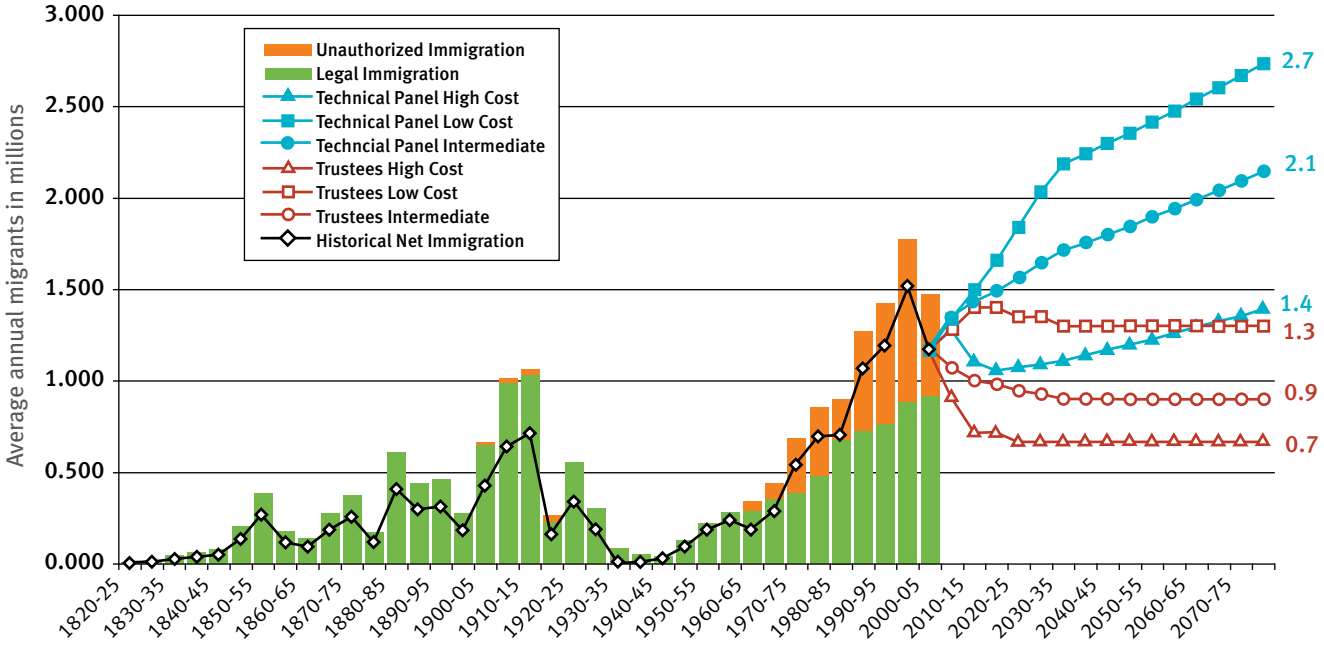
Legal immigration to the U.S. has undergone large swings in the history of the country. With the exception of a few periods marked by wars or economic difficulties, immigration flows to the U.S. moved steadily upward and peaked just prior to World War I during 1905–1915. Levels then declined largely as a result of decreased flows resulting from World War I and the first quantitative restrictions placed on immigration in the early 1920s. Immigration reached historic lows during the Great Depression and World War II. Since the end of the War, there has been a steady increase in the level of legal immigration (Figure 14). Immigration began to increase after World War II, but quantitative and geographic restrictions limited the level of legal immigration during the post-war period. After 1965, legislative changes throughout the second half of the 20th century gradually expanded the limits and led to larger numbers of legal admissions. By 2001–2006, the annual number of legal admissions averaged more than 1 million per year—a level last attained in 1910–1914.[57]

Components of Immigration

In the Trustees' projections, three categories of immigrants are taken into account. Each of these groups has a different history, different amounts of data available for analysis, and different characteristics that affect the OASDI trust funds. Accordingly, the assumptions and methods must be treated separately. The formal assumptions are formulated for somewhat different groups (defined below), but these three groups form the basis for the assumptions: (1) legal immigrants; (2) "other" immigrants,

[57] This comparison excludes the legalizations associated with the Immigration Reform and Control Act of 1986 (IRCA) that artificially inflated the annual admissions for 1989–1991.

Figure 14: Net Migration, Legal Immigration, and Unauthorized Migration to the U.S. 1820-2006 , with Projections of Net Migration to 2080 according to Trustees Report and Technical Panel Recommendations: Average Annual Migrants



consisting of illegal immigrants (i.e., unauthorized and undocumented migrants) and certain legal non-immigrants (i.e., temporary legal residents); and (3) emigration of legal immigrants.

Official government counts of legal immigrants are compiled by the Department of Homeland Security's (DHS) Office of Immigration Statistics (OIS).[58] These data form the basis for measuring legal immigrants, but they cannot be used without modification. The current data count the legal immigrants at the point when they formally become "legal permanent residents" (LPR). However, many of the LPRs have been in the country for a number of years—some had various permanent legal statuses such as refugee, asylee, or parolee; others had long-term temporary statuses such as foreign student or guest worker; some had short-term temporary statuses such as visitor for business or for pleasure (i.e., tourist); and others entered clandestinely or had expired legal statuses. To use the LPR data for demographic estimation, it is necessary to avoid double counting by subtracting those who had been counted upon entry in other statuses. Further, for some estimates, it is necessary to make adjustments for the various dates of entry of individuals attaining LPR status in a given year.[59] Notwithstanding the imprecision of LPR data, this is by far the best measured component of total net immigration. As of 2006, there are roughly 25 million legal permanent residents in the U.S. with slightly more than half being U.S. citizens by naturalization.[60]

Legal non-immigrants are authorized to enter the U.S. for specific periods of time and specific purposes. Short-term temporary admissions include tourists and visitors for business who make up the vast majority of the more than 30 million entries on legal temporary visas each year. Although some may overstay their visas and become unauthorized migrants, these admissions do not become part of the resident population. On the other hand, other temporary migrants are entitled to live in the U.S. for extended periods of time and many are permitted to work legally in the country and are, thus, obligated to pay Social Security taxes on their earnings. Some examples of the latter include foreign students, diplomats, so-called "high-tech guest workers" or H1-B

[58] Before 2003, these data were compiled by the Immigration and Naturalization Service (INS) in the Department of Justice and various other agencies before the creation of INS.

[59] Note that the data in Figure 14 for 1960–2005 have been adjusted to take into account status upon entry and the timing differences between entry and date of admission. See Passel, 2004, and Passel et al., 2004, for more detail on this problem and methods of adjustment.

[60] Passel, Jeffrey S., "Growing Share of Immigrants Choosing Naturalization," Pew Hispanic Center Report, Washington, D.C., March 28, 2007a.

visas, au pairs, visiting scholars, and NAFTA workers. Thus, only those legal non-immigrants who reside in the U.S. long enough to pay Social Security taxes and could eventually collect benefits are relevant to our discussion. In recent years, there has been a steady increase in the number of such persons residing in the U.S. at a given moment, reaching perhaps 1–1.5 million.[61] Over the last 30 years, the net annual change in the legal non-immigrant population has increased, but there are fluctuations in net arrivals that reflect changing economic and political conditions as well as changing limits on various categories.

The flow of unauthorized migrants into the country has proved difficult to measure (on either a net or gross basis). However, over the last 25 years, measurement of this component has improved substantially so that it is now possible with some degree of accuracy and precision to assess the size of the unauthorized population resident in the U.S., as well as net unauthorized migration over multi-year periods. The best measures of net unauthorized migration are derived as the change in the size of the population.[62] Moreover, some new methods permit assessment of year-to-year changes in the flows, mainly by providing estimates for specific dates of arrival of the unauthorized population at a given point in time.[63]

Although this population is by definition unauthorized, many of the migrants eventually manage to gain LPR or some other legal status. If such persons are added to the population upon their illegal entry, care must be taken not to double-count them as part of the immigration flow when they attain LPR status. The clearest example of this phenomenon comes from the late 1980s and early 1990s when approximately 2.6 million formerly undocumented immigrants attained LPR status as a result of the 1986 Immigration Reform and Control Act (IRCA). LPR admissions reached 1.5 million in fiscal 1991, yet only about 600,000 persons in each year were conventional LPR admissions. The rest were formerly unauthorized migrants adjusting to LPR status. Most of them had been in the U.S. for more than 5 years and many came in the 1970s or even earlier. Trends in immigration can be greatly distorted if these LPRs are not assigned to their actual periods of entry. In Figure 14 and Figure 15 and throughout this discussion, such persons are not included in data concerning legal immigration, but rather are counted as illegal immigrants at their time of entry into the country.

A final component of net international migration is the movement of legal immigrants out of the country or "legal emigration."[64] This component has proved somewhat elusive, but a variety of techniques have lead to estimates of out-flows in the range of 200,000–300,000 per year.[65] The latter two applications use rates of emigration applied to foreign-born populations to project levels of emigration consistent with the existing data. The Panel recommends that the Trustees adapt a version of these methods to their population projections. Such methods require the development of separate projections of the foreign-born population as the vast majority of legal emigration is by former immigrants.

Trends in Net International Migration

Notwithstanding the lack of complete, precise data on all components of net migration, it is still possible to construct historical series of estimates of immigration that are consistent with the periodic observations of the foreign-born population provided by decennial census data and more recent surveys. The estimates presented here draw

[61] Passel, 2006, op. cit.

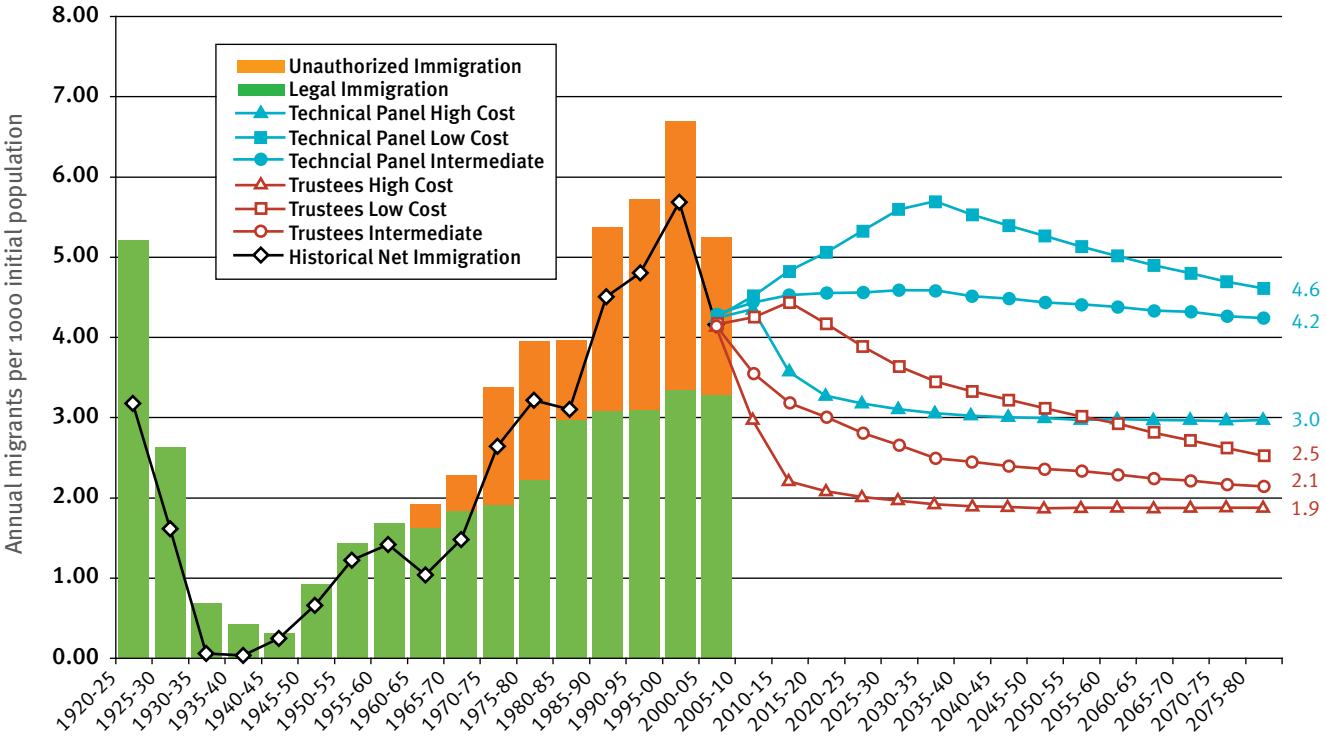
[62] For example, Passel, 2006, op. cit.; and Hoefer, Michael, Nancy Rytina, and Christopher Campbell, *Estimates of the Unauthorized Immigrant Population Residing in the United States: January 2006*, Department of Homeland Security, Office of Immigration Statistics, Washington, D.C., September, 2007.

[63] Passel and Suro, 2005, op. cit.; and Warren, Robert, "Illegal Alien Resident Population: Estimates of the Undocumented Immigrant Population Residing in the United States (October 1996)," U.S. Immigration and Naturalization Service, Office of Policy and Planning. Washington, D.C., December, 2001; and Warren, Robert, "Estimates of the Unauthorized Immigrant Population Residing in the United States: 1990 to 2000," U.S. Immigration and Naturalization Service, Office of Policy and Planning, Washington, D.C., January, 2003.

[64] Note that with the current methods used by the Trustees and those recommended by the Panel, the components of unauthorized migration and legal temporary migration are measures as net figures or the difference between in-flows and out-flows so that it is not necessary to measure emigration of either group. In contrast, legal immigration, well-measured by the LPR data, only accounts for in-flows, so it is necessary to include the component of out-migration in assessing net legal immigration.

[65] For examples of estimates and methods see: Hollmann et al. 2000, op. cit.; Passel, 2005, op. cit.; Warren, Robert and Ellen P. Kraly, "The Elusive Exodus: Emigration from the United States," Population Trends and Public Policy Occasional Paper No. 8, Population Reference Bureau: Washington, D.C., 1985; Ahmed, B. and G. Robinson, 1994, "Estimates of Emigration of the Foreign-Born Population: 1980-1990," Technical Working Paper No. 9, Population Division, U.S. Census Bureau, Washington, DC. December, 1994; and Mulder, Tamany J., Betsy Guzman, and Angela M. Brittingham, "Evaluating Components of International Migration: Foreign-Born Emigrants," Technical Working Paper No. 62, Population Division, U.S. Census Bureau, Washington, DC. June, 2002.

Figure 15: Net Migration, Legal Immigration, and Unauthorized Migration to the U.S. 1920-2006, with Projections of Net Migration to 2080 according to Trustees Report and Technical Panel Recommendations: Annual Migrants per 1,000 initial Population



on the work of the 2003 Panel[66], but rely principally on historical projections by Passel[67] for the 1960–2005 period and the work of Edmonston and Passel[68] covering the 1900–1990 period. Figure 14 shows levels of legal immigration and net international migration for 5-year periods beginning in 1820. Figure 15 shows the same data since 1920 presented as migration rates or the NMR that relate the migration figures to the population size at the beginning of each 5-year period.

For most of U.S. history (i.e., through the early 1970s), legal immigration exceeded net migration because emigration or return migration was larger than unauthorized migration (which was negligible until the 1970s except for a small amount of unauthorized Mexican migration in the early years of the 20th century). By the 1980s, however, growth of the unauthorized population surpassed legal emigration so that net international migration was larger than legal immigration. When viewed in 5-year periods, both the absolute level of immigration (either in-migration only or net) and the net migration rate show a wide range of variation. The net migration rate does show less variability, however. For the 75-year period from 1840 through 1915, most of the annualized NMR values were in the range of 3 to 8 net immigrants per 1,000 population, per year. For the period, the average was 5.7 net migrants per 1,000 population, per year with the rate for legal immigration averaging 8.7. For the historical peak period of 19th and early 20th century immigration (1880–1915), the average NMR was about 9.2 for legal immigration and 6.0 per 1,000 for net international migration.

Restrictive immigration legislation of 1917, 1921, and 1924 followed by the Great Depression and World War II led to major drops in immigration levels and rates. Gradually expanding legal immigration and new large-scale unauthorized immigration toward the end of the 20th century raised the levels and rates from the unprecedented low levels of the 1930s. The numbers of immigrants reached

[66] Wilmoth, John R., "Theoretical and Technical Aspects of Projecting Net Migration as a Function of Population Size," Social Security Advisory Board Working Paper: cited in 2003 Technical Panel on Assumptions and Methods, Report to the Social Security Advisory Board, October 2003.

[67] Passel, 2004, op. cit.; and Passel and Cohn, 2008.

[68] Edmonston, Barry and Jeffrey S. Passel, "The Future Immigrant Population of the United States," in Edmonston and Passel (eds.), *Immigration and Ethnicity: The Integration of America's Newest Arrivals*. The Urban Institute Press: Washington, D.C., 1994.

historic highs by the 1980s—net international migration in every period from 1980–85 onward exceeded the previous high of 700,000 net migrants per year last reached in 1910–15. However, in relation to population size, immigration—as measured by NMR—was well below the previous highs as it averaged about 5.4 immigrants per 1,000 population for this most recent 25-year period and 8.7 for 1890–1915; and net migration averages about 4.5 per 1,000 for 1980–2005 versus 5.7 for the earlier period.

Long-term averages of the NMR are below the current values. For the full 185-year history from 1820 through 2005, the average NMR was 3.2. For the 20th century, the average was just under 2.9. And, for the most recent 75-year period of 1930–2005, the NMR averages about 2.7 per 1,000.

Measuring the current level of annual legal immigration requires some assumptions about new arrivals and when persons adjusting to LPR status actually arrived in the U.S. After including refugee arrivals and discounting adjustments of previous unauthorized migrants, legal immigration levels for 1990–2005 averaged about 860,000 per year. Note that LPR admissions exceeded 1.1 million for several years following 2001 as the Immigration and Naturalization Service (INS) and then DHS cleared some backlogs. Net unauthorized migration averaged over 600,000 per year during this period as the total number of unauthorized migrants living in the U.S. reached close to 12 million by the end of 2005.[69] Using Census Bureau emigration estimates and the underlying rates applied to the estimated foreign-born population, we estimate emigration at about 275,000 per year.[70] Finally, the net in-flow of legal temporary migrants averaged about 75,000–100,000 over this 15-year period. Combining these components yields average annual net immigration for this period at about 1.3–1.4 million with substantially higher levels in recent years and the several years around 2000.

Beginning with the 2000 Census, data enhancements have led to changes in the method of generating official measures of net immigration for the Census Bureau's population estimates. The new methods estimate net international migration from consecutive years of the American Community Survey (ACS) with adjustments for mortality.[71] With this method, annual estimates of net migration averaged over 1.2 million for 2000–2006, reaching almost 1.4 million by the end of the period.[72] Based on our own analyses and comparisons with the Census Bureau's estimates, the Trustees' assumption of net migration for 2006 of 1,075,000 seems considerably low, as do the projected values (which assume declines from this low level) when post-2000 trends show increasing levels of immigration.[73]

Current Trustees' Assumptions

The Trustees Report uses logic similar to the above analysis (but with some outdated data) and considers three sets of flows: (1) legal immigration; (2) legal emigration; and (3) net "other" migration.[74]

As summarized in Table 5, the assumptions used since 1981 to define the level of net international migration have been straightforward. Prior to 1988, the Trustees Reports did not include an allowance for illegal migration; there was little data on which to base an estimate and this assumption was consistent with population estimates and projections done by the Census Bureau. Since 1995, the Trustees' intermediate scenario has included an ultimate annual inflow of 900,000 persons per year. For the most recent years, this assumption allowed for 800,000 legal immigrants per year, minus 200,000 legal emigrants, plus 300,000 net other immigrants. Before 2003, the Trustees assumed that immigration levels would converge to these levels quickly, usually within three years. In the 2007 Report, immigration converges more slowly than in the pre-2003 reports, falling from 1.2 million in 2005 to 900,000 in 2027, but with almost half of the drop occurring in the first year.

The ultimate assumption of 900,000 net migrants per year was derived, in part, based on the provisions of current immigration law. By the Immigration Act of 1990, the "worldwide cap" for legal admissions[75] has been fixed at 416,000–675,000 persons per year since 1995. Adding an allowance of 80,000 for refugee and asylee admissions (which are not included

[69] Passel, 2006, op. cit.
[70] Passel, 2004, op. cit.
[71] U.S. Census Bureau, National Population Estimates, July 1, 2006, Population Division, Washington, D.C., 2007.
[72] New analyses of birth and death statistics for Hispanics, in conjunction with ACS and Census data suggest that even the Census Bureau's measures understate the level of net immigration somewhat.
[73] U.S. Census Bureau, 2007, op. cit.
[74] "Other-than-legal" includes both illegal aliens and aliens admitted lawfully under temporary work visas. It does not include tourists.
[75] This cap covers family-sponsored preferences, employment preferences, and diversity immigrants. Immediate relatives are part of the calculation, but the cap is "pierceable" permitting admission of much larger numbers.

Table 5: Assumed Ultimate Levels of Net Migration for 3 Scenarios, by Entry Status (Legal vs. Other), Trustees Reports, 1981-2007

Ultimate assumption for net migration (1000s of persons per year; average across annual reports)										
Years of Trustees Reports	Total			Legal Immigration			Other Immigration			Ultimate
	Low-Cost	Inter-mediate	High-cost	Low-Cost	Inter-mediate	High-cost	Low-Cost	Inter-mediate	High-cost	
1981-1984	438	400	363	438	400	363	0	0	0	Year 1
1985-1987	667	467	267	667	467	267	0	0	0	Year 1
1988-1990	750	600	450	450	400	350	300	200	100	Year 1
1991-1994	1,050	800	650	700	600	550	350	200	100	Year 1-8
1995-1999	1,150	900	750	710	610	560	440	290	190	Year 2-8
2000-2002	1,210	900	655	760	600	455	450	300	200	Year 2-3
2003-2007	1,300	900	673	850	600	473	450	300	200	Year 21

Notes: 1) Trustees Reports have been grouped with those of neighboring years having similar sets of net migration assumptions; 2) The "ultimate" date is defined here as the first year of the projection period for which the ultimate assumption was used for all scenarios. Thus, for the projection beginning in 2007, the complete set of ultimate assumptions was used from 2027 onward, corresponding to Year 21 of the projection period. In some cases, the speed of convergence to ultimate values varied across Trustees Reports for neighboring years.

in the worldwide cap)[76] plus approximately 10 percent in various other categories yields the assumption of 800,000 legal immigrants per year. During 1992-2000, the average number of legal admissions was around 780,000, but levels were much higher for 2001–2006 (averaging about 1.03 million in across the period). The Trustees' assumption of 200,000 emigrants annually is broadly consistent with current estimates but somewhat low compared with recent Census Bureau research. The Trustees' ultimate assumption of 300,000 net other immigrants lies well below estimates of levels in recent years; even the higher assumption of 400,000 for 2008–2020 is far lower than figures implied by recent data.

Thus, the only component of the Trustees' net migration assumption that can be justified by reference to current law is the largest one, consisting of all legal admissions other than refugees and asylees. Moreover, the "worldwide cap" of recent years is not a strict limit, but rather a target. Most significantly, the cap includes an annual allowance for immediate relatives of U.S. citizens, even though in reality there is no numerical restriction on this form of entry. Indeed, this category was the largest single category of legal immigration every year since 1986.[77] The rapid growth in admissions of immediate relatives is a major part of the wide variability in legal immigration levels during periods with a constant "numerical limit" (i.e., the number of legally permissible admissions within categories that are truly restricted by an annual quota). Since 1995, this legally designated "numerical limit" has been 421,000,[78] or less than half of the Trustees' ultimate net migration assumption of 900,000, yet LPR admissions have continually exceeded the Trustees' intermediate assumption since then.

There are also many indications that immigration levels were considerably higher in the latter half of the 1990s and in 2000–2001 than the average for the period or even the most recent year. All three components of international migration appear to have peaked at that time.[79] The reasons for the increases and subsequent decreases differ for each of the components. Moreover, the 25–35 percent declines suffered by each in 2002–03 may be linked to idiosyncratic factors and thus considered transitory. The very strong economy of 1998–2000 drew large numbers of unauthorized migrants into the country and spurred other potential migrants to apply for green cards. The recession which began in 2000–01 was exacerbated by economic shocks associated with the aftermath of 9/11. These factors led to increases in the unemployment rates

[76] The cap allows for 70,000 refugees and 10,000 asylees; the asylee cap was lifted in 2005 to cut down on backlogs.

[77] Table 5 in U.S. Department of Homeland Security, Office of Immigration Statistics, Yearbook of Immigration Statistics: 2006, Washington, D.C., January, 2007.

[78] In fact, the value of 421,000 represents a lower bound for the numerical limit in a given year and can be supplemented by unused allocations from preceding years for immediate relatives and other (much smaller) categories of entry that have no numerical limitation.

[79] Passel and Suro, 2005, op. cit.

and decreased demand for labor. Thus, it is not at all surprising that levels of illegal immigrant in-flows dropped substantially in 2002–03.[80] Data from 2005–2007 show indications of a rebound in net unauthorized migration as unemployment has dropped, but the new arrivals do not appear to have reached the peaks attained in 1998–2001.

LPR admissions dropped by more than 30 percent between fiscal years 2002 and 2003; the survey-based estimates showed a similar decline.[81] Unlike the case of unauthorized migration, the decline in LPR admissions appears to have been largely due to bureaucratic issues rather than a decrease in the desire on the part of potential migrants to move to the U.S. In reaction to the 9/11 attacks, the Department of State suspended all admissions of refugees. More stringent security checks and clearances were done for almost all LPR admissions. These enhanced security measures meant that each case took longer to process and the added delays led to a slowdown in admission and ultimately to the decreased numbers. The subsequent increases in 2004–2006 and the remaining large backlogs for admission point to a continued high level of demand to immigrate.

All of these factors contributed to a decrease in levels of legal temporary admissions after 2001. The economic slowdown led to decreased demand on the part of employers for temporary labor. Security delays meant that some legal temporary applicants were not admitted; some (especially students) missed deadlines and so did not come; and, finally, others decided not to come. In addition, a temporary increase from 65,000 to 195,000 in the number of H1-B visas available annually that was passed in the late 1990s expired at this time. With the economic difficulties cause by the recession, employers did not need the additional workers and so the increased cap expired. More recent numbers on temporary migration appear to be increasing as the post-9/11 effects wear off.

Thus, even assuming that current immigration laws do not change, the levels assumed by the Trustees are far below current measures. Further, it does not follow necessarily that future net migration trends will be flat or decreasing as assumed by the Trustees. Furthermore, this Panel strongly endorses the recommendation made by the 2003 Panel that there is no need to freeze assumptions about immigration law. Social Security law must be held constant when projecting the financial status of the trust funds, but there is no such requirement for immigration law. This Panel also believes that the Trustees should present policy makers with the most likely picture of the future, and that it is unrealistic to assume that there will be no changes in immigration law over the next 75 years and beyond. Therefore, the Panel recommends assuming that legislative limits regarding legal immigration can be adjusted to fit economic and social circumstances; likewise, enforcement policies may be changed as needed.

Basis for Panel Recommendations

Rather than an approach based on current law, the Panel recommends that the Trustees derive their net migration assumption from an analysis of historical trends. Ideally, the analysis would employ a model-based framework and underlying theory for projecting immigration. Although there has been a considerable amount of research in this area in recent years, there is still no widely-accepted theory to address the problem. The Social Security Administration sponsored some work to survey existing national projections and available methods for projecting immigration and to make recommendations for future work.[82] These authors argue for a complicated "driver-based" model to project immigration; the drivers include demographic factors, economic factors, other non-policy drivers (e.g., relative wealth, trade, technology, politics), policy drivers, as well as country-specific effects. The Panel feels that implementation of this approach would be premature, requiring a considerable degree of effort with little immediate pay-off in light of the current theoretical basis. However, the work does point to a number of factors that could affect future levels of immigration.

Howe and Jackson identify six broad theoretical frameworks that could be used to develop projection models:

- Policy framework—national immigration policy determines levels of immigration;
- Neoclassical framework—in a global labor market, labor will migrate toward higher wages if the wage differential is larger than the moving cost;

[80] Ibid.
[81] Ibid.

[82] Howe, Neil and Richard Jackson, Projecting Immigration: A Survey of the Current State of Theory and Practice, Center for Strategic and International Studies: Washington, DC. April, 2005; and Jackson, Richard, "Long-Term Immigration Projection Methods: Toward a Driver-based Model," Presentation at ISIM Workshop, Center for Strategic and International Studies, September 26, 2006.

- World systems framework—immigration occurs when countries are incorporated in a capitalist world market; attitudinal shifts, remittances, and community effects lead to "cumulative causation" and increasing levels of immigration;
- New economics framework—extended family economic units participate in a series of decisions and moves to maximize income, diversify income sources, and insure against risk;
- Social network framework—networks of kin and other social contacts in both sending and receiving areas reduces costs and risks of migration, facilitating movement and settlement; momentum develops over time to increase migration;
- Dual labor market framework—segmentation of labor market in receiving countries sets up niches for immigrants and encourages migration.

Only the policy framework points to potential decreases in net immigration. Over the long-run the neoclassical framework could suggest lower levels of immigration, but there is no indication that an equilibrium state has been reached or that the equilibrium would be lower than current levels. Within broad limits, virtually all of the others point in the direction of a continuing demand for immigrants in large numbers in the U.S. economy.

The basic demography of the projections points to a continuing strong demand for immigrants. Comparing a basic set of projections with a hypothetical set assuming no future immigration, Passel and Cohn[83] find that virtually all future growth in the working-age population is due to new immigrants and their offspring. With no future immigration, the 18–64 year old population would decline from 186 million in 2005 to 179 million in 2050; this age group would never exceed 191 million and would continue its decline after 2050. With assumptions similar to the Panel's recommendations, the labor force ages would grow by 37 percent to 255 million or by an average of 0.7 percent per year. While this rate of growth is not dramatic or excessive, even maintaining this level of growth would require increasing numbers of immigrants.

Lowell et al.[84] explicitly examine the impact of immigrants on past and future labor force trends. Although their projection horizon is far shorter than the Trustees', they conclude that there will be a demand for growing numbers of immigrants to maintain labor force growth across a range of needs. To the extent there will be a need for "low-skilled" workers (i.e., in jobs with minimal requirements for formal education, such as service workers and health care and home care aids for the aging population), immigrants will be essential since the number of native high school dropouts in the labor force is projected to decrease. At the other end of the educational spectrum, the U.S. economy will continue to need growing numbers of highly educated workers; immigrants are projected to provide a growing share of the future workforce with at least a bachelor's degree.

With the strong immigration trends of the past 25 years and indications of continued need for immigrants in the U.S. economy, the Panel concluded that there is no strong reason to anticipate a sharp break with past trends in the near future. The annual net inflow since 1950 has grown around 4 percent per year on average with recent periods of even higher growth. The Trustees' assumptions imply a sharp disruption in a trend that has endured for more than five decades. We consider such a large historical discontinuity to be highly unlikely. In the absence of strong arguments about why the pool of potential immigrants is going to shrink in the foreseeable future, or about how the government will successfully cap the inflow at a prescribed level, we find it more reasonable to anticipate that future migration trends will resemble past ones. Although this resemblance could take many forms, the Panel suggests that the most reasonable approach overall is to link assumed migratory flows over the long run to the size of the U.S. population.

The Trustees choice to begin the projection with a level of immigration that is considerably below the current measured level is particularly troubling. While the previous Panel could excuse such an error by noting the potential uncertainty surrounding immigration levels in the immediate post-census environment, that rationale is no longer tenable. There are now a number of consistent contemporaneous data sources together with material from Census 2000, as well as historical demographic analyses of trends in census counts by nativity (Passel 2004), that all point to current levels of net immigration that are considerably higher than the Trustees' assumed starting point. Further, bringing the starting value in line with current trend information will enhance the evidence and arguments

[83] Passel and Cohn, 2008, op. cit.

[84] Lowell, B. Lindsay, Julia Gellatt, and Jeanne Batalova, "Immigrants and Labor Force Trends: The Future, Past, and Present," *Task Force Insight* No. 17, Migration Policy Institute: Washington, DC. July, 2006.

for higher immigration levels in the projections.

The Panel recommends that migration assumptions be based on historical analysis of the net migration rate (NMR). The previous panel recommended setting the ultimate migration assumption at the long-run historical average of NMR for the entire period for which we have data, i.e., 1820-2006, or an NMR at 3.2 per 1,000. This figure obviously averages periods of very high immigration with very low immigration. The current panel recommends a more limited historical analysis—the period from 1980 to the present. This period coincides with a modernization of the country's immigration regime that puts it in the context of a global economic system. During this period, we have seen the establishment of large-scale settlement in the U.S. of unauthorized migrants, integration of the U.S. economy within a globalized system, and the development of inexpensive and quick means of communication across international boundaries. All of these factors serve to facilitate migration to the U.S. (if not settlement in the country). During the same period, a number of other potential migration-related developments have occurred including: the emergence of the U.S. as the sole super-power (in addition to its place as the preeminent economy); the development of the internet and e-mail; relatively inexpensive travel; and European countries becoming migrant-receiving rather than migrant-sending countries. The uniqueness of the current era suggests that earlier periods might be sufficiently different in terms of migration to restrict the historical analysis to the most recent 25 years.[85]

We have formulated our recommendation in terms that relate the trend in immigration to population trends. We have also provided alternative formulations in terms of the NMR that would yield approximately the same results, but the exact numerical values of future immigration would depend on fertility and mortality assumptions. With population growth at approximately 1 percent per year, setting the annual growth in net international migration at 1 percent should maintain the existing NMR. In practice, assuming that net international migration grows at 1 percent from the starting NMR value of 4.4 per 1,000 in combination with the Panel's recommended fertility and mortality assumptions results in a very gradual increase in the NMR to a bit under 4.6 by 2025 followed by a gradual decline to 4.4 in 2050 and 4.2 in 2080. The average NMR over the 2005–2080 period is 4.4 per 1,000 population—equal to the average for 1980–2005. The Panel felt that this assumption would be easier to implement than one stated in terms of NMR; however, we would not object to an intermediate assumption stated in terms of a constant NMR of 4.4. The Panel recommends applying the same growth factors to the three main types of immigration (legal immigration, legal emigration, and other immigration), but continuing to investigate alternative formulations.

The Panel recognizes that immigration levels are certain to fluctuate in the future. However, short-term annual movements away from underlying trends are likely to be responses to economic fluctuations or short-term political considerations. Since the economic factors in the projections are assumed to move smoothly as trends of central tendencies, the Panel feels that similar assumptions would be appropriate for immigration as well. The Panel strongly encourages the Trustees to move away from an assumption of constant levels of immigration in the intermediate-cost scenario.

For the alternative scenarios, the Panel examined fluctuations in migration over the last 25–50 years. For the low-cost scenario (which implies higher net immigration), the Panel formulated a scenario in which the average NMR would almost reach the levels attained in the most recent period of very high net immigration—the 1990s when the average NMR was 5.2 per 1,000. The low-cost scenario starts with an assumption that net immigration will have grown by 1.0 percent per year for the entire 75-year projection horizon to reach 2.8 million in 2080; we further assumed that growth over the last 50 years would be only half as fast as the average. These assumptions imply an increase in the NMR from 4.4 for 2007 to 5.7 for 2030–2035. This peak duplicates the NMR for 1995–2000, the highest value reached in the last 75 years. Following the peak, the NMR would decrease to an ultimate value of 4.6 for 2075–2080 and beyond. With these assumptions, the average NMR for 2005–2080 would be 5.1 and the population in 2080 would be about 80 million larger than in the intermediate scenario. An alternative, acceptable formulation would set the NMR at 5.1 for the entire period.

For the high-cost or low immigration scenario, the Panel devised a potentially plausible set of circumstances that could lead to lower levels of immigration and a lower NMR. The scenario assumes that unauthorized

[85] The passage of the 1965 immigration amendments also marks another turning point for U.S. immigration. While the panel prefers the post-1980 period as a basis for historical analysis, the post-1965 period represents a reasonable alternative.

migration is gradually reduced so that net "other" immigration drops from the initial value of 500,000 for 2007 to 200,000 in steps of 50,000 per year. This lower level is consistent with a much smaller net in-flow of unauthorized migrants but maintains a continuation of temporary legal migration. At the same time, some controls are placed on legal immigration so that the numbers are held constant for this initial period. Then, beginning in 2012 when net immigration will have declined to 1.1 million, immigration would increase, but much more slowly than in the intermediate scenario—by 0.25 percent per year for legal immigration and 0.5 percent for other. With these assumptions, the NMR declines gradually from the initial value of 4.4 to about 3.0 after 25 years, and then remains roughly constant at that value for the rest of the 75-year projection horizon. This NMR is slightly lower than the 3.2 average for the entire U.S. immigration experience from 1820 to 2005 and virtually identical to the average for the post-World War II period.

Figure 14 and Figure 15 illustrate the future trends of net international migration implied by the Panel's recommendations, in terms of both numbers and rates.[86] For each scenario, levels of net migration are substantially higher than what is implied by the Trustees' assumptions (except for the initial 15 years in the Trustees' high-immigration, low-cost scenario). The Trustees' assumptions lead to 69 million net immigrants over 2007–2081 in their intermediate-cost scenario, 51 million in the high-cost and 99 million in the low-cast. The Panel's recommendations lead to substantially larger figures—135 million in the intermediate scenario, 122 million and 150 million in the other scenarios.

Discussion

Over the next few decades, there are a number of trends that could affect the volume of immigration to the U.S. The 2003 Panel suggested that some of these could lead to stagnating growth or diminished levels of net international migration in future years and decades. However, in virtually every case, there are offsetting factors or theoretical arguments that are more likely to lead to increases. For example:

- "The recent economic slowdown could lower the demand for immigrant labor." The economic slowdown of 2002–2003 did lead to reduced immigration flows, but they have since increased to levels higher than 2001. Any impact of economic slowdowns is likely to be transitory as the overall demographic trends have a built-in bias toward continued high (and possibly increasing) levels of immigration. Further, neither the Trustees' nor the Panel's economic assumptions call for extended periods of slower economic growth.
- "Heightened security concerns may result in more limited refugee admissions and stricter border enforcement." Again, this situation has occurred since 2001, but immigration levels have bounced back. If enforcement does result in lower levels of unauthorized migration, potential employers of immigrants are likely to demand alternative channels to access the workers needed in businesses. The result would likely be the same level of immigration but within different legal categories.
- "In the 1990s, many immigrants who were legalized under the Immigration Reform and Control Act (IRCA) legislation of 1986 brought their families to the U.S., but that source of inflow has nearly disappeared." This statement is also true, but there are no indications of coming decreases and continuing immigration contains the seeds for future immigration through family connections to home countries. Indeed, several of the analytic frameworks (e.g., Social Networks and New Economics) posit family networks as a basis for increasing immigration flows.
- "Fertility rates began to fall in Mexico around 1970, and this trend is expected to continue. The number of Mexicans at ages 15-19 is projected to start declining soon after 2010, which may reduce the supply of potential immigrants to the U.S.[87] This shift could have important implications for legal immigration, since Mexico accounts for around 20 percent of such flows in recent years, but it is especially relevant for illegal immigration, which historically has come primarily from Mexico and Central America." While the Mexican demographic factors are likely to lead to reductions in migration from Mexico, most projections of the Mexican population[88] still project siz-

[86] The NMR for the Panel's intermediate scenario uses a projection based on the Panel's fertility and mortality assumptions. The NMR values for the other scenarios are approximations based on the Panel's own calculations of projection scenarios. Full implementation with the Trustees' projection model could yield slightly different results.

[87] Centro Latinoamericano y Caribeño de Demografia (CELADE), "Estimaciones y Proyecciones de la Población, 1950–2050," 2003.

[88] Consejo Nacional de Población (CONAPO), "Proyecciones de la Población de México 2005-2050," 2006; and U.S. Census Bureau, International Data Base, Population Projections for Mexico, Population Division: Washington, D.C., 2005.

able migration through at least 2050, although perhaps at diminished levels. Further, there are many other potential sources of migration. [See also next comment.]

- "As Europe and Japan age rapidly, they may demand more foreign labor and compete with the U.S. for potential immigrants." There is no projected shortage of potential migrants in the world. The United Nations projects that the less developed world will add about 1.8 billion persons of working age (defined as 15–64 by the UN) between 2005 and 2050 alone (a value which already assumes out-migration of more than 100 million people). There will be competition for potential migrants, especially those with advanced levels of education, but the political system and dynamic economy of the U.S. are likely to be continuing draws for new immigrants. It is also true that much of the growth will not be in traditional sending countries associated with current migration. All of these trends may simply mean that the U.S. will have to put into place more attractive policies and working conditions to attract the needed migrants, but they will be available.
- "The failure of Congress to pass immigration reform in 2007 will lead to a focus on security by the administration and a number of state and local governments, which will in turn lead to reduced migration. These actions will make life more difficult for unauthorized migrants by stopping more of them at the border, making it more difficult for them to get jobs, and ultimately detaining and deporting large numbers of them. As a result, fewer unauthorized migrants may come to the U.S. and more of them may depart (either by choice of forcibly). Then, net immigration in the short-term would fall well below the projected values recommended by the Panel." While this scenario is certainly plausible, if there is a continuing strong demand for immigrant labor, Congress may be pressured into passing some sort of comprehensive reform or a guest worker program. In the Panel's opinion, the economic pressures for higher levels of immigration are more likely to continue. However, if the restrictions and security measures prevail, revisions in the projection scenarios will be needed.

The Panel does not feel that any of these countervailing factors is strong enough to lead to recommending a different trend assumption for the U.S. On the other hand, there are a number of factors that point toward continued high levels or a sustained growth of net migration to the U.S. For example:

- The demand for immigrant labor seems likely to grow with the U.S. population and economy simply as a matter of scale. This demand will be reinforced by population aging that will place increased demands on health and service sectors, both of which are heavy users of immigrant workers.
- The increasing share of the U.S population that is foreign-born continues to enlarge the network of individuals who can assist new immigrants. Therefore, the mere momentum of past migration may help to sustain and reinforce future inflows. This phenomenon can be especially important in opening up new sources of immigrants over the 75-year horizon of the projections.
- Large untapped pools of potential immigrants exist in many parts of the world, especially Asia. With affordable transoceanic transport, immigration (authorized or not) from distant countries could increase, especially if foreign governments (e.g., China) relax their limits on emigration.
- Attempts to set legal caps on immigration seem likely to fail. In the past, such legislation has often produced unintended consequences, many involving sharp increases in net immigration levels (Briggs 1996). For example, more tightly guarded borders during the 1990s apparently led to reduced emigration, as foreign-born residents (especially unauthorized ones) anticipated greater difficulty returning to the U.S.[89]
- The projected changes in the U.S. age structure can generate even more demand for labor. There are several aspects of this. As noted above, an aging population requires more service and healthcare workers. Immigrants can provide this labor while at the same time providing needed workers in IT and other sectors that can enhance productivity, in part because immigrant workers tend to be younger and more productive.[90]

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[89] Massey, Douglas S., Jorge Durand, and Nolan J. Malone, *Beyond Smoke and Mirrors: Mexican Immigration in an Era of Economic Integration*, Russell Sage: New York, 2002; and Cornelius, Wayne A. and Jessa M. Lewis (eds.), *Impacts of Border Enforcement on Mexican Migration: The View from Sending Communities,* Center for Comparative Immigration Studies: UCSD, La Jolla, CA, 2007.

[90] Lowell et al., 2006, op. cit.

- While incomes and wages may rise in less developed countries, the wage differential with the U.S. is likely to persist. Thus, there will continue to be pressures toward migration. In the only framework that would predict decreases in migration, the "neoclassical", wage differentials are the principal driver for migration. Yet, one of the difficulties encountered by neoclassical analyses is trying to explain why current levels of immigration are not higher in the face of very substantial wage differences. This conundrum is perhaps best summed up by Hanson, who says, "...given the large magnitude of U.S.-Mexico wage differences and the small apparent cost of crossing the border illegally, the volume of migration flows from Mexico to the United States is *surprisingly low*" (emphasis added).[91]
- The U.S. will be forced into competition for immigrants with current receiving countries as well as a number of new potential destinations. Nonetheless, the U.S. will remain attractive, both politically and economically.

Related Topics

Given any level of migration, OCACT must make assumptions about the age-sex pattern of migration. Currently, this distribution differs for the three broad categories of migrants. The projection model also includes assumptions about how immigrants interact with the labor force and the Social Security system. Currently, legal immigrants are assumed to have the same demographic and economic characteristics as the population as a whole, as are half of other immigrants. One-quarter of other immigrants are assumed to pay Social Security taxes but to receive no benefits, and one-quarter are assumed neither to pay taxes nor to receive benefits.

The Panel feels that overall, these assumptions are inadequate. Some changes, such as adjustments in the age-sex distributions of the components of immigration, can easily be made within the current projection framework. Others involving the differential demographic behavior of immigrants and natives and differences in interaction with the labor force require more fundamental changes in the projection models.

[91] Hanson, Gordon H, "Illegal Immigration from Mexico to the United States," National Bureau of Economic Research Working Paper #12141, March, 2006, p. 42

Age-Sex Distribution of Net Migration

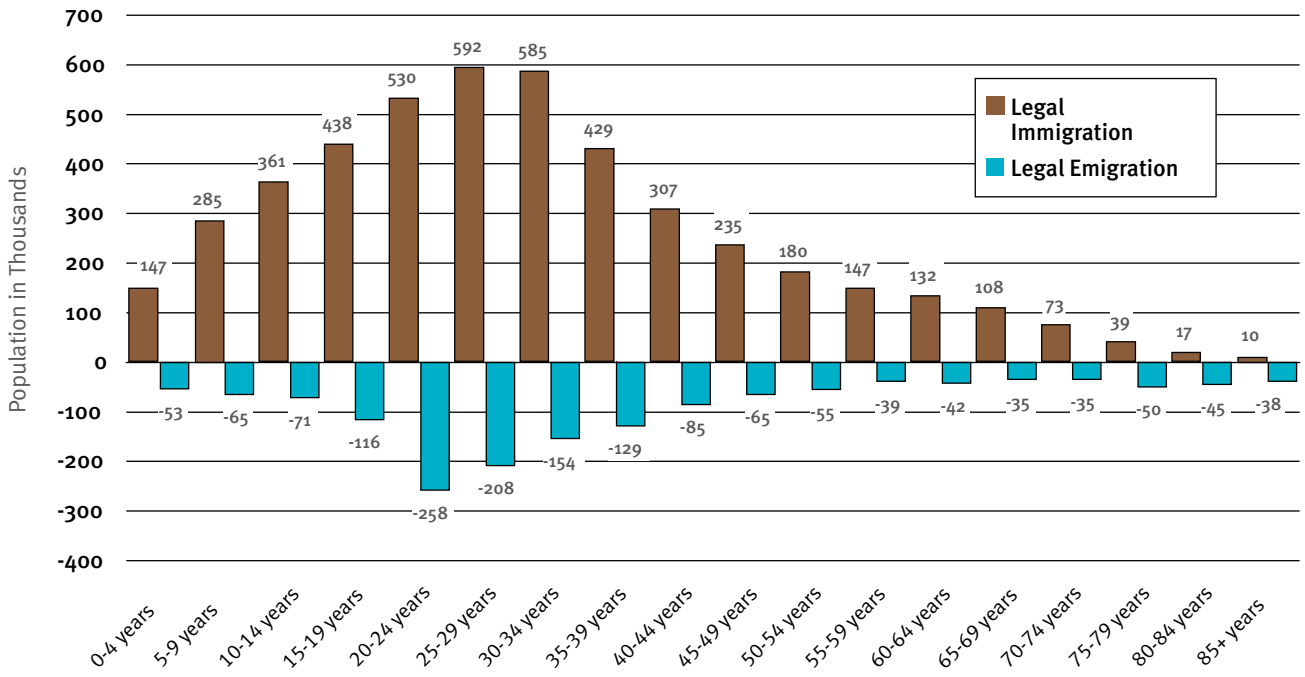
Conceptually, the major types of immigration measured in the Trustees' projection model are demographically different. Legal immigration is measured as an in-flow only. The corresponding outflow is measured in the emigration component. The demographic model treats unauthorized migration and legal temporary migration as net flows.

Legal immigration and emigration have somewhat different age distributions in that the emigrants tend to be older than the immigrants (see Figure 16). Information on age and sex for the legal permanent resident (LPR) component (in-migration) can be readily obtained from OIS data on admissions. (Some minor adjustments may be required for refugees and other specialized immigrant arrivals.) The distribution of emigrants is available from a number of research studies.[92] However, since the emigrants are drawn from the resident immigrant population, their distribution is a function of this population and rates of emigration. Since the composition of the resident legal immigrant population can change over time, this relationship argues for developing the age-sex distribution of emigrants from a set of emigration rates. If the projection model does not support this application (as is currently the case), a second-best approach is to use the age-sex distribution of emigrants available from current studies. Because emigration may exceed immigration in some age groups (especially older ones), it is important that the age-sex distribution of net legal immigration not be solely based on the age-sex distribution of arriving immigrants only.

Examination of the age distribution of temporary legal migrants and unauthorized migrants shows that they tend to stay relatively constant rather than aging. This pattern is perhaps clearest if we consider the population of foreign students living in the U.S. While the total numbers may move up or down, we would expect the age distribution to be relatively constant over time because the group is made up largely of college students. Put another way, we expect people to move out of this population as they graduate from college or leave the country, but there will be more new students than departures if the population is growing. To achieve the relatively constant age distribution, it is necessary that the age distribution of net legal temporary migration be negative at some ages indicating that more people leave the group

[92] For example, Hollmann et al. 2000, op. cit.; and Mulder et al. 2002, op. cit.

Figure 16: Sample Age Distributions for Legal Immigration and Legal Emigration for 2000-2005



than enter. To a very great degree, net unauthorized migration behaves the same way. Thus, it is essential that the Trustees use different assumptions for the age distribution of these immigration components than for legal immigration and emigration.

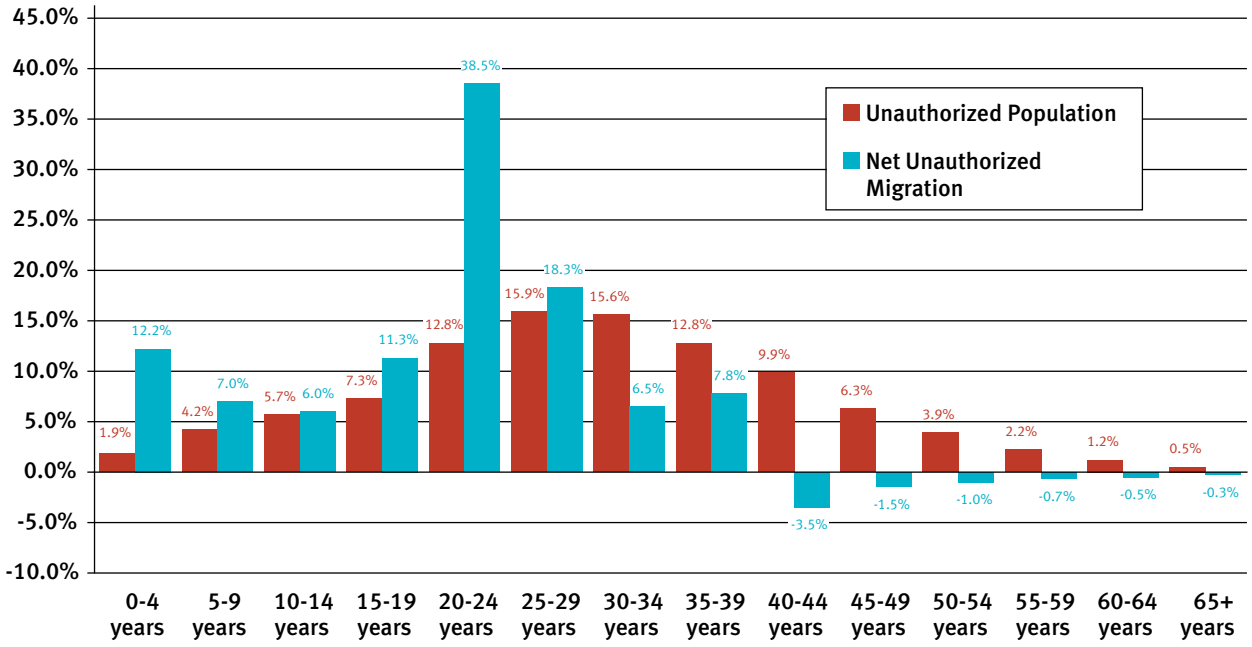
The conventional approach to the unauthorized and temporary components is to use an age-sex distribution of temporary migrants (or unauthorized migrants) taken from a survey or some other dataset. Such an age distribution is positive for every age group in which migrants are found; the distribution is never negative. However, the unauthorized migrant population has large concentrations in the ages 18–29 and relatively few persons at ages 40–45 and over. While the population ages somewhat with the passage of time, these age concentrations can still be found. To achieve such relative stability over time requires that a very high percentage of the in-flow goes into the early 20s and that after age 35 to 40 the net flow is negative (i.e., more unauthorized migrants depart than arrive). Figure 17 illustrates the difference in distribution between the unauthorized migrant population and unauthorized net immigration.

A consequence of using the wrong distribution is that the population ages "too quickly" by not allowing for out migration of persons at ages 40 and over. Thus, over the medium- to long-term, the size of the labor force is slightly understated and the size of the older population not in the labor force is overstated. This problem can be fixed with the current methodology by using a corrected age distribution. Since the temporary and unauthorized components capture net migration, the simplest way to derive the correct distribution for this component is to take the difference between the age-sex distributions at two points in time and correct the difference for mortality that occurred in the interval.

Model Enhancements

Elsewhere, the Panel lays out the case for the use of micro-simulation in the Trustees' projections. The immigration assumptions illustrate the potential power of this approach. Specifically, the immigrants have very different patterns of educational attainment and income than natives. Further, the different types of migrants differ more from each other than from natives. Although legal immigrants are much more likely than natives to have failed to complete high school, they are also more likely than natives to have bachelor and graduate degrees. Unauthorized migrants are considerably less likely to be college graduates and much more likely to have less than a high school education. Legal temporary migrants are almost the mirror image of this pat-

Figure 17: Sample Age Distributions for Net Unauthorized Migration and Unauthorized Population: Distribution based on 2000-2005 Change and 2005 Population



tern with fewer high school "drop outs" and many, more with post-high school education. The current model assumes all immigrants have the same education distribution as natives.

Other key differences between natives and immigrants are in labor force participation, fertility, emigration, and, as noted above, in payment of Social Security taxes and receipt of benefits. Male immigrants of working age are more likely than natives to participate in the labor force with unauthorized migrants being much more likely. Female immigrants are considerably less likely to participate in the labor force than native women. Unauthorized immigrant women are more likely to be married, more likely to have young children, and less likely to be in the labor force than either native women or LPR women. These behaviors are associated, in part, with higher fertility than native women. The current model assumes, however, that a new immigrant takes on the behavior of the average U.S. person in their age group (predominantly natives) immediately upon entering the U.S. population.

Finally, almost all emigration involves movement out of the country by foreign-born persons, i.e., former immigrants. As the size of the foreign-born population increases, the level of emigration would be expected to increase. This pattern can be easily captured by applying out migration rates to the foreign-born population.

All of these differences, and many others, can be easily incorporated into a working micro-simulation model. The Panel strongly recommends that the Trustees pursue research to incorporate the differentials noted into the projection model. Ideally, the research would be in the direction of adopting micro-simulation models, but there are other possible approaches.

An alternative approach to micro-simulation involves elaboration of the Trustees' cell-based projection model. Essentially, the population would be subdivided into native- and foreign-born populations, by age and sex at a minimum, but also possibly by marital and labor status. This matrix of population values would be carried forward in time using the same models and procedures as with the current projections. New immigrants would be fed into the foreign-born matrix, but their native-born children would be fed into the native matrix. Where key parameters are known to differ—as in total fertility rates, educational distributions, or labor force participation—different sets of rates and proportions would be applied to the native and foreign-born matrices. Where the parameters are thought to be the same or at least not known to differ in critical ways, the current factors could be used. Methods similar to this have been used by the Census Bureau to develop separate projections of the foreign-born population and to model emigration levels as a

function of rates.[93] Even more elaborate models have been used to capture generational dynamics of the Hispanic population[94], education and labor force projections[95], and race-generational dynamics of the 20th century.[96] Projections from this disaggregated model would more accurately capture the dynamics of the interaction of immigrants with the Social Security system. The Panel recommends that the Trustees pursue one of these two approaches to developing projections more appropriate to the dynamics of a population for which immigration is a principal driver of population and labor force change.

D. Disability Incidence and Termination

Assumption Recommendation A-5: **Disability Incidence Rates: The Panel recommends that the assumptions of disability incidence for the intermediate projection remain the same as in the 2007 Trustees Report. Disability incidence assumptions were lowered in the 2007 Report and the Panel believes this revision was reasonable given the data on health and benefit trends. These same data on health and benefit claiming lead the Panel to recommend changes to the low- and high-cost alternative scenarios. Specifically, the Panel recommends raising disability incidence in both the low- and high-cost scenario, from 4.4 to 4.6 and 6.6 to 6.9, respectively. These changes increase the uncertainty bands around the intermediate assumption and introduce asymmetry into the risk profile, allowing for larger cost overruns than cost savings in the alternative scenarios.**

Assumption Recommendation A-6: **Disability Termination Rates: The Panel recommends that the assumptions of disability termination remain the same as in the 2007 Trustees Report but calls for more research on these matters going forward. Changes in the mix of impairments and the age of benefit claiming suggest that life expectancies of the average future beneficiary could increase more quickly than those of the rest of the population. While termination rates are much less important to overall cost projections than incidence rates, greater understanding of the factors affecting future trends is warranted.**

Method Recommendation M-14: **Improvements in Current Models: The Panel recommends that consideration be given to augmenting the cell-based model of disability incidence and termination rates to include impairment specific data. The Panel also calls for additional examination of the evolution of male and female disability incidence rates and for more explicit discussion of the historical and forecast time path of these rates, including why they are not converging more over time. Overall, the Panel recommends that the judgmental adjustments to the cell-based model of disability incidence and disability termination be more formally documented.**

Method Recommendation M-15: **Behavioral Models and Risk Assessment: The Panel recommends that the models used to develop the short- and long-range projections for the DI program be better integrated and that the long-range projection methodology be better documented. More fundamentally, the Panel recommends that greater emphasis be placed on developing behavioral models of disability benefit claiming that could better inform the judgmental adjustments to historical extrapolations underlying the intermediate projections, improve the short- and long-run forecasts, and increase understanding of the risk factors associated with short- and long-run program growth.**

Method Recommendation M-16: **Communications about the Disability Program: The Panel recommends more focus on communication about key components of the disability program followed by the research community. Specifically, the Panel recommends highlighting the distinction between eligibility for disability benefits—based on health—and claiming behavior, which is based on eligibility and socio-economic conditions, age, and policy variables such as the normal retirement age. The Panel also recommends that published materials report disability prevalence rates, in addition to incidence and termination rates. Prevalence rates are the preferred metric in the research literature for summarizing the stock of workers receiving disability benefits and provide important information about the size of the program over time. Finally, the Panel recommends that the relationship between the DI and retirement programs be made explicit—DI is just a form of early retirement—especially in discussions about future influences on program size.**

[93] Hollmann et al. 2000, op. cit.
[94] Passel 2004, op. cit.; and Passel and Cohn, 2008, op. cit.
[95] Passel, 2005, op. cit.
[96] Edmonston and Passel, 1994, op. cit., including a methodological explanation,

Overview

The Panel finds the Trustees' forecasts of the size and cost of the Disability Insurance (DI) program as reported in the 2007 Trustees Report to be reasonable and generally consistent with views of other agencies and the broader research community. The Panel is less confident in the Trustees' assessment of risks to these forecasts and recommends several modifications and additions, including: raising the assumptions on disability incidence in the high- and low-cost alternatives, allowing for asymmetry in the deviations from intermediate projections represented in the high- and low-cost scenarios, and devoting greater resources to examining components of risk to the disability incidence forecasts. Methodologically, the Panel echoes recommendations from previous Technical Panels and calls that greater attention be paid to the behavioral aspects of disability benefit claiming, especially in relation to socio-economic factors such as changing labor market conditions, wage dispersion, workplace accommodations, and increases in the normal retirement age.

Explanations and Discussion[97]

SSA projects future costs of the Disability Insurance (DI) program based on projections of two key variables: (1) the disability incidence rate, and (2) the disability termination rate. The disability incidence rate (computed yearly) shows the number of newly entitled DI beneficiaries as a percentage of the number of DI insured workers. The disability termination rate shows the number of exits from disability beneficiary status due to death, recovery, and conversion (i.e., movement onto the retirement system at the normal retirement age). Prevalence rates are derived from separate projections of incidence, death, and recovery rates, and the total number of conversions. The main uncertainty in projections of DI costs comes from projections of the disability incidence rate, with termination rates affecting projections to a much lesser degree.

Forecasting DI beneficiary incidence rates is inherently complex. Covered workers eligible for benefits apply for them based on a set of factors related to their health and their prospects in the labor market. Policy variables affecting eligibility and enforcement regimes also affect application behavior and their relationship to awards. Forecasts of DI incidence rates, then, must account for expected trends in health impairments and their effect on work, expected changes in socio-economic variables that affect claiming behavior for a given health impairment, and views about the future direction of policy variables influencing eligibility. Since many of these trends are difficult to predict, and the relationships between these factors and claiming behavior could change over time, the actuaries forecast disability benefit incidence using cell-based, judgmentally-adjusted extrapolations from historical trends, in place of structural behavior-based modeling. This approach has been accepted by this Panel and previous reviewers as producing reasonable projections of short-run rates of disability incidence.[98] There are a few areas where improvements could be made.

Improvements to Current Models

First, at present the cell-based model includes simple age by sex stratification. The rapid rise in claims among individuals with mental impairments and muscular-skeletal impairments suggests some payoff to expanding the stratification to be impairment-specific. The age by gender by impairment disability incidence rates would also be useful in understanding whether total incidence rates for males and females are likely to converge to the same value over time.

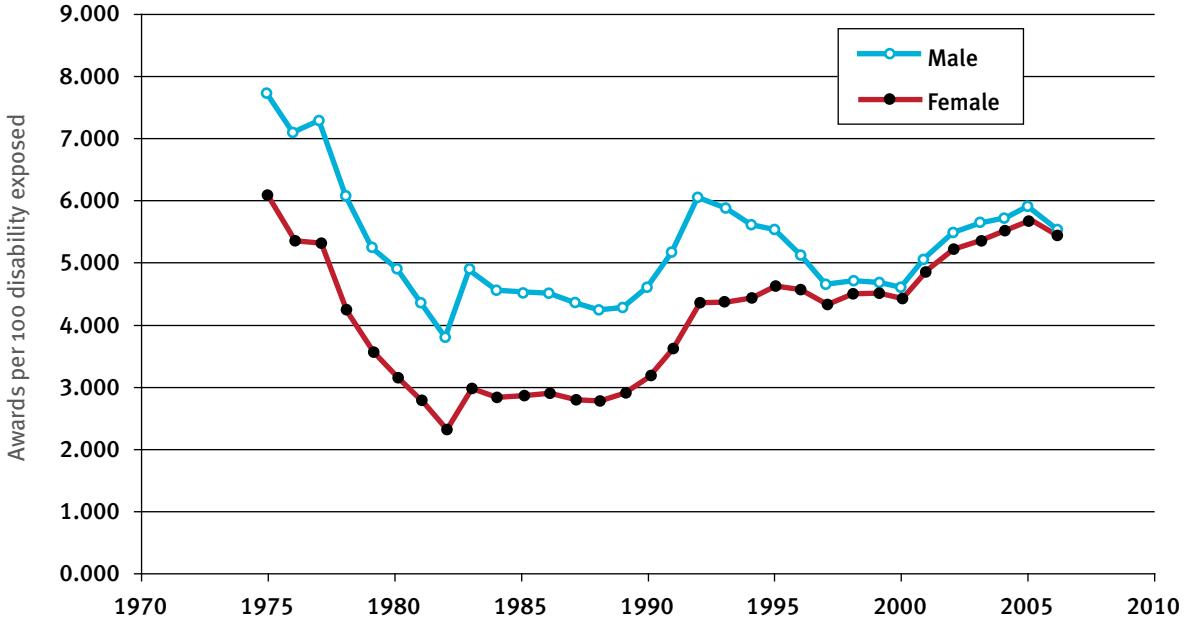
More fundamentally, though, it is not clear that the current cell-based extrapolation accurately captures the uncertainty surrounding the intermediate projections. The magnitude of uncertainty about the DI program can be seen in the fluctuations in disability incidence rates that have occurred over the past 30 years as illustrated in Figure 18. Very little of this variation can be explained by aggregate changes in health status. Research on other potential factors associated with these movements point to a large influence of increases in female labor force participation, and changes in socio-economic and policy variables (e.g., changes in labor market conditions, the easing of disability program standards, and changes in the normal or early retirement age).[99]

[97] The Panel evaluated the procedures used by the OCACT to project costs and revenues for the DI program based on published and unpublished documentation and conversations with OCACT staff. The assumptions and methods are documented in the *2007 Annual Report of the Trustees, Short-Range Actuarial Projections of the OASDI Program: Actuarial Study* Number 119, 2005; and *Social Security Disability Insurance Program Workers Experience: Actuarial Study* Number 118, 2005.

[98] This Panel and the previous two Technical Panels accepted the intermediate assumptions of disability incidence, in the relevant Trustees Reports, based on this method.

[99] Autor, David and Mark Duggan, "The Growth in the Social Security Disability Rolls: A Fiscal Crisis Unfolding," *Journal of Economic*

Figure 18: Disability Incidence Rates by Gender, 1975-2006



The influence of these variables suggests that risks to any projection based on extrapolations from simple age by sex cell-based trends could be substantial. The Panel believes that the historical fluctuations in disability incidence rates, and their apparent relationship to labor market conditions, wage dispersion, and changes in OASDI policy, create considerable uncertainty around the intermediate forecast. In the Panel's view, this uncertainty points to the potential for larger cost overruns than cost savings and larger risk bands around the estimate than those presented in the 2007 Trustees Report.

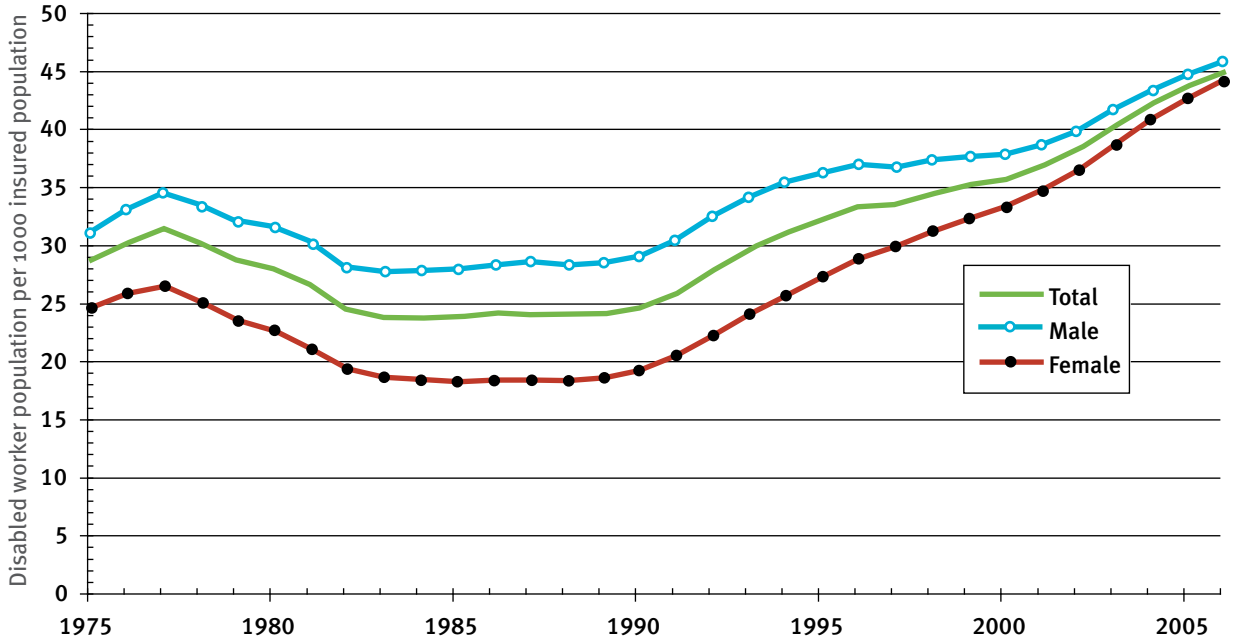
Disability termination rates are much less important in the overall calculation of DI program costs. However, there is still relevant debate around their forecasts. The key issue in forecasting disability termination rates is in accurately forecasting death rates for those on benefits. Following rapid improvement in age-adjusted mortality rates for the DI population through the 1990s, DI mortality rates have slowed to rates closer to the overall population. The 2007 Trustees Report sees this more recent trend continuing for the foreseeable future. Although the Panel recommended no change to the assumptions about disability termination in the 2007 Trustees Report, we do recommend more formal analysis of the relationship between impairment mix and age-adjusted mortality rates in the DI population over time. It would be useful to see how these changes can be related to past changes in the age-sex adjusted mortality experience of beneficiaries, and if a reasonable relationship is found, how well it can be used to forecast out-of-sample values.

Behavioral Modeling

Ultimately, greater understanding of the potential influences on short- and long-run program growth comes from producing complementary behavioral models. This Panel echoes previous panels in recommending more resources be devoted to this effort. There are several benefits from improving behavioral modeling of disability benefit incidence. Information from behavioral models can inform the judgmental adjustments embedded in the current projections. They also can aid in prioritizing among the many variables that influence disability benefit application and award, and in understanding the potential risks to the short- and long-run forecasts. Ideally, assumptions made with respect to DI beneficiary incidence rates should be consistent with those made about age-based labor force participation rates and other key factors used to determine Old Age Insurance (OAI) incidence rates, costs

Perspectives, Summer, 2006, pp.71-94; Duggan, Mark and Scott Imberman, "Why are the DI Rolls Skyrocketing?", Forthcoming in *Health at Older Ages*, edited by David Cutler and David Wise, University of Chicago Press; and Burkhauser, Richard V. and Mary C. Daly, "U.S. Disability Policy in a Changing Environment," *Journal of Economic Perspectives*, Winter, 2002, pp.213-224.

Figure 19: Disability Prevalence Rate, by Gender, 1975-2006



and revenues. Having a behavioral model that allows for these interactions would aid in creating a more unified structure.

Communications

As described above the projection process should consider both changes in underlying health factors and in the social environment that result in changes in DI beneficiary incidence rates. In projecting changes in the social environment, OCACT should especially recognize how ongoing policies and trends—such as the increase in the Normal Retirement Age (NRA) and the increasing incidence of awards on the basis of mental disorders—will affect workers with disability when they decide between continued efforts to remain in the work force and program application. These dual components of disability claiming status should be explained in the Trustees Report and other publications about the OASDI system.

Another important aspect of communication regarding the DI program is to report prevalence rates. Prevalence rates show the number of individuals at any point in time receiving disability benefits. As Figure 19 highlights, apart from a short period in the early 1980s, the prevalence of disability benefit receipt has been flat or rising. Prevalence rates capture both the inflow to the program and the duration of time on the program. As such, they more accurately capture the consequences for system finances of the fluctuations in incidence rates shown in Figure 18. Therefore, they are a very useful gauge of costs associated with keeping the existing stock of beneficiaries funded. Reporting prevalence rates, in addition to incidence and termination rates, provides researchers and policy makers with important information about the future path of claims on resources. Although predicting the future path of policy is beyond the scope of the Trustees, understanding and documenting the factors likely to inform and affect policy decisions, (such as prevalence rates), is important and useful.

While the DI and Old-Age and Survivors Insurance (OASI) programs have separate funds, analysts and policymakers should understand that these separate calculations are nevertheless intertwined, and the assumptions for each fund must be consistent. In fact, after a DI beneficiary reaches the Normal Retirement Age, his or her benefits are paid from the OASI fund. In some sense, it is best to think of DI as nothing more than a case of "early-early" retirement. Changes in the Normal Retirement Age not only mechanically change the age at which people convert to the OASI fund, they also potentially influence the decision to apply for DI in the first place.

Chapter 3: Economic Assumptions and Methods

A. Labor Force Participation Rate

Assumption Recommendation A-7: **Labor Force Participation Rate: The Panel recommends no change in the intermediate and high-cost projections of labor force growth reported in the 2007 Trustees Report, but calls for an increase in the labor force participation rate used in the low-cost alternative. The Panel believes there is considerable upside risk to the intermediate assumption on labor force participation related to the possibility that greater life expectancy, improved health, unmet demand for workers, changing workplace requirements, and the reduction in rule-based private retirement plans could increase participation rates at older ages. The Panel believes that allowing for this possibility is important and could ultimately affect both the intermediate and low-cost scenarios. As such, we recommend increasing total labor force participation in the low-cost scenario from 72.8 to 77.0 percent for males and from 60.6 to 65 percent for females.**[100]

Method Recommendation M-17: **The Labor Force Participation Model: The Panel recommends that the OCACT labor force participation model be reviewed and potentially restructured. Currently, the model is large and unwieldy, making modifications difficult and costly. Additions to the model required to incorporate emerging trends (e.g., participation rates by nativity) only add to the complexity. Thus, we recommend that the Trustees implement suggestions made in the 2003 Technical Panel and restructure the model, making it simpler, more transparent, and econometrically more rigorous.**

Method Recommendation M-18: **Important Subgroups to Study: The Panel recommends more carefully following differences in labor force participation among various groups including natives and non-natives and older workers from different cohorts. Given the growing importance of both immigrants and older workers in the workforce, improved understanding of differences in their labor force behavior will be important to improving the accuracy of future projections.**

Method Recommendation M-19: **Integration of Labor Force with Other Projections: The Panel recommends that more consideration be given to how changes in the population and labor force might impact trends in hours of work, productivity and annual earnings and that these interrelationships be noted in the Trustees Report. This communication of the interconnectedness of the assumptions and projections is a useful component of policy discussions and decisions. The absence of such recognition hinders accurate characterizations of the tradeoffs and complementarities embedded in changes to particular variables, trends or policy alternatives.**

Overview

The 2007 Trustees Report projects no net change in the labor force participation rate for males and only a slight increase for females over the next 75 years. Although the Technical Panel recommends no change to this intermediate projection, we believe there is significant upside risk to this projected path. As such, we recommend putting more weight on the possibility that greater life expectancy, improved health, unmet demand for workers, changing workplace requirements, and the reduction in rule-based private retirement plans will increase participation rates at older ages and increase the total labor force participation rates in the low cost scenario from 72.8 to 77 for males and from 60.6 to 65 percent for females. The Panel believes that allowing

[100] The change in total participation rates comes from assuming that rates for each 5-year age group above 55 would attain, in 75 years, the participation rates of the next younger 5-year age cohort at the beginning of the projection period. For example, those aged 55-59 would in 2081 experience the participation rates of 50-54 year olds in 2007, and so on for each successive 5-year cohort.

for this possibility is important and at a minimum should be reflected in the low cost scenario.

In terms of methodology, the Panel reasserts recommendations made by the 2003 Technical Panel and calls for a thorough review and potential revision to the methods and models used by OCACT to project labor force participation rates. Specifically, we recommend that the models underlying projections of labor force participation be simplified, better documented, and more directly linked to other trends important to the finances of Social Security including trends in hours worked, productivity and annual earnings. Improvements in these areas will allow researchers to compare models and projections on these variables across agencies and against newly emerging research findings.

Explanations and Discussion

The OCACT labor force model converts estimates of the population into estimates of Social Security taxpayers by age and sex. Together with assumptions defining the growth in real wages, the labor force model produces estimates of annual revenues to Social Security. The current labor force participation model is quite complex. The base methodology involves three steps: (1) estimate the historical link between the age-specific labor force participation rates (LFPR) and economic, demographic and policy variables (e.g., business cycle, disability rates) for various groups (classified by age, sex, marital status and child presence); (2) subjectively adjust some estimated coefficients based on economic theory, prior beliefs, and the "full mosaic" of all estimated coefficients; (3) estimate fitted values of the LFPRs of each group based on projections of explanatory variables and these estimated/imposed coefficients. The models for older ages are conceptually similar, but estimate retirement hazard rates (the percent of workers in the labor force who retire). These retirement rates are applied to the participation rates for younger workers to obtain the remaining participation rates.

As detailed in the 2003 Technical Panel, the multistep process involved in this model as well as its sheer size make it unwieldy and difficult to follow. The subjective adjustments applied to the estimates further cloud the results, making it difficult for researchers or other outside parties to understand, replicate or improve upon the model. Implementing any one of the several suggestions described in the 2003 report would be an important step toward increasing transparency and improving discussion around the results.

A simplified model structure would also improve OCACT ability to respond to changes in the population and the labor market likely to influence future participation rates. If there were fewer regressions or a pooled regression, adding new variables or altering the specification would be far easier, cheaper and faster. As such, this would improve OCACT's ability to perform risk assessments and run alternative scenarios relevant to policy makers. Given the uncertain nature of the paths of many of the variables feeding into the labor force participation decision, the flexibility to perform simulations could greatly increase understanding. We recommend that more resources be devoted to reviewing and restructuring the labor force participation model used by OCACT.

In addition to improving the overall methodology and models underlying projections of labor force growth, the Panel also calls for greater analytic focus on two important subgroups of potential workers: immigrants and older individuals. It is the Panel's view that given projected unmet demand for workers going forward, trends in non-native workers and older workers will be critical to forecast accurately a variety of variables including labor force growth, real wages, hours worked, and productivity.

Immigrants

At present the OCACT model does not account for nativity when projecting labor force participation. As Figure 20 shows, foreign-born men participate at greater rates than natives and their rates of participation have been rising while those of native-born men have been falling. Foreign-born women participate at lower rates than native-born women but this gap has closed in recent years, as labor force attachment of foreign-born women has increased. Given the growing share of potential workers who are immigrants, tracking differences in these rates and ongoing changes over time between natives and non-natives is likely to improve the forecast of labor force participation and thus growth, at least in the short-run.

Older workers

An even more critical area for additional tracking, research, and modeling is in the behavior of older workers. As reflected in the Panel's recommendation for the low-cost alternative, we believe there are several reasons to think trends in work behavior among older workers will increase over time. First, the trend toward earlier

Figure 20: Labor Force Particpation Rate, by Nativity and Gender: 1994-2006

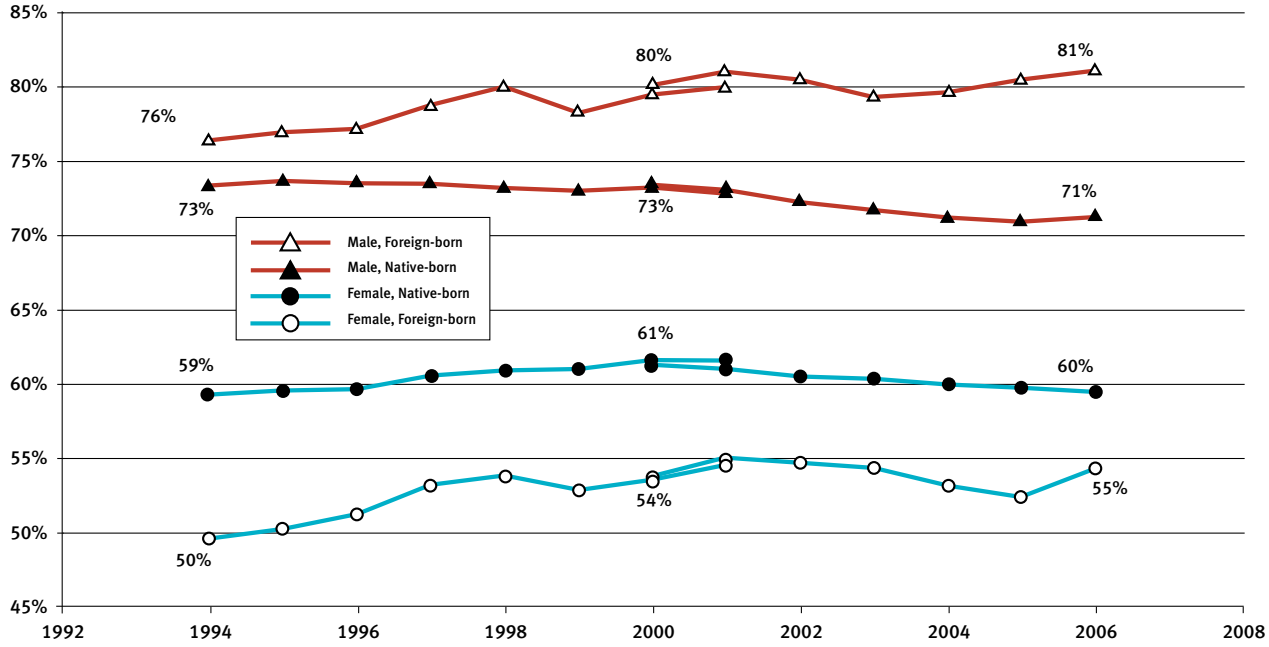
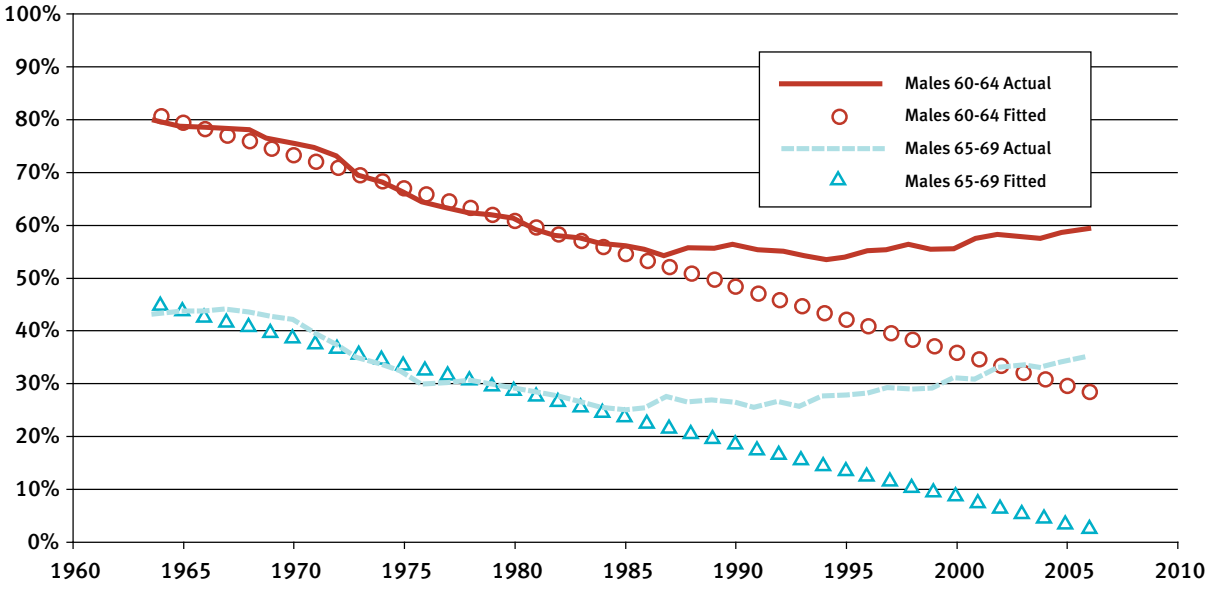


Figure 21: Male Labor Force Participation Rates: Ages 60-64 and 65-69, Actual vs. 20-year Forecast Fitted to 1964-1986 Data

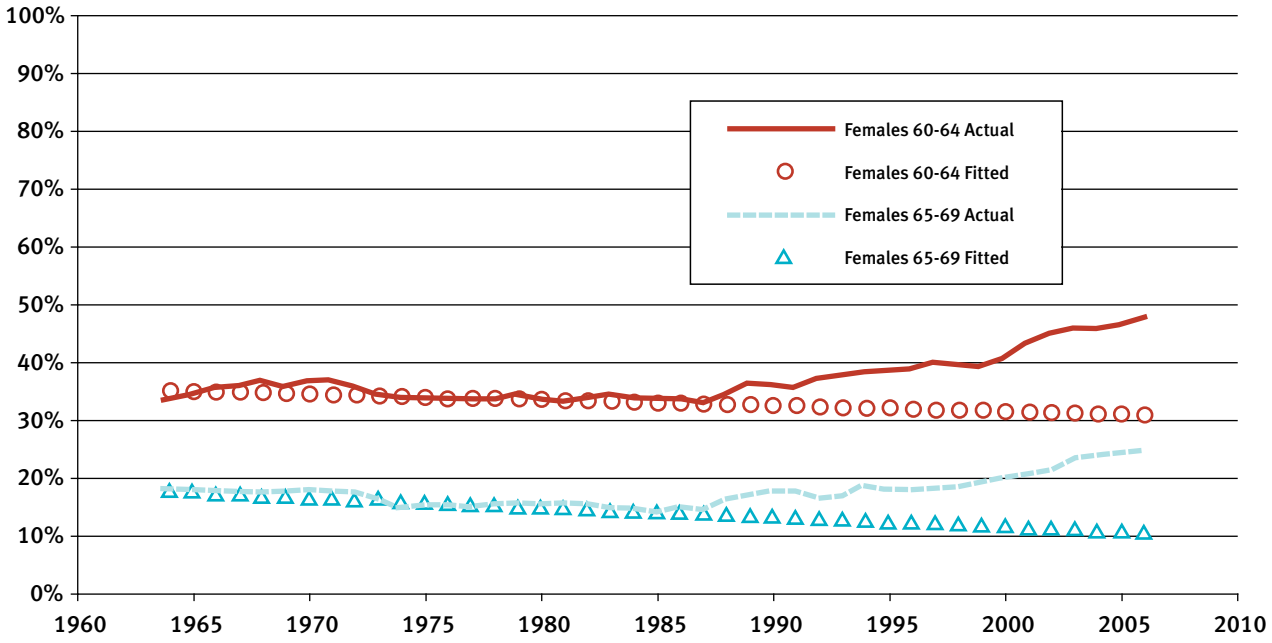


retirement seems to have stopped or at least temporarily paused. The participation rates for older men have been relatively stable over the past 20 years and are now slightly higher than those of the mid-1980s (see Figure 21). Until about 1985, the trend toward earlier retirement was offset for women by the trend toward higher labor force participation in general, resulting in rather flat participation rates for older women. In recent years, the trend has shifted to increasing participation at older ages (see Figure 22).

Although it is still too early to know exactly what is driving the changes in labor force participation at older ages, possible explanations include improvements in health, availability of less physically demanding jobs, changes in employer-sponsored benefits, and changes in Social Security benefit rules.[101]

[101] Urban Institute, "Work and Retirement: Facts and Figures," Au-

Figure 22: Female Labor Force Participation Rates: Ages 60-64 and 65-69, Actual vs. 20-year Forecast Fitted to 1964-1986 Data



Data from the National Center for Health Statistics show that the health of older Americans has improved steadily over the last 20 years. Although the rate of improvement appears to have slowed of late, ongoing improvements are anticipated. Better health combined with access to less physically demanding jobs means that fewer older workers cite health as a reason for not working. Institutional constraints to working at older ages also have been declining. Many employers have replaced traditional rule-based defined benefit pension plans (which penalized older workers for staying on the job) with defined contribution plans which increase in value with extra years of work. On the health side, a declining share of employers offer retiree health insurance, discouraging retirement until Medicare begins. Finally, Social Security reforms made for those born after 1938 are starting to kick in. These reforms gradually raise the normal retirement age from 65 to 67, increase the rate at which monthly payments rise with delayed benefits, and eliminate the benefit reduction for those working beyond the full retirement age. Combined these factors likely contributed to the rise in labor force participation at older ages observed over the past several years and are likely to affect it further going forward.

gust, 2006. [http://www.urban.org/UploadedPDF/900985_work_and_retirement.pdf]

B. Unemployment

Assumption Recommendation A-8: **The Panel recommends that the assumptions on unemployment remain unchanged from the 2007 Trustees Report. The Panel finds a long-run unemployment rate of 5.5 percent is a reasonable assumption for future unemployment rates.**

C. Real Wage Growth

There are numerous concepts of the real wage corresponding to alternative measures of the nominal wage in the numerator and alternative price indexes in the denominator. The concept of the real wage relevant for the Trustees Report is earnings (excluding fringe benefits) per employee, divided by the CPI. Social Security benefits are indexed to wage growth, but the effect of wage growth on benefit expenditures is smaller than the effect on payroll tax revenues. First, there is a lag between the years a worker pays taxes and the year the worker becomes entitled to benefits. Second, following entitlement, benefits are indexed not to wages but to the slower-growing CPI. Therefore, system finances are sensitive to changes in real wage growth.

The Trustees Report contains separate estimates of the growth in labor productivity, and the growth in each of several linkages between labor productivity and real wage growth. As shown in the following ex-

pression, real wages depend on output per hour (labor productivity); labor compensation as a share of GDP; wage, salary and self-employment earnings as a share of labor compensation; hours per worker; and the ratio of the GDP deflator to the consumer price index:

Real Wage Growth Linkages

	(Earnings/CPI)/ (Employment)	=	**(GDP/GDP Deflator)/** (Total Hours)	x	**(Labor Compensation)/** (GDP)	
x	**(Earnings)/** (Labor Compensation)	x	**(Total Hours)/** (Employment)	x	**(GDP Deflator)/** (CPI)	

The term on the left-hand side of the expression is average real annual earnings per employed person, referred to as the real wage. The real wage equals wage, salary and proprietors' earnings as reported in the National Income and Product Accounts, deflated by the CPI to convert it to a real figure and divided by employment to put it on a per-worker basis. The first term on the right hand side of the equation is real output per hour, or labor productivity. It is important to note that this measure of productivity applies to the whole economy, not the private or non-farm private business sectors that are described in the regular quarterly releases of the Bureau of Labor Statistics. The numerator of this productivity ratio is total real GDP and the denominator is economy-wide hours as tracked quarterly in an unpublished series by the Bureau of Labor Statistics (BLS). In the second term, the ratio of labor compensation to GDP, labor compensation includes employers' benefit and social insurance costs in addition to amounts disbursed as wages, salaries and self-employment income. The third term on the right-hand side shows earnings as a share of total labor compensation. The fourth term equals average annual hours per employed person. The last term captures the ratio of the price deflator relevant to the total output of the economy (as used to deflate real GDP, the numerator of the productivity ratio), relative to the CPI (which is used to index Social Security benefits).

The above equation relates the level of the real wage to the levels of the various linkage ratios on the right-hand side of the equation. However, in practice, the forecasts of the Trustees Report project not the levels but rather the growth rates of productivity, the real wage and each of the linkage variables just described. The relevant annual growth rates listed here are the Trustees' "ultimate" growth rates, typically starting within 10 years of the beginning of the projection period and extending to the end of the 75-year horizon.

The 2003 Technical Panel recommended that the Trustees increase the projected rate of growth in the real wage (referred to as the real wage differential) from 1.1 percent per year as stated in the 2003 Trustees Report to 1.3 percent per year. In terms of the above equation, they obtained this recommendation by raising the productivity growth rate from 1.6 to 1.7 percent per year and by reducing the negative growth rate of the earnings/compensation ratio from -0.2 to -0.1 percent per year. On balance there has been very little change from the recommendations of the 2003 Technical Panel and the assumptions of the 2007 Trustees Report. The productivity growth rate of 1.7 percent per year is the same. The only differences are: 1) the 2007 Trustees Report includes a projected growth rate of the earnings/compensation ratio of -0.2 instead of the -0.1 recommended by the 2003 Technical Panel; and, 2) the Trustees choose a projected growth rate of the GDP Deflator to CPI ratio of -0.4 percent per year as compared to the -0.3 percent per year recommended by the 2003 Technical Panel.

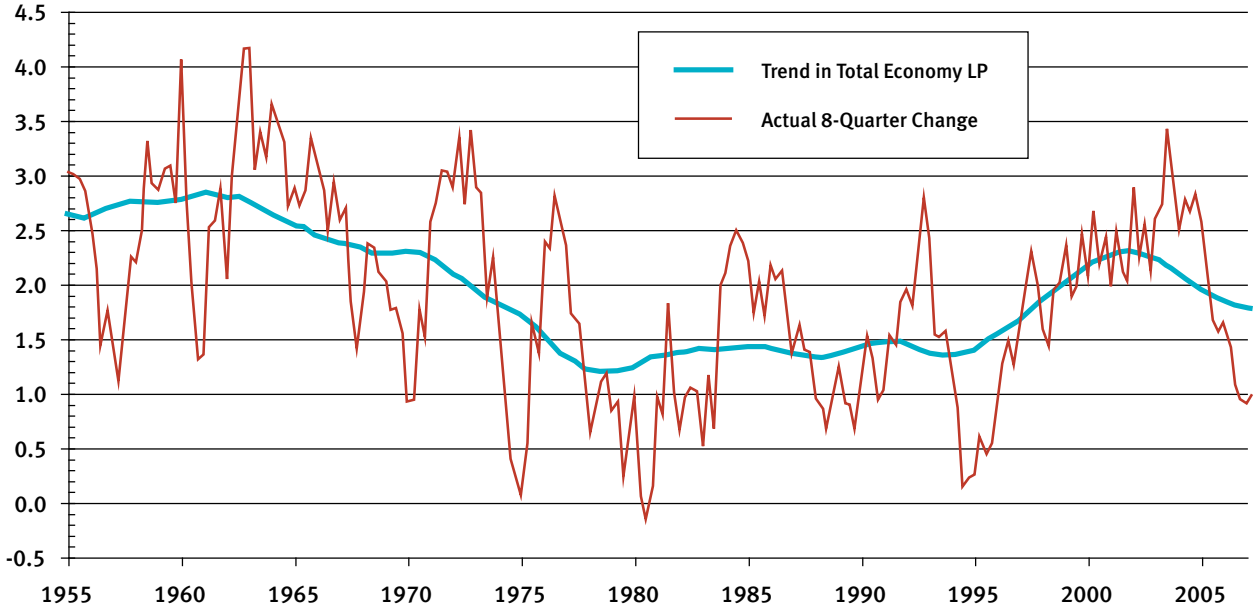
2007 Trustees Report Ultimate Growth Rate Assumptions

Real Wage Growth =	1.1 pct/yr
+ Growth in labor productivity	1.7 pct/yr
+ Growth in [labor compensation/GDP]	0.0 pct/yr
+ Growth in [earnings/labor compensation]	-0.2 pct/yr
+ Growth in [total hours/employment]	0.0 pct/yr
+ Growth in [GDP deflator/CPI]	-0.4 pct/yr

Productivity Growth

Assumption Recommendation A-9: **The Panel recommends that the assumption on productivity growth be maintained at the same rate as in the 2007 Trustees Report, that is, 1.7 percent per year. This recommendation reflects the sharp slowdown in actual productivity growth between mid-2004 and mid-2007 that has reduced the possibility that**

Figure 23: Actual 8-quarter Annual Rate of Change of Total Economy Output per Hour and Estimated Trend Growth



the American economy entered a new era of rapid high productivity growth after 1995. Instead, it appears that the marked acceleration of productivity growth between 1995 and 2004 can be attributed to special one-time factors that are unlikely to recur. In forecasting future productivity growth, substantial weight must be given to the poor performance of productivity growth in the period 1972-1995.

The 2007 Trustees Report projects ultimate labor productivity growth rates of 1.7 percent per year for the intermediate-cost case, 2.0 percent for the low-cost, and 1.4 percent for the high-cost case. These projections are for the total U.S. economy (real GDP per hour worked).

Although productivity growth over the past decade has been notably faster than 1.7 percent per year, the Trustees, OCACT, and the Technical Panel must take a longer view when forecasting productivity growth over the next 75 years. To put the last decade in a broader historical context, Figure 23 contrasts facts on the actual behavior of total economy productivity growth with statistically estimated trends. The thin red zigzag line is the annualized growth rate of total economy productivity over the previous eight quarters. We see that this series exhibits highly volatile spikes of positive and negative growth. For the purposes of Social Security forecasts, short-run volatility is relatively unimportant. Rather, averages taken over a longer period of time must be utilized.

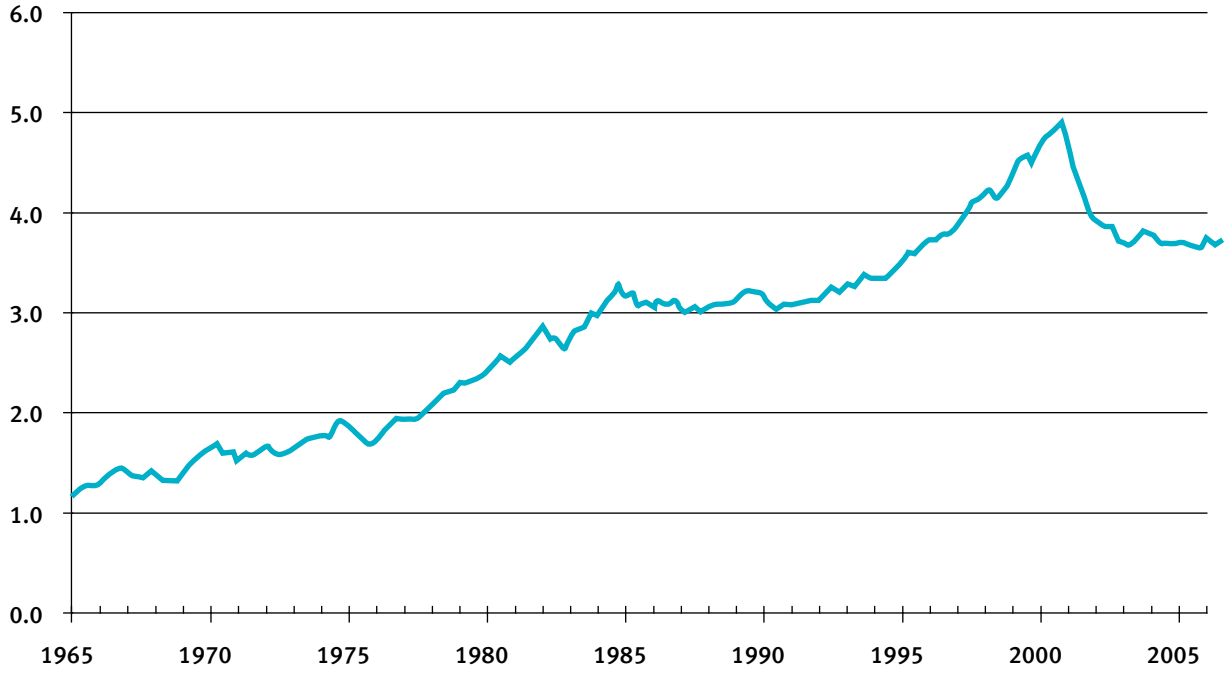
The thick blue line in the figure displays the long-run trend in total economy productivity growth. These trends are developed as the average of trends computed by two different statistical procedures, the so-called Hodrick-Prescott filter and the Kalman filter.[102] Compared to the current 2007 Trustees' assumption of 1.7 percent per year for productivity growth in the long run, the estimated trend is both above and below 1.7 percent over substantial periods. The trend reached a peak of 2.7 percent per year in 1962 and remained well above the current Trustees' long-run estimate, falling below 1.7 percent only in 1973. Between 1973 and 1998 the trend was well below 1.7 percent but then revived between 1998 and 2006, reaching a peak of 2.3 percent in 2002.

Clearly, the average of the past 40 or so years reveals an average growth rate of total economy productivity that is quite close to the current 2007 assumptions of the Trustees over the next 75 years. So the question is: Are there reasons why the Trustees' estimates should give special weight to particular periods in the post-war era when total economy productivity growth has been so volatile?

To address this question it is useful to consider the drivers of the volatility in productivity growth shown in Figure 23. First, why was productivity growth particularly rapid in 1950-65 and much slow-

[102] See Gordon, 2003, pp. 221-3, for details about the methods of de-trending used in Figure 23. Over the past decade the Hodrick-Prescott and Kalman filter methods yield very similar estimates of the underlying productivity trend.

Figure 24: Share in Nominal GDP of Nominal Investment in Information Processing Equipment and Software



er from 1965 to 1995? Although there is a considerable literature on this topic there is no consensus. A plausible hypothesis refers to impact of "Great Inventions" (electricity and the internal combustion engine) and their lagged influence on productivity growth. As the Great Inventions worked their way through the economy, productivity growth was particularly rapid during the period 1920-1965. Then after 1970 their impact petered out.

Second, why did productivity growth revive after 1995, with the trend rising from 1.4 percent in 1995 to a peak of 2.3 percent in 2002, before falling back to about 1.8 percent in 2007? Again, there is an enormous literature on this topic, especially for the period from 1995-2000. This research, ably summarized by Oliner-Sichel-Stiroh[103], creates a prima facie case that the main reason for the productivity growth resurgence in the 1995-2000 period was an enormous upsurge of investment in information and communication technology (ICT).[104] The standard methodology of growth accounting, which weights the contribution of labor and capital input by their shares of income compensation, attributes almost all of the 1995-2000 resurgence in productivity growth to ICT capital investment (see Figure 24).

But what about the 2001-04 period when trend productivity growth increased further but investment in ICT capital collapsed? Several theories about this period have been offered. First, Brynjolfsson and his co-authors, and Susanto Basu and his co-authors argue that it took firms a long time to figure out how to productively use the hardware and software inventions of the late 1990s, the marriage of personal computers with communication technology embodied in internet connections, web browsers, and e-mail[105]. They argue persuasively that the big burst of ICT investment in the late 1990s had a delayed spillover effect to subsequent productivity. Much of the productivity benefit of the post-90s investment boom occurred not in 1997-2000 but in 2001-04. Others have argued that the trajectory of corporate profits, accounting scandals, and executive compensation created unprecedented pressure for corporations to cut costs, particularly payroll, during 2001-04 and the recovery of profits in 2004-07 helps to explain the slowdown in productivity growth during that period. Finally, the "early recovery productivity bubble"

[103] Oliner, Stephen D., Daniel E. Sichel, and Kevin J. Stiroh, "Explaining a Productive Decade," *Brookings Papers on Economic Activity*, no. 1, 2007, pp. 81-152.

[104] Other key contributions are Gordon, 2003, and Jorgenson-Ho-Stiroh, 2005.

[105] See Brynjolfsson, Erik, Lorin M. Hitt, and Shinkyu Yang, "Intangible Assets: Computers and Organizational Capital," Brookings Papers on Economic Activity, no. 1, 2002, pp. 137-81; and Basu, Susanto, John G. Fernald, Nicholas Oulton, and Sylaja Srinivasan, "The Case of the Missing Productivity Growth, or Does Information Technology Explain Why Productivity Accelerated in the United States But Not in the United Kingdom?" in *NBER Macroeconomics Annual 2003*, MIT Press, 2004.

helped to push up productivity growth in 2001-04 and also helps to explain why the decline in productivity growth in 2004-07 was so sharp and sudden.

Based on available research this panel believes it is reasonable to treat the upsurge in trend productivity growth between 1995 and 2005, and 2000-2005 as temporary phenomena, reflecting a combination of one-time events. Based on the above analysis, the Panel recommends that the long-run total economy productivity projection should remain at 1.7 percent per year, which is a bit above the historical growth rate from 1965 to 2007. The high- and low-cost scenarios should remain at 1.4 percent and 2.0 percent, respectively.

One concern not so far discussed in this section is the "Baumol Disease" hypothesis that was recently reviewed by Blackstone.[106] The Baumol disease hypothesis is that certain types of hands-on service activities are immune to productivity growth, as in the classic example of the string quartet that always needs four players. Rapid productivity growth in the late 1990s temporarily put the Baumol disease on hold, but it has now revived as reflected in slow productivity growth since 2004. Future projections of productivity growth should take account of the increased share of the future workforce that will be employed because of longer life expectancies projected in this report. With more employment in activities like home health care and nursing home care, a larger share of the labor force will be subject to Baumol's disease which surely affects employment activities which involve one-on-one contact.

Compensation to GDP Ratio

Assumption Recommendation A-10: **The share of labor compensation in GDP has historically been quite stable, and the Panel agrees with the current assumption of a constant ratio.**

The ratio of employee compensation (defined to include wage and salary accruals and supplements to wages and salaries) to GDP has shown little variation over the last five decades. The average ratio over the period from 1950 through 2006 was 57.1 percent, with a high of 59.4 percent and a low of 53.5 percent. As shown in Table 6, the ratio edged up from the 1950s to the 1970s, but has stabilized over the past three decades at around 58 percent. The 2007 Trustees Report assumes the ratio will remain stable, and the Panel recommends that this assumption be retained.

Earnings to Compensation Ratio

Assumption Recommendation A-11: **The Panel recommends that the change in the earnings to compensation ratio be reduced in the intermediate-cost assumption from a decline of 0.2 percent per year to a decline of 0.1 percent per year for the first 25 years of the projections, with a zero decline after that. In the low-cost assumption, the current ratio should be held constant, while in the high-cost assumption, the ratio should decline by 0.2 percent per year for the first 25 years and by 0.1 percent thereafter.**

Prior to World War II, non-cash compensation accounted for only a tiny fraction of workers' total compensation. Restrictions on cash wage increases imposed by the War Labor Board during the war years encouraged employers to offer nonwage benefits such as pension plans and health insurance. These employer-provided benefits proved over time to be popular, in part because such non-cash compensation is not subject to personal income tax, and they grew in importance in subsequent decades. The costs of legally required benefits also became a larger share of total compensation.

As shown in Figure 25, these changes led to a steady decline in the share of total compensation accounted for by cash earnings that persisted through about 1980. The National Income and Product Accounts provide the most consistent source of data

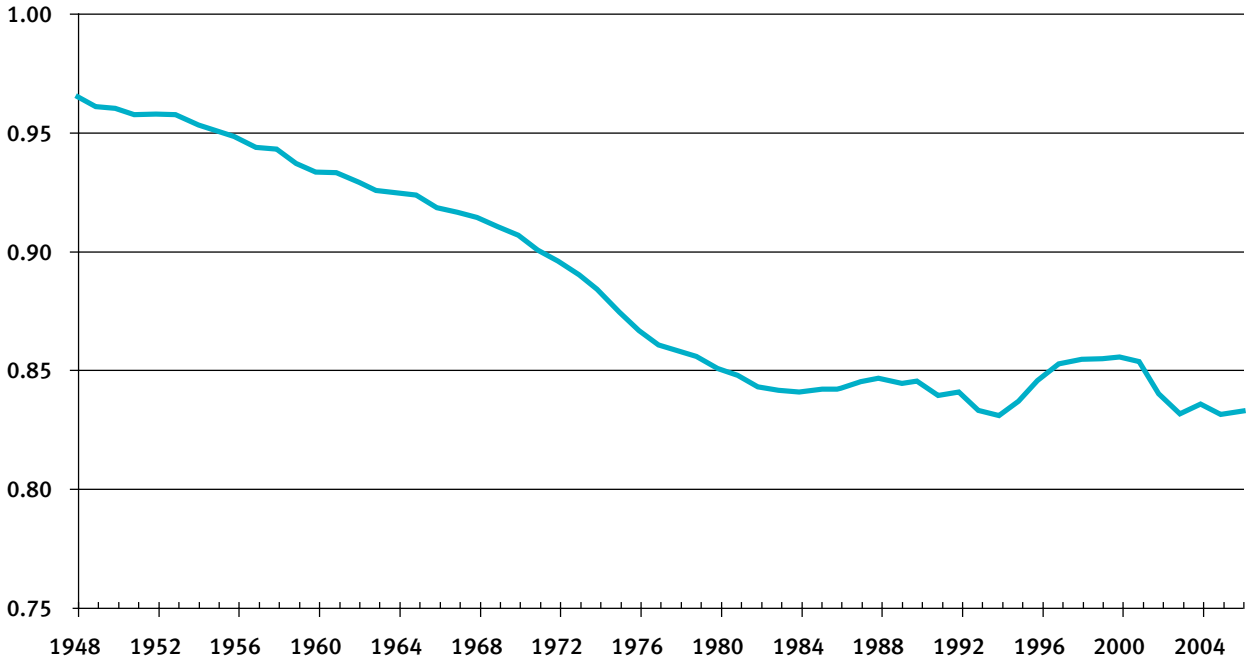
Table 6: U.S. Average Compensation Ratios

	1950-59	1960-69	1970-79	1980-89	1990-99	2000-06	1950-2006
Compensation/GDP	0.549	0.565	0.585	0.580	0.570	0.576	0.571

Compensation is defined as wage and salary accruals plus supplements to wages and salaries.
Source: National Income and Product Accounts (7/27/07)

[106] Blackstone, Brian, "Is Productivity Growth Back in the Grips of Baumol's Disease?" *Wall Street Journal*, August 13, 2007, p. A2.

Figure 25: Trend in the Ratio of Total Earnings to Total Compensation, 1948-2006



Source: Data from the National Income and Product Accounts, Bureau of Economic Analysis. The numerator of the ratio equals farm and nonfarm proprietors' income plus wage and salary disbursements; the denominator equals farm and nonfarm proprietors' income plus total employee compensation, including social insurance contributions and employer-provided benefit costs.

on labor compensation and its composition. In 1929 (not shown in the chart), cash earnings accounted for 98.9 percent of total compensation; by 1980, this share had fallen to 85.0 percent. Since 1980, however, there has been no consistent growth in benefit costs as a share of total compensation, and the ratio of earnings to total compensation has stabilized. The average annual growth rate between 1980 and 2006 is exactly -0.10 percent.

One factor that has contributed to the leveling in the ratio of earnings to compensation has been the declining ratio of employer pension and profit sharing contributions to total compensation shown in Figure 26. The long-term shift from relatively generous defined benefit plans to less generous defined contribution plans helps to explain this decline.[107]

Another factor important to determining future trends in the earnings to compensation ratio is the future of employer-paid health insurance. Employer-paid health insurance costs rose steadily as a share of compensation through the early 1990s. This growth slowed dramatically in the mid-1990s, reflecting the growth in HMOs and Preferred Provider Organizations (PPO), together with the shifting of some health insurance costs from employers to employees.[108] Employers' group health insurance costs as a proportion of compensation dropped by a full percentage point. More recently, however, employer-paid health insurance costs as a share of total compensation have again resumed its historic upward movement, as shown in Figure 27.

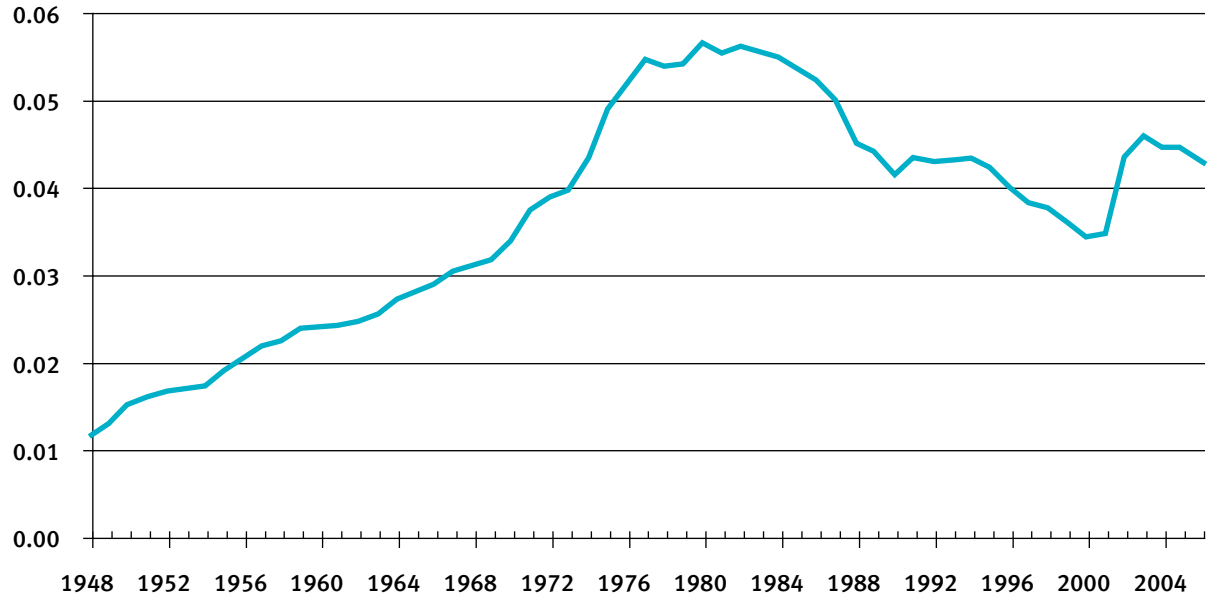
The Trustees currently assume that the ratio of earnings to compensation will fall by 0.2 percent per year for the indefinite future. The projected decline in the earnings to compensation ratio is based primarily on the Trustees' belief that tax-exempt health benefits will make up an increasingly large portion of compensation. As already noted, earnings accounted for 82.8 percent of total compensation in 2006; a 0.2 percent annual decline in the earnings to compensation ratio would lead to earnings accounting for just 71.3 percent of compensation after 75 years.

Over much of the 20th century, the development of new treatments fueled steady growth in health care expenditures. Many observers believe that scientific advances will continue to

[107] For an overview of recent trends, see: Poterba, James, Steven Venti, and David A. Wise, "The Changing Landscape of Pensions in the United States," *National Bureau of Economic Research Working Paper #13381*, September 2007; and Rappaport, Anna M., "Retirement System at the Crossroads," *Employee Benefit Plan Review*, February 2003, pp. 17-20.

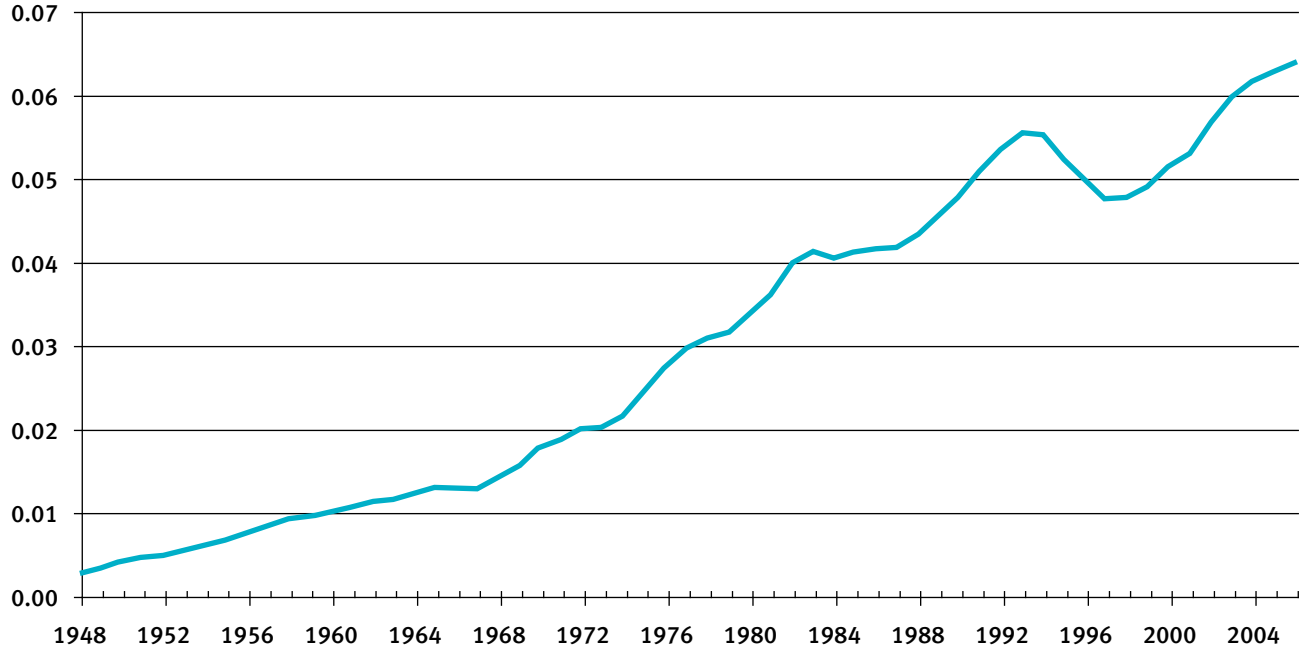
[108] Schwenk, Albert E., "Trends in Health Insurance Costs," *Compensation and Working Conditions*, Spring, 1999, pp. 24- 27.

Figure 26: Employer Pension and Profit-Sharing Contributions as a Share of Total Compensation, 1948-2006



Source: Data from the National Income and Product Accounts, Bureau of Economic Analysis. The numerator of the ratio is employer pension and profit sharing plan contributions; the denominator equals farm and nonfarm proprietors' income plus total employee compensation, including all social insurance contributions and employer-provided benefit costs.

Figure 27: Employer Group Health Insurance Contributions as a Share of Total Compensation, 1948-2006



Source: Data from the National Income and Product Accounts, Bureau of Economic Analysis. The numerator of the ratio is employer group health insurance contributions; the denominator equals farm and nonfarm proprietors' income plus total employee compensation, including all social insurance contributions and employer-provided benefit costs.

push health care costs upward for the foreseeable future.[109] On the other hand, recent experience suggests that there will be significant resistance to future increases in the health insurance costs borne by employers. Employers already have shifted a significant share of health insurance costs to their employees. Even more dramatic shifts in

[109] See, for example, Aaron, Henry, "The Unsurprising Surprise of Renewed Health Care Cost Inflation," *Health Affairs*, January 23, 2002.

this direction should perhaps be anticipated, with employers offering their workers a defined contribution to be applied towards health insurance coverage—or even a defined contribution to be applied towards the benefit package of an employee's choice—rather than a health insurance plan that offers a defined set of benefits.[110] Another factor is that lower income tax rates could reduce the attractiveness of employer-provided benefits relative to wage and salary compensation.

Simply shifting health insurance costs from employers to employees need not raise the share of earnings that are subject to payroll taxes, which ultimately is what matters for the revenues flowing into the Social Security trust funds. A growing number of employers offer premium conversion or flexible benefit plans, under which employee-paid health insurance premiums are sheltered from both income and social insurance taxes.[111] By making the tradeoff between health insurance benefits and cash compensation more explicit, shifting costs to employees may slow the growth in total health insurance expenditures.[112] We also can expect continued efforts by insurers and policy makers to restrain costs through familiar measures such as co-payments and deductibles, requirements for second opinions, and even restrictions in coverage to treatments deemed cost-effective. Looking further into the future, continued upward pressure on medical care costs could lead to increased interest among medical researchers in the development of innovations that can reduce treatment costs without compromising the quality of care.

The Panel is uncomfortable with projecting that the share of earnings in total compensation will fall as much over this period as is currently assumed. The idea that this ratio will continue to decline over the indefinite future, and the resulting implication that the earnings share of compensation eventually will approach zero, is even more problematic.

On balance, these considerations, together with modest -0.1 percent annual rate of decline observed since 1980, lead the Panel to conclude that, for the intermediate projections, it would be more realistic to adopt as an intermediate assumption a 0.1 percent annual decline in the earnings to compensation ratio over the first 25 years and a zero rate of decrease after that. The implied ultimate level of the earnings-compensation ratio would be 80.8 percent. In the low-cost assumption the current ratio should be held constant, while in the high-cost assumption it should decline by 0.2 percent per year for the first 25 years and at 0.1 percent after that, implying an ultimate ratio of 75.0 percent. By comparison the 2003 Technical Panel recommended a decline of -0.1 percent with a cut-off when the ratio reached 75.0 percent.

Average Hours of Work

Assumption Recommendation A-12: **The Panel recommends that the 2007 Trustees' assumption of no change in average hours of work per week be changed to a decline of -0.1 percent per year for the first 25 years with a zero rate of decline thereafter. The high-cost assumption should be an annual decline of 0.2 percent for the first 25 years and a decline of 0.1 percent rate thereafter. The low-cost assumption would then be zero change, the same as the 2007 Trustees' assumption.**

For much of the twentieth century, average weekly hours exhibited a declining trend. As shown in Figure 28, average weekly paid hours fell from 39.7 hours in 1948 to 34.0 hours in 1983, continuing a secular decline that had begun much earlier. Recent data suggest this process may have reached its limit. Since the mid-1980s, average weekly hours are essentially unchanged, exhibiting a cyclical rise in the late 1990s that was reversed in the first few years of this decade.

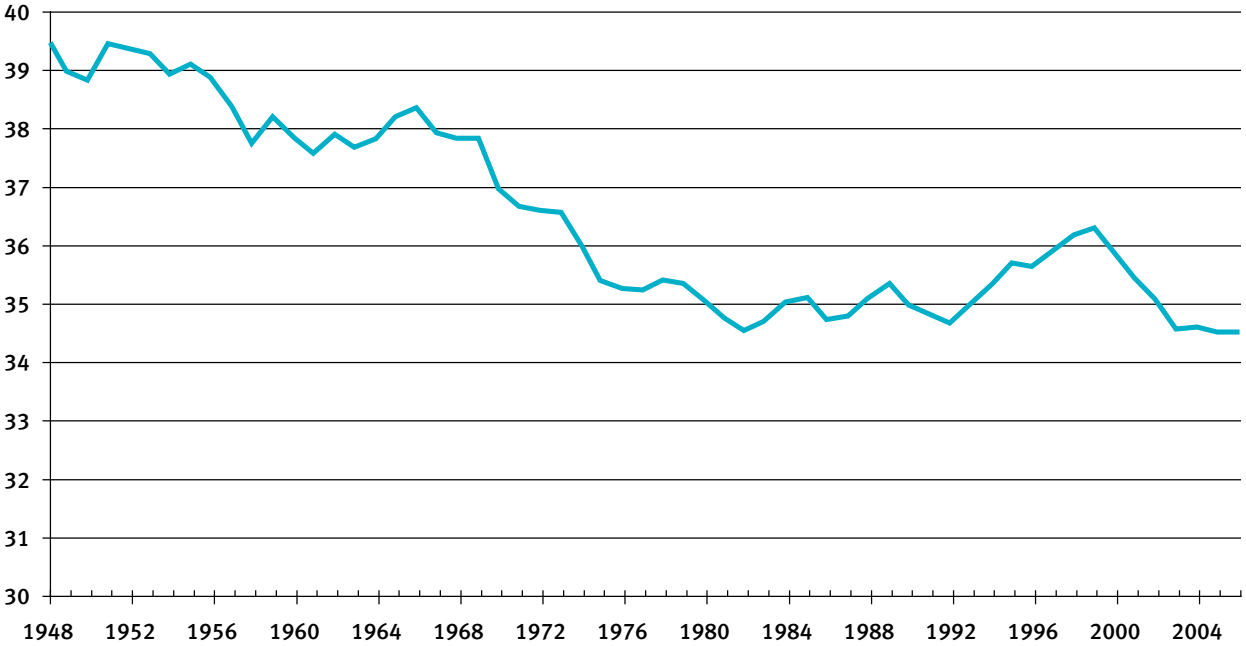
Until 2002, the Trustees had assumed that average weekly paid hours would decline at 0.1 percent per year over the projection period. The current Trustees' assumption is that average weekly paid hours will remain constant. The reasoning underlying the prior assumption of continuing decline in average weekly hours seems to have been that, as workers' real incomes rose, they would choose to consume increased leisure, leading to further reductions in the length of the work week. Beyond a certain point, however, the fixed costs of maintaining an employment relationship borne by both employers and employees argue against further declines in hours.

[110] U.S. Department of Labor, "The Evolution of Compensation in a Changing Economy," *Report on the American Workforce*, Washington DC, 2001, p. 82.

[111] U.S. Bureau of Labor Statistics, "Employee Benefits in Medium and Large Private Establishments, 1997," *Bulletin* 2517, Washington, D.C.: U.S. Government Printing Office, September 1999.

[112] Recent evidence on individuals' cost sensitivity with respect to health insurance purchases is reported in Goldman, Sood, and Leibowitz, 2003, which shows that increases in the relative price of health insurance faced by participants in a large company's flexible spending plan reduced the amount of insurance they purchased.

Figure 28: Trend in Average Weekly Paid Hours, 1948-2006



Source: Data from the Bureau of Labor Statistics. Average weekly hours equal total annual hours divided by 52 times average monthly employment. The total annual hours estimates were provided by the BLS Office of Productivity and Technology. Average employment is a CPS figure, with an adjustment to account for armed forces employment.

One fact that might lead some observers to question the Trustees' projection of stability in average weekly hours is the shortening of the work week that has been observed in some European countries. A useful comparison is to calculate the annual growth rate in hours per employee over two periods, 1960-86 and 1986-2006. The annual growth rate in the U.S. came to a halt, from -0.33 percent per year in the earlier period to -0.02 percent per year in the later period. The figures for Europe (the EU-15) fell by more than half from -0.86 to -0.33, but remain at a substantial rate of decline. As with the fertility rate, this is one among a number of areas in which it is the Panel's judgment that future U.S. trends can be better predicted based on our own past experience than on European developments.

However, the Panel feels that the continuing decline in hours in Europe together with the sharp decline in the U.S. between 2000 and 2006 make at least a modest further decline likely. As a compromise recommendation, we select an annual rate of decline of hours per employee of 0.1 percent for the first 25 years of the projections and zero thereafter. This is consistent with the significant possibility for a substantial upward movement in the average retirement age (reflected in the Panel's low-cost labor force participation assumption). We feel that some of the added employees in the labor force in the 65-75 age groups will choose to work part-time rather than full-time.

The issue of how to think about hours of work is slightly complicated because while weekly hours worked is a common measure, the variable of interest for Social Security purposes is total annual earnings, and thus annual hours. If the ratio of average weekly employment (the average of the number of people working in each week) to average annual employment (number of people working at all during a year) is constant, weekly and annual hours will have the same trend. Over recent decades, however, there has been a decline in the prevalence of part-year work, as women have become more attached to the labor market. This shift presumably is picked up in the adjustment that the actuaries make when they project (annual) Social Security covered employment based on (weekly) CPS employment. More explicit attention to the factors that underlie the trend could perhaps improve the projections, though any effect is likely to be quite small.

GDP Deflator/CPI Growth Rate Differential

Assumption Recommendation A-13: **The differential growth rate between the GDP deflator and the Consumer Price Index (CPI-W) should be reduced from the Trustees' choice of -0.4 percentage points to -0.2 percentage points. We find no historical evidence to support the Trustees' choice and indeed in the past six years the differential growth rate has been zero.**

Of the 0.6 percentage point gap between projected productivity growth and real wage growth, the largest single component is the differential in growth between the GDP deflator and the CPI, projected in the 2007 Trustees Report to be -0.4 percentage points annually. This factor stems from the underlying definition of productivity as real GDP per hour in the entire economy. The GDP deflator is used to derive the productivity growth rate, which directly affects total growth in the economy and the taxable wage base. Yet ongoing Social Security benefits are adjusted annually by the CPI-W, the wage earners' version of the Consumer Price Index, one of three versions released monthly by the BLS. Any tendency for the GDP deflator to grow more slowly than the CPI-W affects the future actuarial balance of the system by pushing up benefits relative to the gains in system income made possible by productivity gains.

Six price indexes are relevant to a consideration of the future evolution of the differential growth in the GDP deflator and the CPI-W. The first two are the deflators for total GDP and for Personal Consumption Expenditures (PCE), both published quarterly by the Bureau of Economic Analysis (BEA). These differ only in coverage; the GDP deflator covers all of current production, whereas the PCE deflator covers only the two-thirds of GDP consisting of personal consumption expenditures, thus excluding equipment and structures investment, as well as government spending and net exports.

The other four indexes are different versions of the CPI. The CPI-U reflects the price experience derived from the spending patterns experienced by all households in the U.S. except those households residing in rural areas, in the armed forces, or in institutions. The CPI-W applies to a subset of the CPI-U population: those households with a full-time employee, the majority of whose income is derived from wage-earner or clerical-worker occupations. The same methodology is employed in the CPI-U and CPI-W, and the samples of areas, retail outlets, and prices are identical. The only difference in their construction is the expenditure weights used to aggregate the prices. Social Security benefit cost of living adjustments are indexed to the CPI-W, the only CPI definition available when benefits were indexed by legislation, in 1972. The GDP and PCE deflators are often revised back into history to reflect new data and methodological improvements. But because they are used in many legal contracts, the CPI-U and the CPI-W are never revised.

While the CPI-U and CPI-W are never changed after publication, the BLS also publishes two alternative versions of the CPI-U that reflect methodological changes over time. The CPI-U-RS ("research series") is available back to 1978 and incorporates numerous methodological improvements made to the CPI during the last 30 years. The CPI-U-X1 is another version of the CPI-U. It is useful in assessing CPI inflation in years before 1978.

Table 7 displays growth rates for all six of these price indexes—the GDP and PCE deflators, the CPI-U and CPI-W, the CPI-U-RS linked at 1978 to

Table 7: Major U.S. Price Indexes, Annualized Growth Rates, 1967-2006

	GDP Deflator	PCE Deflator	CPI-U	CPI-W	CPI-U-RS/X1	Implied CPI-W-RS
2003-2006	3.04	2.75	3.04	3.06	3.06	3.08
2000-2003	2.07	1.82	2.21	2.08	2.19	2.07
1997-2000	1.56	1.67	2.35	2.31	2.25	2.21
1992-1997	1.99	2.06	2.69	2.63	2.34	2.28
1987-1992	3.31	3.81	4.22	4.11	3.74	3.64
1982-1987	3.09	3.40	3.26	2.99	3.34	3.06
1977-1982	7.67	7.86	9.30	9.29	8.24	8.23
1972-1977	6.97	6.96	7.43	7.38	7.06	7.02
1967-1972	4.66	4.10	4.49	4.51	4.03	4.05

the CPI-U-X1, and our calculation of the CPI-W-RS. The annualized growth rate of all six indexes is displayed for five year intervals spanning 1967-97 and over three year intervals between 1997 and 2006.

To highlight the differences in the growth rates of the various price indexes, Table 8 displays key growth rate comparisons, allowing positive and negative differences among the price indexes to be easily identified. In most periods the GDP deflator grows more slowly than the PCE deflator, but in the two most recent periods (2000-2003 and 2003-06) and in the first two periods (1967-72 and 1972-77) the GDP deflator grew more rapidly than the PCE deflator. There is no "iron law" that the GDP deflator must grow more slowly than the PCE deflator.

In all periods shown (except for 1982-87) the rate of inflation in the PCE deflator is substantially slower than in the CPI-U. This is the major reason for the historical differential between the growth rate of the GDP deflator and the CPI-W. A small offsetting contribution is made by the fact that in all periods but the first and last, the growth rate of the CPI-W is modestly slower than the CPI-U.

The fourth column in Table 8 displays the differential growth rates between the CPI-W (used for Social Security indexation) and the implied constant-methodology CPI-W-RS. This difference is negligible in the two most recent periods, reflecting methodological improvements that have been applied equally to the CPI-U and CPI-W. The differential growth rate was particularly large in 1977-1982, when the pre-1983 CPI methodology for the measurement of housing prices had its greatest impact in overstating inflation.

The critical differential is in the fifth column of Table 8, namely the differential between the GDP deflator and the CPI-W-RS that incorporates current measurement methodology. Quite remarkably, this difference has been close to zero during 2000-03 and 2003-06. In contrast, the difference over the pre-2000 period back to 1967 is an average annual growth rate of -0.15 percent per year. Even excluding the past six years, it is notable that the annual growth rate of -0.15 is much slower than the Trustees' assumed rate of -0.4 percent per year.

The most important issue in projecting this differential forward is that methodological improvements in the CPI have not eliminated the differential growth rate of the PCE deflator and the CPI-U. The past provides some guidance for the Trustees. Historical perspective is provided by Table 9, which restates the differences in Table 8 over alternative historical horizons of 10, 20, 30, and 39 years.

Again, the fifth column is the most important. It displays the differential growth rate of the GDP deflator and constant-methodology CPI-W-RS. Over

Table 8: Differences between Price Indexes, Annualized Growth rates, 1967-2006

	GDPD-PCED	PCED-CPIU	CPIU-CPIW	CPIW-CPIW/RS	GDPD-CPIW/RS
2003-2006	0.29	-0.30	-0.02	-0.02	-0.04
2000-2003	0.25	-0.39	0.12	0.02	0.00
1997-2000	-0.10	-0.68	0.04	0.10	-0.65
1992-1997	-0.07	-0.63	0.06	0.35	-0.29
1987-1992	-0.49	-0.41	0.11	0.48	-0.32
1982-1987	-0.31	0.14	0.28	-0.07	0.03
1977-1982	-0.19	-1.45	0.02	1.06	-0.56
1972-1977	0.01	-0.46	0.04	0.37	-0.04
1967-1972	0.56	-0.38	-0.02	0.46	0.61

Table 9:Differences between Price Indexes over Alternative Horizons, 1967-2006

	GDPD-PCED	PCED-CPIU	CPIU-CPIW	CPIW-CPIW/RS	GDPD-CPIW/RS
1996-2006	0.13	-0.47	0.05	0.04	-0.25
1986-2006	-0.11	-0.48	0.07	0.23	-0.28
1976-2006	-0.14	-0.53	0.09	0.32	-0.26
1967-2006	-0.03	-0.52	0.07	0.35	-0.13

the past ten years, this differential of -0.25 points has been well below the Trustees' assumption of -0.4, and over longer horizons the differential has been equivalent or smaller. The most important source of the differential is the differential growth of the PCE deflator and the CPI-U, which in turn is mainly due to the difference between the fixed weights used in the CPI and the chain weights used for the PCE deflator.

Just looking at the history in Table 9, it is clear that there is no historical precedent for the 2007 Trustees' assumption of a -0.4 percent per annum growth rate in the GDP deflator vs. CPI-W differential. Detailed analysis of the data provides further reasoning that the differential growth rate should be smaller.

Referring back to the first column of Table 8, concerning the GDP deflator vs. the PCE deflator, there is no reason to expect that any particular sub-period would be most relevant for the 75 year forecast horizon. The average growth rate over 1967-2006 is -.03 percent per year, and we suggest that the best forecast for this differential growth rate is zero.

For the PCED vs. CPI-U differential, much of history is based on now outmoded CPI methodology. The average of 2003-06 is most relevant, -0.30 percent per year. For the CPI-U vs. CPI-W differential, the 1967-2006 average is +0.07, and there is no reason why this quite stable growth rate should change in the future. Methodology improvements in the CPI-W vs. CPI-W-RS growth rates are irrelevant for the future since the CPI has now adopted all the techniques used in the research series CPI-W-RS.

Summing up the components of the GDP deflator to CPI-W-RS differential relevant for the next 75 years comes out to -0.23. Assuming that the BLS will adopt further methodological improvements in the CPI at various stages over the next 75 years, the Panel's recommendation of -0.2 may still overstate the differential.

Summary of Real Wage Growth

Assumption Recommendation A-14: **Together, Assumptions A-8 through A-12 result in a rate of real wage growth in the intermediate assumptions of 1.3 percent per year, slightly higher than the 1.1 percent assumed in the 2007 Trustees Report.**

The recommendations also result in recommended low-cost wage growth of 1.8 percent and high-cost wage growth of 0.8 percent, in both cases 0.2 percentage point higher than the 2007 Trustees' assumptions.

2007 Technical Panel Growth Rate Recommendations

Real Wage Growth =	(Year 0-25) 1.3 pct/yr (Year 26-75) 1.5 pct/yr
+ Growth in labor productivity	1.7 pct/yr 1.7 pct/yr
+ Growth in [labor compensation/GDP]	0.0 pct/yr 0.0 pct/yr
+ Growth in [earnings/labor compensation]	-0.1 pct/yr 0.0 pct/yr
+ Growth in [total hours/employment]	-0.1 pct/yr 0.0 pct/yr
+ Growth in [GDP deflator/CPI]	-0.2 pct/yr -0.2 pct/yr

Note that our projected -0.1 percent annual growth rate of the earnings/compensation ratio and hours/employee ratio persists only for the first 25 years of the projections and are zero thereafter. Thus our real wage growth rate for 2032 to 2082 is 1.5 percent a year, a substantially faster rate than the 1.1 percent rate in the 2007 Trustees Report.

D. CPI growth rate

Assumption Recommendation A-15: **The Panel recommends that the assumed rate of increase in the Consumer Price Index be reduced by 0.3 percentage point in the intermediate assumption, from 2.8 percent to 2.5 percent per year. The assumption of the future inflation rate in the GDP deflator should be reduced from the current 2.4 percent assumption to 2.3 percent, corresponding to our previous recommendation that the GDP deflator to CPI differential be reduced from -0.4 percent to -0.2 percent per year.**

Social Security is indexed to inflation, so the effect of unexpected changes in future inflation on system finances is muted. However, due to timing effects, in that faster inflation will increase the growth in the taxable wage base prior to its effect on benefits, some sensitivity remains.

As reviewed in the previous section, the concept of inflation used to index Social Security benefits tends to rise faster than the GDP deflator, which is relevant to the measurement of productivity.

Figure 29: Eight Quarter Inflation Rate for GDP Deflator and CPI-W, 1955-2007

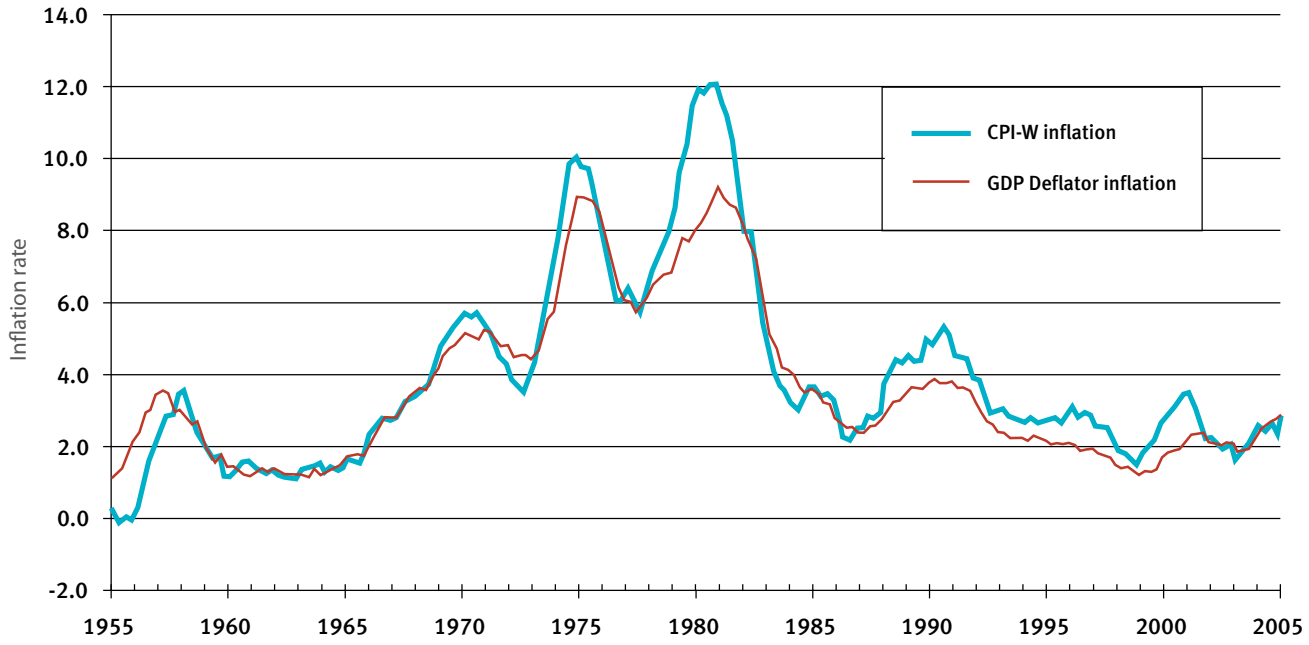


Figure 29 displays the difference between the two inflation measures and points to particular periods when the difference was very large (notably the period 1978-82) and other periods when the difference was very small (2002-06).

Our consideration of the future behavior of inflation profits from an enormous literature on the U. S. inflation process. For 25 years a consensus model has performed well in explaining the historical behavior of U. S. inflation—why inflation accelerated in the late 1960s and late 1980s, why inflation was so high in the 1970s and so low in the late 1990s, why inflation and unemployment moved in opposite directions in the late 1960s and late 1980s but in the same direction in the 1970s and late 1990s.

The consensus or mainstream model of the inflation process can be written as:

Inflation today = Inherited Inflation + Demand Effect + Supply Effect

Because this model of inflation has three driving forces—inertia, demand and supply, it has frequently been called the "triangle" model.[113]

The role of "inherited inflation" is fundamental. If there are no pressures pushing up or down on current inflation from demand or supply factors, then inflation will continue at the rate inherited from the past. However, inflation can be jarred away from this inherited rate by shocks to the demand or supply sides of the economy. The classic demand-induced inflation in the U.S. occurred during 1965-1970, when a combination of Vietnam War government spending, sharp cuts in income tax rates, and a generally ebullient atmosphere for spending on consumer durables and business investment pushed the unemployment rate down from 5.5 percent in 1963 to roughly 3.5 percent during 1966-1969.

The demand effect can be represented as the "gap" between the actual unemployment rate and a hypothetical "natural unemployment rate" that is consistent with steady inflation.[114] For instance, from the perspective of 45 years of data (1962-2007), we can estimate that in the late 1960s an unemployment rate of 5.5 percent would have been necessary to avoid an acceleration of inflation. The actual observed 1966-1969 unemployment rate of 3.5 percent implied an acceleration of inflation of roughly 1 percentage point per year; and inflation accelerated from 1 percent in the early 1960s to 5 percent in 1970. The rule of thumb is that inflation accelerates by 0.5 percent for each percentage point gap between actual and natural unemployment. This rule of thumb was first noticed in the 1960s and is validated forty years

[113] Dew-Becker, Ian and Robert J. Gordon, "Where Did the Productivity Growth Go? Inflation Dynamics and the Distribution of Income," *Brookings Papers on Economic Activity*, no. 2, 2005, pp. 67-127.

[114] The "natural unemployment rate" in the contemporary literature is more often labeled as the "NAIRU," the Non-Accelerating Inflation Rate of Unemployment.

later in the latest academic estimates of the inflation process. Likewise, a positive gap—with unemployment above the natural rate—will cause inflation to decelerate. This is validated by the disinflationary periods of 1981-1986, 1990-1993, and 2000-2003.

Inflation remains at the rate of inherited inflation if the demand effect is zero, that is, if the unemployment gap is zero. When unemployment is low and the gap is negative, inflation accelerates, as in 1966-1969 and 1987-1989. When unemployment is high and the gap is positive, inflation decelerates, as in 1981-1986, 1990-1993, and 2000-2003.

But inflation and unemployment have not always been negatively correlated. The U.S. experienced "twin peaks" of high unemployment and inflation in 1974-1976 and 1979-1981, and a "valley" of low unemployment and inflation in 1997-1999. Theories developed at the time of the first 1974-1975 oil shock, and subsequent empirical work, have validated the role of supply shocks (the "supply effect" in the above equation) as an additional factor that can cause inflation to accelerate or decelerate, sometimes quite rapidly.

These theories reflect two realistic aspects of any economy, which can usefully be imagined as divided into energy and non-energy sectors. The first aspect is that price and wage behavior in the non-energy sector is very "sticky," or slow to adjust, which makes inflation adhere to inherited inflation when there are no demand or supply effects. Second, sudden quantum jumps to prices have occurred for crucial products, e.g., farm products and oil, for which the demand is highly price inelastic.

The combined effect of these two aspects is that when oil prices jump by a factor of four, as in 1974-1975, the economy cannot cut back its spending on oil to any significant degree. It is stuck with its gas-guzzling automobiles, its aging fleet of jet planes, and its poorly-insulated houses and apartments. This decreases the income available to purchase non-energy goods and services, and real spending in the non-energy sector declines. In 1974-1975 and 1979-1981 it declined by a lot. "Inflation Creates Recession," in the words of a 1975 *New York Times* article—and this mantra has been subsequently ratified by theory, econometric estimation, and is now incorporated in all macroeconomic textbooks.

This model of inflation and unemployment behavior greatly simplifies the Trustees' task of projecting the future inflation rate. Over long periods of time, the supply shocks are likely to average out to zero. Over long periods of time, the demand unemployment gap is likely to average out to zero. This means that future inflation will equal inherited inflation.

We can simulate the mainstream model, based on estimated parameters for the period 1962- 2006, assuming in the future no supply shocks and an actual unemployment rate equal to the natural rate of unemployment (perhaps 5.5 percent) by early 2005.[115] This yields a future inflation rate in the GDP deflator of 2.3 percent. Since, in another section of our report, we project a differential between the GDP deflator and the CPI-W of -0.2 percent, this implies future growth in the CPI-W of 2.5 percent.

Some of the critical actuarial variables may be best modeled as an average over the past 20 or 30 years, but the inflation rate is decidedly not among that set of variables. Inflation earlier than six years ago is simply irrelevant for any projection of future inflation, including the 5 percent inflation rate registered in 1970 or the 10 percent registered in 1980. Unless a specific reason is suggested to support a positive demand or supply effect on average over the next 75 years, then the best projection of CPI inflation for the future is not 2.8 percent, but rather that implied by the inflation inherited from a weighted average of the actual experience of the past six years, and this turns out to be roughly 2.5 percent.

Thus, the Panel recommends an intermediate projection of 2.5 percent per year. Although the Panel recommends low and high cost rates of 1.5 and 3.5, respectively, we note there is a possibility that improved monetary policy will reduce the volatility of inflation in the future, which would indicate narrowing those bands over time. (Note that lower inflation results in a larger actuarial deficit, due to the time lag between the effects of CPI changes on taxable payroll and on benefit payments. Lower inflation has an immediate effect on nominal wages, and thus on revenues, while the reduction in benefits due to a smaller cost of living adjustment is experienced only after about a year. Thus, the lower taxable payrolls have a stronger effect than the lower benefits, thereby resulting in higher cost rates.)

E. Interest rates

Assumption Recommendation A-16: **The Panel recommends using a long-term nominal rate of 5.17 percent, based on a real rate of 2.6 percent and a**

[115] The simulations are based on updated versions of the estimated equations in Dew-Becker and Gordon, 2005, op. cit.

CPI inflation rate of 2.5 percent. The corresponding real and nominal rates for the high cost scenario should be shifted down to 1.8 percent and 5.36 percent respectively. For the low cost scenario, we recommend lowering the real rate to 3.3 percent, and the nominal rate to 4.85 percent. These changes are based on a uniform reduction in the CPI inflation rate of .30 percent in all scenarios.

Method Recommendation M-20: **The Panel recommends that the Trustees modify their approach to determining real and nominal interest rates to place more weight on the forward-looking information in recent Treasury yield curves.**

Method Recommendation M-21: **For calculations involving discounting such as the actuarial balance, the Panel recommends that the Trustees consider using risk-adjusted rates instead of a risk-free real interest rate.**

Overview

Interest rates influence the time path of trust fund balances, and the overall actuarial balance, through their effect on expected returns on trust fund securities[116] and on the discount rate. It is the real interest rate that has the greatest effect, but both real and nominal interest rates affect the projections.

As for other quantities, the Trustees tend to make relatively small changes in projected interest rates from year to year, a practice that sometimes causes assumed rates to deviate significantly from those suggested by either market yields or by professional forecasters. At present, the Trustees assumed interest rates, both real and nominal, are much above the consensus view, and the Panel recommends reducing the assumed rates to levels more in line with the consensus estimates.

More fundamentally, the Panel recommends that the Trustees modify their approach to determining interest rates by placing more weight on the information in recent Treasury yield curves. It is notable that interest rates are the only variable where the Trustees can draw on information from a large, active, and forward-looking market where the stakes for participants are high. Suitably adjusted for the term premium and transitory market conditions, the yield curve generally provides the best available forecast of future interest rates.[117] While this does not cover the entire 75 years of the forecast, the information could at least be incorporated into the medium run out to 20 or 30 years. At present, the "long-run" rate assumptions are completely phased in within 6 or 7 years.

The idea that long-run Treasury yields contain the best available information about expectations of future Treasury rates is known as the "expectations hypothesis." It posits that investors seeking profit-making opportunities tend to push long-run rates to levels consistent with their expectation of future rates. Imagine, for instance, that the 2-year Treasury yield is 5 percent, and that the current 1-year Treasury yield is 4.5 percent. If investors expected 1-year rates to be less than 5.5 percent next year, they would expect to profit from buying a 2-year bond financed by selling a 1-year T- bond. If the rates were expected to be higher, they would be better off investing in the 1-year bond financed by selling a 2-year bond of equal value. Thus the forces of supply and demand tend to move long-term interest rates in line with expected future rates. The fact that rate projections by professional forecasters tend to be consistent with the expectations hypothesis demonstrates the wide acceptance of this idea.

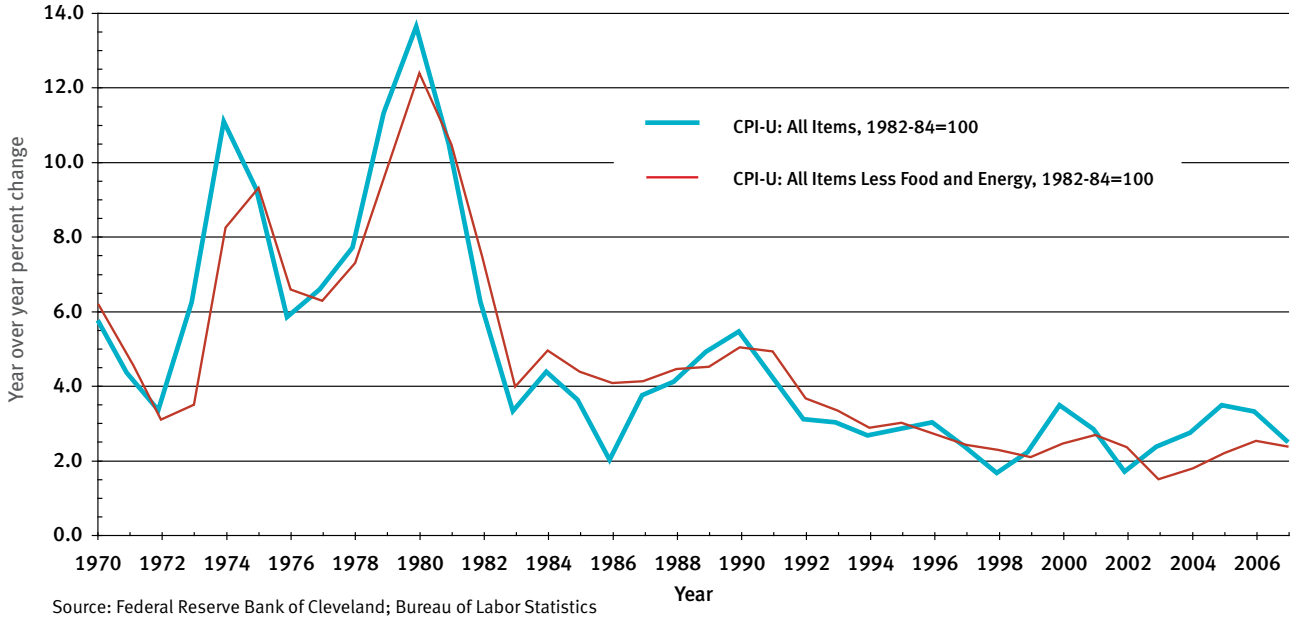
Theoretically, the expectations hypothesis does not hold exactly if investors are risk averse, and the evidence suggests that in fact the relationship is systematically violated. Deviations, however, occur in a predictable direction that can be adjusted for. Specifically, long-term interest rates contain a "term premium" or "risk premium" that makes future short-term rates systematically lower than those implied by the expectations hypothesis. Thus, in using the term structure to forecast future rates, it is standard to rely on the "modified expectations hypothesis" that incorporates an adjustment for the term premium, as well as for any identifiably transitory market conditions.

An alternative approach to forecasting interest rates draws inferences from historical averages. Although it is useful to consider this data, a backward-looking approach to forecasting rates is confounded by several problems that are elaborated on below. Since historical data informs the forward-looking projections implied by the yield

[116] Trust fund returns are based on special issue Treasury bonds. Since October 1960, the formula for the rate on new special issues has been the average market yield on all marketable government obligations that are not due or callable for at least 4 years from the date of determination. These securities can be redeemed at par at any time.

[117] Buser, Stephen A., Karolyi, George Andrew and Sanders, Anthony B., "Adjusted Forward Rates as Predictors of Future Spot Rates," Dice Center Working Paper Series 96-5, 1996. Available at SSRN: http://ssrn.com/abstract=40165 or DOI: 10.2139/ssrn.40165

Figure 30: Historical Annual Inflation Rates, 1970-2007



Source: Federal Reserve Bank of Cleveland; Bureau of Labor Statistics

curve, relying primarily on those measures is consistent with learning from the past.

Inferring Real Interest Rates

By definition, the nominal interest rate is the real rate compounded with expected CPI inflation. Before 1997 the Treasury issued only nominal securities, hence historical real interest rates have to be inferred from observed nominal interest rates and inflation. Inflation complicates inferences about real rates for several reasons: Realized inflation can deviate widely from expected inflation; and past inflation may be a poor proxy for future inflation. More recent data from the Treasury Inflation-Protected Securities (TIPS) market avoids the complications associated with inflation, but also must be interpreted with caution due to other differences between the two markets.

Episodes of high and variable inflation (or deflation) can cause real bond returns to differ significantly from what investors' initially expect. Examples of such surprises include the spikes in inflation in the mid-1970's and early 1980s that resulted in negative real bond returns, and the sharp deflation in the early 1920s that caused realized real rates to skyrocket. More subtly, the unexpectedly rapid return to low inflation in the late 1980s may have increased realized real returns during that period and into the 1990s.

Inflation surprises make it difficult to infer historical expectations about real interest rates from historical nominal data. A simple averaging of ex post realized real rates from 1870 to 2004 implies an average rate just under 3 percent.[118] However, because large inflation surprises are rare even over this long period, they may not average out to zero. We conclude that there is considerable uncertainty about whether the long-run average accurately reflects historical expectations of real returns. Inflation also complicates inferences about real rates because inflation over the next 75 years may behave quite differently than in the past. In recent years, inflation in the U.S. (see Figure 30) and other developed economies has been stabilized at low rates, and most economists believe that central banks have the knowledge and determination to maintain low inflation. This has several implications for long-term interest rate projections. Reduced inflation risk decreases the volatility of nominal rates going forward. It should also lower the inflation risk premium, and hence the level of required real returns.

More recently, the introduction of TIPS has provided policymakers with a more direct measure of real Treasury interest rates. Drawing inferences from this market is complicated by its being relatively new, small, and far less liquid than the market for nominal Treasury obligations.[119] Dur-

[118] Girola, James, "The Long-Term Real Interest Rate for Social Security," Research Paper No. 2005-02, U.S. Dept. of Treasury, March 30, 2005.

[119] Since the returns on the special issue securities in the trust fund are linked to those on nominal Treasury's, these discrepancies

ing its first four years in operation, real returns on TIPS were in the 3.5 to 4 percent range, much higher than the real return reasonably expected on nominal Treasury securities of comparable maturity. Most observers attributed these high yields to the market's newness and illiquidity, and did not rely on it to make inferences. In recent years, TIPS yields have been more consistent with nominal Treasury yields and other sources measuring inflation expectations. Indeed, the Fed now routinely uses TIPS data in their Monetary Report to the Congress. Nevertheless, differences between the TIPS and nominal Treasury market persist, and some caution is warranted in interpreting the rates.[120]

Rate Recommendations

Consistent with our methodological advice, we focus primarily on recent Treasury yield curve data and consensus inflation forecasts to evaluate the Trustees' projections of real and nominal interest rates.[121] Although rates in recent years were lower than in the past, as discussed earlier, we believe that the market correctly discounts the likelihood of a recurrence of high and variable inflation.

The first point of comparison is the direct evidence from the TIPS market. Table 10 reports statistics on daily TIPS yields from January 2003 to February 2007. Over this period, the average 10-year real rate was 2.02 percent and the average 20-year rate was 2.15 percent. Although TIPS yields have increased somewhat since then, the 2.9 percent real rate assumed by the Trustees is well above the maximum rate of 2.68 percent realized over this period.[122]

Table 10: Implied Real Yield Curve

	5 year	7 year	10 year	20 year
Average	1.56%	1.80%	2.02%	2.15%
Average since 01/07	2.41%	2.43%	2.40%	2.40%
Std. Dev.	0.55%	0.40%	0.28%	0.22%
Min.	0.39%	0.87%	1.36%	1.69%
Max.	2.65%	2.64%	2.68%	2.68%

* 20-year data begins 7/2004

The Trustees set projected nominal rates to be consistent with their real interest rate and inflation assumptions. The result is a nominal rate in the intermediate case that is inconsistent with the nominal Treasury yield curve. Since 2003, the long end of the nominal Treasury yield curve has on average hovered around 5 percent, whereas the Trustees assume a long-term nominal rate in the intermediate case of 5.7 percent.[123] Part of the discrepancy is attributable to the assumption of high real rates. However, the Trustees' assumption of 2.8 percent long-term CPI inflation also exceeds the medium term consensus view, and contributes to the discrepancy with market data. A recent survey of 49 professional forecasters reports a median inflation estimate of 2.35 percent over the next 10 years (longer forecasts do not seem to be available); the Trustees' estimate over the next 10 years is 20 basis points above the upper quartile of those estimates.[124]

By taking a stand on real interest rates, inflation expectations can be inferred from long-term nominal Treasury yields. A long-term nominal rate of 5 percent combined with the Trustees' assumption of a 2.9 percent real rate implies expected inflation of just over 2 percent. This is clearly inconsistent with the 2.8 percent inflation rate assumed in the intermediate case, and also low compared to available forecasts.

More broadly, the historically low level of long-term yields in the U.S. and abroad suggests that investors expect inflation to remain moderate. For instance, subtracting the current 30-year TIPS yield of 2.5 percent from the nominal 30-year bond rate of 5 percent implies expected inflation of 2.5 percent, an estimate that is in line with other forecasts. Interest rates in Europe and Asia are also low by historical standards, reflecting a benign inflation outlook worldwide. The Trustees appear to put greater weight on the past than do markets. Their Report mentions that the CPI estimate reflects the possibility of the recurrence of the highly inflation-

might matter.

[120] Some have argued that the TIPS rate is likely below the real rate on nominal Treasury's because rates do not include an inflation risk premium. An effect in the opposite direction, however, is that they may command a liquidity premium on TIPS. As neither effect is possible to quantify, it is not obvious in which direction a bias is more likely.

[121] Because the yield curve is fairly flat in the 10- to 30-year range, we use the level of rates as a close proxy for implied forward rates of the relevant maturities.

[122] Even with the recent concerns about credit risk and disruptions in the credit markets, recent TIPS yields remain around 2.5 percent.

[123] The divergence from market rates is even larger in the short-run with rates of 5.8 percent to 5.9 percent projected between 2009 and 2013.

[124] Federal Reserve Bank of Philadelphia, Survey of Professional Forecasters, February 2007.

ary periods in the 1960s and 1970s, and discusses the forecast relative to a 40-year look-back period.

Based on these observations, the Panel's recommendation in the intermediate case is to set the long-term nominal rate to 5.17 percent, based on a real rate of 2.6 percent, and a CPI inflation rate of 2.5 percent. The corresponding real and nominal rates for the high cost scenario should be shifted down by corresponding amounts: We recommend a real rate in the high cost scenario of 1.8 percent, and a nominal rate of 5.36 percent. For the low cost case these numbers are 3.3 percent and 4.85 percent respectively. The nominal rate recommendations are consistent with those for real rates, and with CPI inflation rates 0.3 percent lower than currently assumed.

Implications for Trust Fund Balances

By 2041 trust fund balance are projected to decline to zero. This means that interest rates beyond the 30 years spanned by the Treasury yield curve do not affect investment returns beyond that horizon. Balance estimates along the way, however, are quite sensitive to the assumed real rates of return between now and the early 2030s. Our calculations show that lowering the real interest rate by 0.3 percent as we recommend, and setting all other cash flows to match those in the 2007 Trustees Report intermediate scenario, lowers the projected trust fund balance in 2035 by almost $640 billion.

Discounting and the Actuarial Balance

The actuarial balance is the present value of income plus current trust fund balances, minus the present value of benefits, expressed as a percentage of the present value of taxable payroll over the same period. It is sometimes interpreted as the amount payroll tax rates would have to be raised today, or the amount the benefit rate would have to be lowered, to bring the system into actuarial balance over a given period. Under the assumptions of the 2007 Trustees Report the 75-year balance stood at -1.95 percent of taxable payroll in 2007.

The choice of real interest rates has a dramatic effect on the actuarial balance, with a lower rate leading to a higher present value cost or a more negative balance. For instance, the sensitivity analysis in the Trustees Report indicates that lowering the real interest rate from 2.9 percent to 2.1 percent worsens the actuarial balance by 0.52 percent. The effect of the real rate on the actuarial balance increases with the time horizon considered, since the growing divergence between projected income and cost rates is amplified by the use of a low discount rate. Periods of relatively low interest rates therefore have the unfortunate side effect of putting considerable weight on distant and therefore highly uncertain estimates.

Fortuitously then, there is theoretical justification for using a higher rate than that on special issue Treasury securities to calculate the actuarial balance. A general rule in computing present values (albeit one that is often ignored in federal financial calculations), is to use a discount rate that is "risk-adjusted" to match the risk in the cash flows being discounted. For instance, a calculation of the present value of the expected returns on stocks is risk-adjusted by discounting at a rate above the Treasury rate equal to the "equity risk premium." The equity premium reflects the higher risk, and hence higher average return, required on stock market investments.[125] The present value then has the interpretation of the dollar amount that would have to be invested today to buy financial claims to fully cover the projected cash flows. Social Security income and expenditures similarly have market risk. Payroll tax revenues, which are proportional to earnings, fluctuate with the aggregate economy. Social Security obligations also vary positively with aggregate earnings. The principal of discounting at a rate consistent with the aggregate risk in the underlying cash flows therefore implies adding a risk premium over Treasury rates in calculating the actuarial balance.

Recently several studies have begun to quantify the risk-adjustment appropriate for long-term wage-linked cash flows.[126] Most directly relevant to the actuarial balance is the work of Geanakoplos and Zeldes, who estimate the value of Social Security liabilities taking into account their market risk. [127] The risk in Social Security liabilities arises

[125] A related use of the idea of risk-adjustment is used in projections of returns on private accounts. In that context, neutralizing the effect of the risk premium involves subtracting the risk premium from the expected return on Treasury securities when projecting future cash flows. In either case, risk adjustment has the effect of treating the higher expected return on stocks as compensation for risk rather than as a costless gain from risk-taking.

[126] Benzoni, Luca, Pierre Collin-Dufresne, and Robert Goldstein "Portfolio Choice over the Life Cycle when the Stock and Labor Markets are Cointegrated," *Journal of Finance* (forthcoming); and Lucas, Deborah and Stephen Zeldes "Valuing and Hedging Defined Benefit Pension Obligations – The Role of Stocks Revisited," manuscript Northwestern University, 2007.

[127] Geanakoplos, John and Stephen P. Zeldes, "The Market Value of Accrued Social Security Benefits," mimeo, Conference on Measuring and Managing Federal Financial Risk, Kellogg School of Management, Northwestern University, February 8-9, 2007.

from the indexing of benefits to aggregate wage growth: liabilities will be higher if the economy on average does well over the next 75 years than if it does poorly. This systematic risk implies that the theoretically correct rate is higher than the risk-free Treasury rate. Geanakoplos and Zeldes estimate that risk-adjusting the discount rate appropriately lowers the present value of liabilities to 73 percent of the present value calculated at Treasury rates. Payroll tax revenues, which also are tied to aggregate economic performance, require similar risk adjustment.

The Panel recommends that the Trustees consider adopting risk-adjusted discount rates for computations that involve discounting. As well as making the measures more accurate theoretically, the use of higher discount weights has the salutary effect of reducing the sensitivity of the results to the more distant, and more uncertain, cash flows.

Equity Risk Premium

Assumption Recommendation A-17: **The Panel concurs with the choice of equity premium assumed in recent analyses by the Office of the Chief Actuary of proposals involving stock market investments.**

Method Recommendation M-22: **In such analyses, the Panel recommends that the Office of the Chief Actuary portray risk-adjusted projections as a neutral risk-adjusted case, not as worst case for average returns.**

The equity risk premium—the average return on stocks over the risk-free rate—has no effect on the analysis of system finances under current law. Periodically, however, the actuaries are asked to analyze the effect of legislative changes that include investments in the stock market.

Although past realizations of the equity premium are readily observable, there is some disagreement about the expected premium going forward. It was once common practice to identify the equity premium with the long-run historical spread between the average realized return on common stocks and the short-term T-bill rate, and some economists continue to endorse this approach, which implies a premium in the range of 7 to 8 percent. More recently, an increasing number of financial economists and market participants believe that the premium has fallen, perhaps permanently. Evidence that supports this view includes the sustained run-up in stock prices that has led to historically low average earnings-price ratios; and the likelihood that risk tolerance has increased with the increased stability of the macro economy and better financial risk diversification. Reflecting this sentiment, the Federal Reserve Bank of Philadelphia's most recent Survey of Professional Forecasters showed a median prediction of the equity premium of 3 percent over T-bills, and only 2.5 percent over bond returns. A 2001 survey of 510 finance and economics professors reports a consensus 30-year equity premium forecast of 5 to 5.5 percent.[128] In recent analyses the actuaries have assumed a premium that falls between those estimated using these two approaches. The Panel is comfortable with this choice, although it may be necessary to revisit it as more evidence becomes available to determine whether the premium is at a permanently lower level. Fairly presenting the implications of the equity premium can be a greater challenge than estimating it. Investments in equities on average earn more than do safe bonds, and clearly system finances on average would be improved by such investments. It is generally agreed, however, that the higher average return is compensation for greater systematic risk, and that there is no free lunch in exchanging $1 of bonds for $1 of stocks, either for individuals or for the government. The problem with emphasizing average outcomes is that policies with stock market investments look like an arbitrage opportunity; they appear to make the system better off at no cost. In fact, with the inclusion of equities the standard method for computing the actuarial balance produces a windfall for the system. Consider investing $100 billion of trust fund assets in equities, expected to earn 10 percent per year forever. At a Treasury rate of 5 percent, the present value of the expected cash flows of $10 billion per year is $200 billion, twice the true value of the investment.

A representation of equity investments that avoids the appearance of arbitrage is to lower projected returns on equity by the amount of the equity premium. Conceptually, this is like assessing a charge on equity for the market risk it imposes on the system. Equivalently, the returns on equity can be projected forward to Treasury rates. This approach has been taken by CBO in reporting on reform proposals, and SSA to some extent has followed suit. For in-

[128] Welch, Ivo, "The Equity Premium Consensus Forecast Revisited," September 2001, Cowles Foundation Discussion Paper No. 1325. This is an estimate of the arithmetic premium over short-term T-bills.

stance, in the analysis of the Liebman-MacGuineas-Samwick proposal, the Office of the Chief Actuary (OCACT) projects system finances both using the expected return on stocks, and assuming stocks earn only the Treasury rate. In interpreting the risk-adjusted projections the actuaries say:

> "This may be viewed as either illustrating the case where the average real yield on equities and corporate bonds is no higher than on government bonds, or illustrating the effect of assuming risk-adjusted returns on equities and corporate bonds. In either case, the "expected" yield on annuitized assets is assumed to match the actual yield, on average. It should be noted that while average real yields for equities have been at or below average bond yields for periods of a decade or so, the likelihood of having *such a low average yield* for a period of several decades is fairly low."[129] [emphasis added]

While this acknowledges the interpretation that projecting at Treasury rates gives a risk-adjusted forecast, it also invites using the numbers as a worst case. This diminishes the conceptual value of presenting a risk-adjusted estimate. It is also not a natural worst case—returns could turn out to be far worse than a steady 3 percent. The Panel recommends that the actuaries portray risk-adjusted projections as being neutral, not worst case, in future analyses of this type.

F. Taxable share of covered wages

Other Recommendation O-1: **The Panel recommends that additional research be undertaken to develop a greater understanding of the implications for trust fund finances of trends in the dispersion of covered wages. That research should aim to provide a stronger basis for projecting the share of covered wages that fall above and below the taxable maximum. In addition, that research should examine the implications of stagnating wages at the lower end of the earnings distribution on the incentives to apply for disability benefits.**

Other Recommendation O-2: **The Panel recommends that the rationale in the Trustees Report for the projection of the share of covered wages that is taxable be made more explicit and should account for the substantial deviation of current trends from previous projections. The Panel recommends that the high and low cost projections of the share of covered wages that is taxable reflect a realistic degree of uncertainty. The long-range sensitivity analyses in the report should include the effect on summarized cost balances of the range of assumptions about the share of covered wages that is taxable.**

Overview

Trends in the dispersion of income and wages have garnered increasing attention from economists. Over the past quarter century, the share of wage earnings going to a relatively small percentage of the highest earners has grown faster than earnings as a whole and considerably faster than the earnings of those at lower levels on the earnings distribution.[130]

By law, there is a maximum amount of each individual's earnings subject to the OASDI payroll tax each year, referred to formally as the "contribution and benefit base" and informally as the "taxable maximum". That threshold is set by law and since 1981 has been indexed to the growth of the national average wage index. [The historical and projected AWI series as well as the "contribution and benefit base" are published in the Trustees Report in table V.C.1].

The "benefit and contribution base" or taxable maximum has grown from $35,700 in 1983 to $102,000 in 2008. The share of total covered wages that is subject to the payroll tax is sometimes called the "taxable ratio". The share of total covered wages subject to the payroll tax has fallen from 90 percent in 1983 to 83 percent in 2007, a result of the unequal growth of earnings.

Each year's Trustees Report discusses the projection of the taxable ratio. Although the underlying factors that influence the trends in the distribution of earnings growth are economic and demographic phenomena, the "contribution and benefits base" and the method of indexing are set by law

[129] Estimated Financial Effects of "A Nonpartisan Approach to Reforming Social Security – A Proposal Developed by Jeffrey Liebman, Maya MacGuineas and Andrew Samwick," memorandum from Stephen Goss and Alice Wade to the authors of the proposal, Office of the Chief Actuary, Social Security Administration, November 17, 2005.

[130] Autor, David H., Lawrence F. Katz and Melissa S. Kearney, "The Polarization of the U.S. Labor Market," *American Economic Review Papers and Proceedings*,Vol. 96, May, 2006, pp. 189-94; Piketty, Thomas and Emmanuel Saez , "Income Inequality In The United States, 1913–1998*," Quarterly Journal of Economics, February 2003, Vol. 143, issue 1; Piketty, Thomas and Emmanuel Saez. 2006. "The Evolution of Top Incomes: A Historical and International Perspective," *American Economic Review Papers and Proceedings*, Vol. 96, no. 2, 2005; Gordon, Robert and Ian Dew-Becker, "Unresolved Issues in the Rise of American Inequality," manuscript, 2007.

and, thus, are treated as program assumptions. The share of payroll subject to taxation is projected over a ten year horizon with high, low and intermediate cost variants. For long-range calculations the taxable ratio in the tenth year is assumed to hold for the remainder of the 75 year projection period.

Discussion

The Trustees Reports recent history of projecting the share of covered earnings below the taxable maximum is a cause for significant concern. Figure 31 shows that the taxable ratio has fallen rather steadily, with some gyrations, since 1983 at the time of the last major Social Security Amendments. In every year since, the assumption [blue dotted lines] has been that the taxable ratio would stay about level (1984, 2000, 2007), or that it would fall slightly and then stay level for the remainder of the 75 year projection (1992, 1997). In virtually every case, the actual data departed significantly from the projected trend after only a few years.

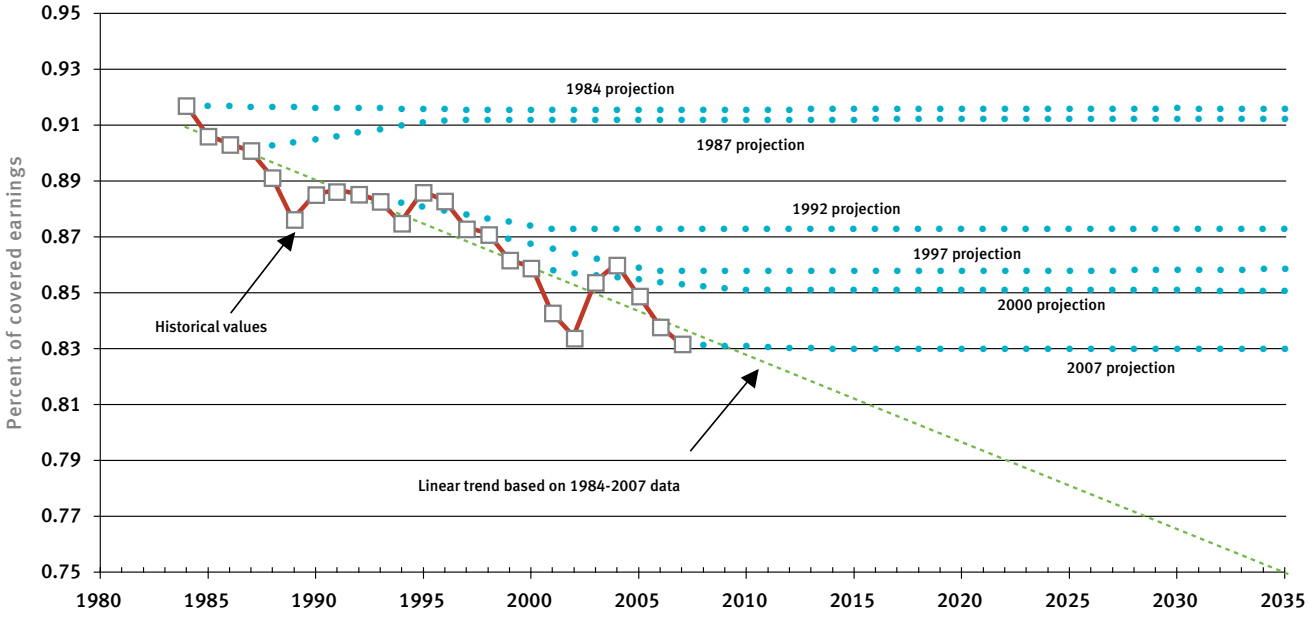
We also note that the range of the projections from the high-cost to low-cost have been unusually narrow, and suggest that the possibility of the taxable ratio falling more quickly than anticipated has consistently been underestimated. In 1984, the 10-year low-cost projection was 91.9 percent and the high-cost was 91.4 percent. The 1996 projection was somewhat less certain with a range between 87.9 percent for the low-cost and 85.6 percent in the high-cost variant. It should be noted that 10 years after the projection, the high-cost scenario was exceeded in both cases. The 2007 Trustees Report contains a long-run taxable ratio assumption of 83 percent (roughly the 2007 actual level) with a low cost assumption of 83.8 percent, and a high cost projection of 82.2 percent. Given the inaccuracy of previous 10-year projections, this seems unrealistically narrow.

Accurate projection of the taxable ratio is important to accurate projections of the trust fund balances. If the taxable ratio continues to decline along the linear trend experienced from 1983 through 2007, [dotted red line in Figure 31] for 30 years and then stays level, with all other assumptions remaining at the Trustees' 2007 intermediate values, the 75-year actuarial deficit would fall from the currently projected 1.95 percent of payroll to 2.59 percent of payroll. This is as large an effect as assuming the total fertility rate falls to 1.5.

Given that the historical projections over the past 25 years have tended to underestimate the extent of the decline in the share of total earnings that are subject the payroll tax, the Panel believes the Trustees and actuaries should examine the basis for these projections. They need to understand better the forces that underlie the trends in wage dispersion, particularly the disproportionate growth at the very top of the distribution (approximately 6 percent of those with covered earnings, have annual earnings that exceed the taxable maximum).

In addition, subsequent Trustees Reports should include a more complete explanation of why the current projections truncate the historical pattern of decline. The 2007 Trustees Report provides two sentences of rationale for their current projection. The first is largely tautological: "This [1983-2005] decline was mainly due to a relative increase in wages for high wage earners." The second suggests that some of the decline is due to changes in the age distribution as the baby boom has moved into ages of higher relative earnings. There is no reference to the growing literature of the causes of wage inequality, and no suggestion as to whether those causes are expected to continue or abate. To the extent that the forces underlying these trends are not well understood, this should be reflected in a wider range between the high and low cost scenarios. Further, the Panel believes such an important source of projection uncertainty should be dealt with explicitly in stochastic models as well as in the sensitivity analysis in the current reports.

Figure 31: Percent of covered earnings below taxable maximum: 10-year (ultimate value) projections 1984-2007 vs. historical values and 25-year projected trendline



References

Aaron, Henry, "The Unsurprising Surprise of Renewed Health Care Cost Inflation," *Health Affairs,* January 23, 2002.

Abma, J.C. and G.M. Martinez, "Childlessness among Older Women in the United States: Trends and Profiles," *Journal of Marriage and Family*, Vol. 68, 2006, pp. 1045-1056.

Actuarial Standards Board, "Actuarial Standards of Practice No. 32: Social Insurance," January 1998. (http://www.actuarialstandardsboard.org/pdf/asops/asop032_062.pdf)

Ahmed, B. and G. Robinson, 1994, "Estimates of Emigration of the Foreign-Born Population: 1980-1990," Technical Working Paper No. 9, Population Division, U.S. Census Bureau, Washington, DC. December, 1994. (http://www.census.gov/population/www/documentation/twps0009/twps0009.html)

Autor, David and Mark Duggan, "The Growth in the Social Security Disability Rolls: A Fiscal Crisis Unfolding," *Journal of Economic Perspectives*, Summer, 2006, pp.71-94. (http://www.econ.umd.edu/~duggan/JEP-Disability.pdf)

Autor, David H., Lawrence F. Katz and Melissa S. Kearney, "The Polarization of the U.S. Labor Market," *American Economic Review Papers and Proceedings 96*, May, 2006, pp. 189-94.

Basu, Susanto, John G. Fernald, Nicholas Oulton, and Sylaja Srinivasan, "The Case of the Missing Productivity Growth, or Does Information Technology Explain Why Productivity Accelerated in the United States But Not in the United Kingdom?" in *NBER Macroeconomics Annual 2003,* MIT Press, 2004.

Bean, F.D., R.M. Cullen, E.H. Stephen, C. G. Swicegood, "Generational Differences in Fertility among Mexican Americans: Implications for Assessing the Effects of Immigration," *Social Science Quarterly,* 65:573-82, 1984.

Bean F.D., C.G. Swicegood, and R. Berg, "Mexican-Origin Fertility: New Patterns and Interpretations," *Social Science Quarterly,* 81(1): 404-420, 2000.

Bell, Felicitie C., and Michael L. Miller, *Life Tables for the United States Social Security Area 1900–2100, Actuarial Study No. 120*, Social Security Administration, Publication No. 11-11536, 2005.

Benzoni, Luca, Pierre Collin-Dufresne, and Robert Goldstein, "Portfolio Choice over the Life Cycle when the Stock and Labor Markets are Cointegrated," *Journal of Finance*, (forthcoming).

Blackstone, Brian, "Is Productivity Growth Back in the Grips of Baumol's Disease?" *Wall Street Journal,* August 13, 2007, p. A2.

Boldrin, M., M. De Nardi, and L.E. Jones, "Fertility and Social Security," NBER Working Paper #11146, 2005.

Bongaarts, John, "How Long Will We Live?" *Population and Development Review,* Vol. 32(4), 2006, pp. 605–628.

Briggs Jr., Vernon M., *Mass Immigration and the National Interest* (2nd edition), Armonk, NY: M.E. Sharpe, 1996.

Brynjolfsson, Erik, Lorin M. Hitt, and Shinkyu Yang, "Intangible Assets: Computers and Organizational Capital," *Brookings Papers on Economic Activity*, No. 1, 2002, pp. 137-81.

Burkhauser, Richard V. and Mary C. Daly, "U.S. Disability Policy in a Changing Environment," *Journal of Economic Perspectives*, Winter, 2002, pp.213-224.

Buser, Stephen A., George Andrew Karolyi, and Anthony B. Sanders, "Adjusted Forward Rates as Predictors of Future Spot Rates," Dice Center Working Paper Series 96-5, 1996. (http://ssrn.com/abstract=40165 or DOI: 10.2139/ssrn.40165)

Carnes, Bruce A. and Jay S. Olshansky, "A Realist View of Aging, Mortality, and Future Longevity," *Population and Development Review,* 33(2):367–381, 2007.

Cigno, A, and F.C. Rosati, "Jointly Determined Saving and Fertility Behavior: Theory and Estimates for Germany, Italy, and the U.S.," *European Economic Review,* 40:1561-1589, 1996.

Centro Latinoamericano y Caribeño de Demografia (CELADE), "Estimaciones y Proyecciones de la Población, 1950–2050," 2003. (http://www.eclac.cl/celade/proyecciones/basedatos_BD.htm)

Congressional Budget Office, "Is Social Security Progressive?" *Economic and Budget Issue Brief*, December 12, 2006.

Congressional Budget Office, "Long-Term Analysis of the Liebman-MacGuineas-Samwick Social Security Proposal," February 8, 2006.

Congressional Budget Office, *Updated Long-Term Projections for Social Security*, June 2006.

Congressional Research Service, *Options to Address Social Security Solvency and Their Impact on Beneficiaries: Results from the Dynasim Microsimulation Model*, Report RL33840, January 29, 2007.

Consejo Nacional de Población (CONAPO), "Proyecciones de la Población de México 2005-2050," 2006. (http://www.conapo.gob.mx/00cifras/5.htm)

Cornelius, Wayne A. and Jessa M. Lewis (eds.), *Impacts of Border Enforcement on Mexican Migration: The View from Sending Communities,* Center for Comparative Immigration Studies, UCSD, La Jolla, CA, 2007.

Dew-Becker, Ian and Robert J. Gordon, "Where Did the Productivity Growth Go? Inflation Dynamics and the Distribution of Income," *Brookings Papers on Economic Activity,* no. 2, 2005, pp. 67-127.

Duggan, Mark and Scott Imberman, "Why are the DI Rolls Skyrocketing?" forthcoming in *Health at Older Ages,* edited by David Cutler and David Wise, University of Chicago Press, 2007. (http://www.nber.org/books_in_progress/disability/duggan-imberman7-18-07.pdf)

Edmonston, Barry and Jeffrey S. Passel, "The Future Immigrant Population of the United States," in Edmonston and Passel (eds.), *Immigration and Ethnicity: The Integration of America's Newest Arrivals*. The Urban Institute Press: Washington, D.C., 1994.

Ehrlich, I and J. Kim, "Has Social Security Influenced Family Formation and Fertility in OECD Countries? An Economic and Econometric Analysis," *Journal of Pharmaceuticals Policy and Law*, 9:99-120, 2007.

Federal Reserve Bank of Philadelphia, *Survey of Professional Forecasters*, February, 2007.

Fix, Michael and Jeffrey S. Passel, *Immigration and Immigrants: Setting the Record Straight*, The Urban Institute Press, Washington, D.C., 1994. (http://www.urban.org/publications/305184.html)

Frank, R. and P. Hauveline, "A Crossover in Mexican and Mexican-American Fertility Rates: Evidence and Explanations of an Emerging Paradox," *Demographic Research*, Vol. 12, 2005, pp. 78-101.

Geanakoplos, John and Stephen P. Zeldes, "The Market Value of Accrued Social Security Benefits," mimeo, Conference on Measuring and Managing Federal Financial Risk, Kellogg School of Management, Northwestern University, February 8-9, 2007.

Girola, James A., "The Long-Term Real Interest Rate for Social Security," Research Paper No. 2005-02, U.S. Department of Treasury, March 30, 2005.

Goldman, Dana, Neeraj Sood, and Arleen Leibowitz, "The Reallocation of Compensation in Response to Health Insurance Premium Increases," NBER Working Paper No. 9540, March 2003.

Gordon, Robert J., "Exploding Productivity Growth: Context, Causes, and Implications," *Brookings Papers on Economic Activity,* 2003, no. 2, pp. 207-79.

Gordon, Robert and Ian Dew-Becker, "Unresolved Issues in the Rise of American Inequality," manuscript, 2007.

Goss, Stephen and Alice Wade, "Estimated Financial Effects of A Nonpartisan Approach to Reforming Social Security – A Proposal Developed by Jeffrey Liebman, Maya MacGuineas and Andrew Samwick," memorandum to the authors of the proposal, Office of the Chief Actuary, Social Security Administration, November 17, 2005. (http://www.ssa.gov/OACT/solvency/Liebman_20051117.pdf)

Government Accountability Office, *Social Security Reform: Issues for Disability and Dependent Benefits*, GAO-08-26, October 26, 2007.

Greenwood, J., A. Seshadri, and G. Vandenbroucke, "The Baby Boom and Baby Bust," *The American Economic Review* 95(1): 183-207, 2005.

Hacker, J. David, "Rethinking the 'Early' Decline of Marital Fertility in the United States," *Demography* 40(4):605-620, 2004.

Haines, M. R, "Total Fertility Rate and Birth Rate, by Race and Age: 1800–1998", in S. B. Carter, S.S. Gartner, M.R. Haines, A.L. Olmstead, R. S., and G. Wright, (eds.), *Historical Statistics of the United States, Earliest Times to the Present: Millennial Edition*, New York, Cambridge University Press, 2006, Table Ab52-117.

Hanson, Gordon H., "Illegal Immigration from Mexico to the United States," National Bureau of Economic Research Working Paper #12141, March, 2006. (http://www.nber.org/papers/w12141)

Hamilton B.E., J.A. Martin, S.J. Ventura, *Births: Preliminary Data for 2005*. Health E-Stats, Released November 21, 2006.

Heyman, J., A. Earle, and J. Hayes, "The Work, Family, and Equity Index: How Does the U.S. Measure Up?" The Project on Global Working Families, Institute for Health and Social Policy, McGill University, Montreal CA.

Hoefer, Michael, Nancy Rytina, and Christopher Campbell, *Estimates of the Unauthorized Immigrant Population Residing in the United States: January 2006*, Department of Homeland Security, Office of Immigration Statistics, Washington, D.C., September, 2007. (http://www.dhs.gov/xlibrary/assets/statistics/publications/ill_pe_2006.pdf)

Hollmann, Frederick W., Tammany J. Mulder, and Jeffrey E. Kallan, *Methodology and Assumptions for the Population Projections of the United States: 1999 to 2100*. U.S. Census Bureau, Washington, D.C., January, 2000. (http://www.census.gov/population/www/projections/natproj.html)

Howe, Neil and Richard Jackson, *Projecting Immigration: A Survey of the Current State of Theory and Practice,* Center for Strategic and International Studies: Washington, DC. April, 2005. (http://www.csis.org/component/option,com_csis_pubs/task,view/id,2528/)

Jackson, Richard, "Long-Term Immigration Projection Methods: Toward a Driver-based Model," Presentation at ISIM Workshop, Center for Strategic and International Studies, September 26, 2006.

Johnson, David. "Comparison of Movements in the CPI and PCE Price Indexes," presented to the Federal Economic Statistics Advisory Committee, March 21, 2003.

Jorgenson, Dale W., Mun S. Ho, and Kevin J. Stiroh, *Productivity: vol. 3: Information Technology and the American Growth Resurgence*, MIT Press, 2005.

Keyfitz, Nathan, *Applied Mathematical Demography, 2nd Edition*, New York: Springer-Verlag, 1985.

Kohler, H-P, F.C. Billari, and J.A. Ortega, "Low Fertility in Europe: Causes, Implications and Policy Options," in F. R. Harris (Ed.), *The Baby Bust: Who will do the Work? Who Will Pay the Taxes?,* Lanham, MD, Rowman & Littlefield Publishers, 2006, pp.48-109.

Lindstrom, David P. and Silvia G. Saucedo, "The Short- and Long-Term Effects of U.S. Migration Experience on Mexican Women's Fertility," *Social Forces*, Vol. 80, No. 4, June 2002, pp. 1341-1368.

Lowell, B. Lindsay, Julia Gellatt, and Jeanne Batalova, "Immigrants and Labor Force Trends: The Future, Past, and Present," *Task Force Insight No. 17*, Migration Policy Institute: Washington, DC. July, 2006. (http://www.migrationpolicy.org/ITFIAF/TF17_Lowell.pdf)

Lucas, Deborah and Stephen Zeldes, "Valuing and Hedging Defined Benefit Pension Obligations–The Role of Stocks Revisited," manuscript, Northwestern University, 2007.

Martin, J.A., B.E. Hamilton, P.D. Sutton, et al., "Births: Final Data for 2004," *National Vital Statistics Reports*, 55(1), Hyattsville, MD, National Center for Health Statistics. 2006.

Massey, Douglas S., Jorge Durand, and Nolan J. Malone, *Beyond Smoke and Mirrors: Mexican Immigration in an Era of Economic Integration*, Russell Sage, New York, 2002.

McKeown, Thomas, *The Role of Medicine: Dream, Mirage, or Nemesis*, Oxford, U.K., Basil Blackwell, 1979.

Morgan, S.P, "Is Low Fertility a Twenty-First-Century Demographic Crisis?" *Demography,* Vol. 40(4), 2003, pp. 598-603

Motsiopoulos, Chris and Richard B. Tucker, *Short-Range Actuarial Projections of the Old-Age, Survivors, and Disability Insurance Program*, Actuarial Study No. 119, Social Security Administration, Office of the Chief Actuary, August, 2005. (http://www.socialsecurity.gov/OACT/NOTES/pdf_studies/study119.pdf)

Mulder, Tamany J., Betsy Guzman, and Angela M. Brittingham, "Evaluating Components of International Migration: Foreign-Born Emigrants," *Technical Working Paper No. 62*, Population Division, U.S. Census Bureau, Washington, DC. June, 2002. (http://www.census.gov/population/www/documentation/twps0062.html)

Oliner, Stephen D., Daniel E. Sichel, and Kevin J. Stiroh, "Explaining a Productive Decade," *Brookings Papers on Economic Activity,* No. 1, 2007, pp. 81-152.

Pampel, Fred C, "Cigarette Use and the Narrowing Sex Differential in Mortality," *Population and Development Review*, 28(1), 2002, pp. 77–104.

Parrado, E. A. and S. P. Morgan, "Intergenerational Fertility among Hispanic Women: New Evidence of Immigrant Assimilation," unpublished manuscript, 2007.

Passel, Jeffrey, "Projections of Population, Educational Attainment, and Labor Force Participation: By Generation, Age, Sex, and Race/Ethnicity: 2000–2050," Urban Institute Technical Report, Washington, D.C., February, 2004a.

Passel, Jeffrey S., "Methodology and Assumptions for Population Estimates and Projections by Race and Generation, 1960–2030," Technical memorandum for National Academy of Sciences' Panel on the Hispanic Population, Urban Institute, Washington, D.C., August, 2004b.

Passel, Jeffrey S., *Size and Characteristics of the Unauthorized Migrant Population in the U.S.: Estimates Based on the March 2005 Current Population Survey*. Pew Hispanic Center, Washington, D.C., March, 2006. (http://pewhispanic.org/reports/report.php?ReportID=61)

Passel, Jeffrey S., "Modes of Entry for the Unauthorized Migrant Population," Pew Hispanic Center Fact Sheet, Washington, D.C., May 22, 2006a. (http://pewhispanic.org/factsheets/factsheet.php?FactsheetID=19)

Passel, Jeffrey S., "Growing Share of Immigrants Choosing Naturalization," Pew Hispanic Center Report, Washington, D.C., March 28, 2007a. (http://pewhispanic.org/reports/report.php?ReportID=74)

Passel, Jeffrey S. and D'Vera Cohn, "U.S. Population Projections, 2005–2050," Pew Hispanic Center Report, Washington, D.C., February 2008.

Passel, Jeffrey S. and Roberto Suro, *Rise, Peak, and Decline: Trends in U.S. Immigration 1992–2004*, Pew Hispanic Center, Washington, D.C. September, 2005. (http://pewhispanic.org/reports/report.php?ReportID=53)

Piketty, Thomas and Emmanuel Saez, "Income Inequality in The United States, 1913–1998*," *Quarterly Journal of Economics*, February 2003, Vol. 143, issue 1.

Piketty, Thomas and Emmanuel Saez, "The Evolution of Top Incomes: A Historical and International Perspective," *American Economic Review Papers and Proceedings* 96, no. 2, May, 2006.

Porter, Eduardo "Illegal Immigrants are Bolstering Social Security with Billions," *New York Times*, April 5, 2005.

Poterba, James, Steven Venti, and David A. Wise, "The Changing Landscape of Pensions in the United States," National Bureau of Economic Research Working Paper #13381, September 2007.

Preston, S.H. and S.R. Sten, "The Future of American Fertility," Paper presented at the 9th Annual Joint Conference of the Retirement Research Consortium, Washington, D.C., August 9-10, 2007.

Rappaport, Anna M., "Retirement System at the Crossroads," *Employee Benefit Plan Review,* February 2003, pp. 17-20.

Rindfuss, R., K.B. Gruzzo and S.P. Morgan, "The Changing Institutional Context of Low Fertility," *Population Research and Policy Review,* Vol. 22, 2003, pp. 411-438.

Schoen, R., "Timing effects and the Interpretation of Period Fertility," *Demography,* 41(4): 801-819, 2004.

Schoen, R., "Insights from Parity Status Life Tables for the 20th Century U.S.," *Social Science Research* 35(1), 2006, pp. 29-39.

Schoen, R., *Dynamic Population Models*, Dordrecht: Springer, 2007.

Schwenk, Albert E., "Trends in Health Insurance Costs," *Compensation and Working Conditions,* Spring, 1999, pp. 24- 27.

Shkolnikov, V.M., E.M. Andreev, R. Houle, and J.W. Vaupel, "The Concentration of Reproduction in Cohorts of Women in Europe and the United States," *Population and Development Review*, 33(1), March 2007.

Stallard, Eric, "Demographic Issues in Longevity Risk Analysis," *Journal of Risk and Insurance,* 73(4), 2006, pp. 575–609.

Technical Panel on Assumptions and Methods (1999), *Report to the Social Security Advisory Board*, November, 1999. (http://www.ssab.gov/Publications/Financing/tech99.pdf)

Technical Panel on Assumptions and Methods (2003), *Report to the Social Security Advisory Board*, October 2003. (http://www.ssab.gov/documents/2003TechnicalPanelRept_000.pdf)

Tuiran, R., V. Partida, O. Morjarro, and E. Zuniga, "Fertility in Mexico: Trends and Forecast," in Completing the Fertility Transition, Department of Economic and Social Affairs, Population Division, United Nations, 2002, pp. 483-506.

Tuljapurkar, Shripad, and Ronald Lee, "Stochastic Forecasts for Social Security," in, David Wise, ed. *Frontiers in the Economics of Aging*, Chicago: University of Chicago Press, 1998, pp.393-420.

United Nations Population Division, *World Population Prospects: The 2006 Revision.* United Nations, New York, 2006. (Database at http://esa.un.org/unpp/)

Urban Institute, "Work and Retirement: Facts and Figures," August, 2006. (http://www.urban.org/UploadedPDF/900985_work_and_retirement.pdf)

U.S. Bureau of Labor Statistics, "Employee Benefits in Medium and Large Private Establishments, 1997," *Bulletin 2517*, Washington, D.C.: U.S. Government Printing Office, September 1999.

U.S. Census Bureau, International Data Base (IDB), Website visited August 15, 2007: (www.census.gov/ipc/www/idb/)

U.S. Census Bureau, International Data Base, Population Projections for Mexico, Population Division: Washington, D.C., 2005. (http://www.census.gov/ipc/www/idb/tables.html)

U.S. Census Bureau, *National Population Estimates, July 1, 2006,* Population Division, Washington, D.C., 2007. (http://www.census.gov/popest/national/)

U.S. Department of Homeland Security, Office of Immigration *Statistics, Yearbook of Immigration Statistics: 2006*, Washington, D.C., January, 2007. (http://www.dhs.gov/ximgtn/statistics/publications/yearbook.shtm)

U.S. Department of Labor, "The Evolution of Compensation in a Changing Economy," *Report on the American Workforce,* Washington DC, 2001, pp. 57-94.

U.S. Immigration and Naturalization Service, *Statistical Yearbook of the Immigration and Naturalization Service, 1998*, Washington, D.C., U.S. Government Printing Office, 2000.

Wang, Haidong and Samuel H. Preston, "Forecasting U.S. Mortality Using Cohort Smoking Index," *Demography,* 43(4), 2006, pp. 631–646.

Warren, Robert, "Illegal Alien Resident Population: Estimates of the Undocumented Immigrant Population Residing in the United States (October 1996)," U.S. Immigration and Naturalization Service, Office of Policy and Planning. Washington, D.C., December, 2001. (Updated) (http://uscis.gov/graphics/shared/statistics/archives/illegal.pdf)

Warren, Robert, "Estimates of the Unauthorized Immigrant Population Residing in the United States: 1990 to 2000," U.S. Immigration and Naturalization Service, Office of Policy and Planning, Washington, D.C., January, 2003. (http://uscis.gov/graphics/shared/statistics/publications/Ill_Report_1211.pdf)

Warren, Robert and Ellen P. Kraly, "The Elusive Exodus: Emigration from the United States," *Population Trends and Public Policy Occasional Paper No. 8*, Population Reference Bureau: Washington, D.C., 1985.

Welch, Ivo, "The Equity Premium Consensus Forecast Revisited," Cowles Foundation Discussion Paper No. 1325, September 2001.

Wilmoth, John R., "Are Mortality Projections Always More Pessimistic When Disaggregated by Cause of Death?" *Mathematical Population Studies,* 5(4), 1995, pp. 293–319.

Wilmoth, John R., "The Future of Human Longevity: A Demographer's Perspective," *Science,* Vol. 280, 1998, pp. 395-97.

Wilmoth, John R., "Theoretical and Technical Aspects of Projecting Net Migration as a Function of Population Size," Social Security Advisory Board Working Paper: cited in Technical Panel on Assumptions and Methods (2003)*, Report to the Social Security Advisory Board,* October 2003.

Wilmoth, John R., "Overview and Discussion of the Social Security Mortality Projections," *Social Security Advisory Board Working Paper*, 2005.

Zayatz, Tim, *Social Security Disability Insurance Program Worker Experience*, Actuarial Study No. 118, Social Security Administration, Office of the Chief Actuary, June, 2005. (http://www.socialsecurity.gov/OACT/NOTES/pdf_studies/study118.pdf)

Compilation of Technical Panel Recommendations

Methodology

Method Recommendation M-1: Further document all models to the extent necessary for others to replicate forecasts. Make available sufficient data for non-government analysts to replicate forecasts, and conduct research to improve forecasting techniques. Include in the analysis an explicit discussion of the historical time periods, and the associated rationale, used for each variable.

Method Recommendation M-2: Explicitly model and document relevant interactions.

Method Recommendation M-3: The Social Security Advisory Board, to whom this Technical Panel reports, should hold semi-annual meetings with OCACT to discuss progress on the recommendations contained in this report as well as those from previous panels.

Method Recommendation M-4: Incorporate asymmetrical risk in the projections.

Method Recommendation M-5: Further develop stochastic modeling capabilities, and make much greater use of stochastic analysis to examine uncertainty, especially the effects interactions have on uncertainty.

Method Recommendation M-6: Consider risk-adjusting discount rates for summarized balances. Using the risk-free interest rate to discount uncertain future cash flows is inconsistent with valuation principles, and over-weights the outcomes that are most uncertain.

Method Recommendation M-7: Increase the use of micro-simulation to analyze and display interaction effects and distributional outcomes of policy changes.

Presentation Recommendation P-1: Shift the emphasis toward the intermediate-term and away from very long-term measures such as the infinite horizon forecasts. Shift emphasis toward the use of annual cost and income rates, and away from summarized 75-year balances.

Presentation Recommendation P-2: Include in the analysis an explicit comparison of the U.S. experience with other countries.

Presentation Recommendation P-3: Report annually the accuracy of previous estimates and projections.

Presentation Recommendation P-4: Increase the use of graphical representations of uncertainty.

Presentation Recommendation P-5: Improve the explanation of trust fund accounting and its implications.

Demographic assumptions and methods

Assumption Recommendation A-1: The Panel believes that there is greater risk (and cost) to the trust funds associated with overestimating the total fertility rate over the next 75 years than underestimating it. We therefore recommend retaining the intermediate assumption of 2.0 from the 2007 Trustees Report, but we assume a high-cost total fertility rate of 1.5, 0.2 lower than that of the Trustees, and a low-cost rate of 2.1, rather than 2.3. In Chapter 1, the Panel recommended that the Trustees adopt asymmetric high-cost and low-cost assumptions relative to their intermediate assumption. We made this recommendation because policy makers and future retirees should be able to understand the direction of our uncertainty in evaluating alternative assumptions for the deterministic projections prepared by Trustees. It should be noted here that the intermediate series is not the "average" or "most likely" assumption, nor are the low- and high-cost alternatives brackets with known sampling distributions, such as a 95 percent confidence interval about the mean.

Assumption Recommendation A-2: Mortality: For the intermediate-cost scenario, the Panel recommends that assumed ultimate rates of mortality decline by

age and sex be increased to an average of 1.00 percent per year to be consistent with those observed during 1953–2003 for the total population. Assumed ultimate rates of mortality decline for the low-cost projections should be held at their current levels (averaging 0.33 percent per year). Assumed ultimate rates of mortality decline for the high-cost projections should be increased to an average of 2.00 percent to reflect the potential for the U.S. to reach rates of mortality reduction seen in international data.

Method Recommendation M-8: Mortality: The Panel recommends that the mortality projection model be simplified by dropping separate projections by cause of death and stating assumptions in terms of age-specific rates of decline for all-cause mortality.

Method Recommendation M-9: Mortality: The Panel recommends that the infinite horizon mortality projection model be dropped.

Assumption Recommendation A-3: Immigration: The Panel recommends that immigration scenarios should tie the level of net immigration to the size and growth of the U.S. population rather than decreasing or increasing constant numbers of immigrants. The Panel recommends that the Trustees move toward expressing their ultimate net migration assumptions as rates (annual number of net migrants divided by population size).

Assumption Recommendation A-4: Immigration: The Panel strongly recommends that the Trustees increase significantly their assumptions regarding future levels of net international migration; at a minimum, projections of future migration should be brought into line with current measured levels of net international migration.

- **In the intermediate scenario,** net international migration should increase from 1,350,000 in 2007 by 1.0 percent per year through 2030; thereafter, net international migration should increase at 0.5 percent per year. At this level, immigration as a percent of population (the "net migration rate" or NMR) remains within the range of both recent and historical experience. With the other demographic assumptions recommended by the Panel, this immigration scenario represents a net migration rate of 4.4 per 1,000 population at the beginning of the projections, gradually rises to 4.6 and then declines to 4.2 after 75 years. With this assumption, the average NMR over 2005–2080 is equal to the average over the 1980–2005 period or 4.4 per 1,000.
- **Our high-cost (lower immigration) scenario** recommendation is to assume that net "other" immigration drops by 50,000 per year from the initial value of 500,000 to 200,000 and that net legal immigration is held constant during this period. Then, beginning from 1.1 million in 2012, legal immigration would increase by 0.25 percent per year and net other immigration at 0.5 percent per year. With these assumptions, the NMR declines from approximately 4.3 per 1,000 at the beginning of the scenario, then drops quickly to 3.0 after 25 years where it remains constant throughout the rest of the 75-year projection. The Panel bases the high-cost scenario on assumptions that unauthorized migration might be brought under control and that the growth rate of legal immigration would be slower than population growth (i.e., a declining NMR).
- **The low-cost (higher immigration) scenario** assumes that annual immigration will have reached 2.8 million by 2080, a value consistent with an annual immigration increase of 1.0 percent. For the period from 2030 to 2080, immigration is assumed to increase by 0.5 percent per year, implying an increase of 2.1 percent per year for the period leading up to 2030. This scenario assumes a relatively rapid rate of increase in the short term, but a slow down for the long run. The NMR in this scenario peaks at 5.7 per 1,000 population for 2030–2035, equal to the 1995–2000 peak. The average NMR is 5.1, or slightly higher than the last 20 years, but less than the average over the long period of relatively high immigration to the U.S. in the second half of the 19th century and the early 20th. The Panel's recommendations for the low-cost and high-cost scenarios are designed to give a greater spread between high and low in the short-term than might be otherwise obtained from basic extrapolation models.

Method Recommendation M-10: Immigration: The Panel recommends that the Trustees make fundamental changes in their approach for deriving net migration assumptions and for implementing the assumptions.

Method Recommendation M-11: Immigration: The Trustees' net migration assumptions should not be based on the provisions of current immigration law, which are consistent with widely varying levels of net migration, and which can reasonably be expected to change in the future; but rather on an analysis of historical trends augmented by on-going and future research on behavioral, demographic and economic determinants of migration.

Method Recommendation M-12: Immigration: The Trustees should disaggregate the demographic projection model by nativity (i.e., into native and foreign-born populations). Such a model would facilitate incorporation of significant known differentials into the projections, including: emigration (largely limited to former immigrants), fertility (higher for immigrants than natives), and labor force participation (higher for foreign-born males and lower for foreign-born females than for the corresponding native groups). Such a disaggregation can be implemented with the current cell-based projection model or micro-simulation models that might be adopted in the future.

Method Recommendation M-13: Immigration: The age-sex distributions of net international migration components should accurately reflect the demographic logic of the model. Specifically, the age distribution of net "other" immigration should encompass both positive and negative values rather than simply reflecting the age distribution of the migrant population.

Assumption Recommendation A-5: Disability Incidence Rates: The Panel recommends that the assumptions of disability incidence for the intermediate projection remain the same as in the 2007 Trustees Report. Disability incidence assumptions were lowered in the 2007 Report and the Panel believes this revision was reasonable given the data on health and benefit trends. These same data on health and benefit claiming lead the Panel to recommend changes to the low- and high-cost alternative scenarios. Specifically, the Panel recommends raising disability incidence in both the low- and high-cost scenario, from 4.4 to 4.6 and 6.6 to 6.9, respectively. These changes increase the uncertainty bands around the intermediate assumption and introduce asymmetry into the risk profile, allowing for larger cost overruns than cost savings in the alternative scenarios.

Assumption Recommendation A-6: Disability Termination Rates: The Panel recommends that the assumptions of disability termination remain the same as in the 2007 Trustees Report but calls for more research on these matters going forward. Changes in the mix of impairments and the age of benefit claiming suggest that life expectancies of the average future beneficiary could increase more quickly than those of the rest of the population. While termination rates are much less important to overall cost projections than incidence rates, greater understanding of the factors affecting future trends is warranted.

Method Recommendation M-14: Disability: The Panel recommends that consideration be given to augmenting the cell-based model of disability incidence and termination rates to include impairment specific data. The Panel also calls for additional examination of the evolution of male and female disability incidence rates and for more explicit discussion of the historical and forecast time path of these rates, including why they are not converging more over time. Overall, the Panel recommends that the judgmental adjustments to the cell-based model of disability incidence and disability termination be more formally documented.

Method Recommendation M-15: Disability: The Panel recommends that the models used to develop the short- and long-range projections for the DI program be better integrated and that the long-range projection methodology be better documented. More fundamentally, the Panel recommends that greater emphasis be placed on developing behavioral models of disability benefit claiming that could better inform the judgmental adjustments to historical extrapolations underlying the intermediate projections, improve the short- and long-run forecasts, and increase understanding of the risk factors associated with short- and long-run program growth.

Method Recommendation M-16: Disability: The Panel recommends more focus on communication about key components of the disability program followed by the research community. Specifically, the Panel recommends highlighting the distinction between eligibility for disability benefits—based on health—and claiming behavior, which is based on eligibility and socio-economic conditions, age, and policy variables such as the normal retirement age. The Panel also recommends that published materials report disability prevalence rates, in addition to incidence and termination rates. Prevalence rates are the preferred metric in the research literature for summarizing the stock of workers receiving disability benefits and provide important information about the size of the program over time. Finally, the Panel recommends that the relationship between the DI and retirement programs be made explicit—DI is just a form of early retirement—especially in discussions about future influences on program size.

Economic assumptions and methods

Assumption Recommendation A-7: Labor Force Participation Rate: The Panel recommends no change in the intermediate-and high-cost projections of labor force growth reported in the 2007 Trustees Report, but calls for an increase in the labor force participation rate used in the low-cost alternative. The Panel believes there is considerable upside risk to the intermediate assumption on labor force participation related to the possibility that greater life expectancy, improved health, unmet demand for workers, changing workplace requirements, and the reduction in rule-based private retirement plans could increase participation rates at older ages. The Panel believes that allowing for this possibility is important and could ultimately affect both the intermediate and low-cost scenarios. As such, we recommend increasing total labor force participation in the low-cost scenario from 72.8 to 77.0 percent for males and from 60.6 to 65 percent for females.[131]

Method Recommendation M-17: Labor Force Participation Rate: The Panel recommends that the OCACT labor force participation model be reviewed and potentially restructured. Currently, the model is large and unwieldy, making modifications difficult and costly. Additions to the model required to incorporate emerging trends (e.g., participation rates by nativity) only add to the complexity. Thus, we recommend that the Trustees implement suggestions made in the 2003 Technical Panel and restructure the model, making it simpler, more transparent, and econometrically more rigorous.

Method Recommendation M-18: Labor Force Participation Rate: The Panel recommends more carefully following differences in labor force participation among various groups including natives and non-natives and older workers from different cohorts. Given the growing importance of both immigrants and older workers in the workforce, improved understanding of differences in their labor force behavior will be important to improving the accuracy of future projections.

Method Recommendation M-19: Labor Force Participation Rate: The Panel recommends that more consideration be given to how changes in the population and labor force might impact trends in hours of work, productivity and annual earnings and that these interrelationships be noted in the Trustees Report. This communication of the interconnectedness of the assumptions and projections is a useful component of policy discussions and decisions. The absence of such recognition hinders accurate characterizations of the tradeoffs and complementarities embedded in changes to particular variables, trends or policy alternatives.

Assumption Recommendation A-8: Unemployment Rate: The Panel recommends that the assumptions on unemployment remain unchanged from the 2007 Trustees Report. The Panel finds a long-run unemployment rate of 5.5 percent is a reasonable assumption for future unemployment rates.

Assumption Recommendation A-9: Productivity: The Panel recommends that the assumption on productivity growth be maintained at the same rate as in the 2007 Trustees Report, that is, 1.7 percent per year. This recommendation reflects the sharp slowdown in actual productivity growth between mid-2004 and mid-2007 that has reduced the possibility that the American economy entered a new era of rapid high productivity growth after 1995. Instead, it appears that the marked acceleration of productivity growth between 1995 and 2004 can be attributed to special one-time factors that are unlikely to recur. In forecasting future productivity growth, substantial weight must be given to the poor performance of productivity growth in the period 1972-1995.

Assumption Recommendation A-10: Compensation to GDP ratio: The share of labor compensation in GDP has historically been quite stable, and the Panel agrees with the current assumption of a constant ratio.

Assumption Recommendation A-11: Earnings to Compensation Ratio: The Panel recommends that the change in the earnings to compensation ratio be reduced in the intermediate-cost assumption from a decline of 0.2 percent per year to a decline of 0.1 percent per year for the first 25 years of the projections, with a zero decline after that. In the low-cost assumption, the current ratio should be held constant, while in the high-cost assumption, the ratio should decline by 0.2 percent per year for the first 25 years and by 0.1 percent thereafter.

Assumption Recommendation A-12: Average Hours of Work: The Panel recommends that the 2007 Trustees' assumption of no change in average hours of work per week be changed to a decline of -0.1

[131] The change in total participation rates comes from assuming that rates for each 5-year age group above 55 would attain, in 75 years, the participation rates of the next younger 5-year age cohort at the beginning of the projection period. For example, those aged 55-59 would in 2081 experience the participation rates of 50-54 year olds in 2007, and so on for each successive 5-year cohort.

percent per year for the first 25 years with a zero rate of decline thereafter. The high-cost assumption should be of an annual decline of 0.2 percent for the first 25 years and a decline of 0.1 percent rate thereafter. The low-cost assumption would then be of zero change, the same as the 2007 Trustees' assumption.

Assumption Recommendation A-13: GDP Deflator-CPI Growth Differential: The differential growth rate between the GDP deflator and the Consumer Price Index (CPI-W) should be reduced from the Trustees' choice of -0.4 percentage points to -0.2 percentage points. We find no historical evidence to support the Trustees' choice and indeed in the past six years the differential growth rate has been zero.

Assumption Recommendation A-14: Real Wage Growth: Together, assumptions A-8 through A-12 result in a rate of real wage growth in the intermediate assumptions of 1.3 percent per year, slightly higher than the 1.1 percent assumed in the 2003 Trustees Report.

Assumption Recommendation A-15: CPI Growth: The Panel recommends that the assumed rate of increase in the Consumer Price Index be reduced by 0.3 percentage point in the intermediate assumption, from 2.8 percent to 2.5 percent per year. The assumption of the future inflation rate in the GDP deflator should be reduced from the current 2.4 percent assumption to 2.3 percent, corresponding to our previous recommendation that the GDP deflator to CPI differential be reduced from -0.4 percent to -0.2 percent per year.

Assumption Recommendation A-16: Interest Rate: The Panel recommends using a long-term nominal rate of 5.17 percent, based on a real rate of 2.6 percent and a CPI inflation rate of 2.5 percent. The corresponding real and nominal rates for the high cost scenario should be shifted down to 1.8 percent and 5.36 percent respectively. For the low cost scenario, we recommend lowering the real rate to 3.3 percent, and the nominal rate to 4.85 percent. These changes are based on a uniform reduction in the CPI inflation rate of .30 percent in all scenarios.

Method Recommendation M-20: Interest Rate: The Panel recommends that the Trustees modify their approach to determining real and nominal interest rates to place more weight on the forward-looking information in recent Treasury yield curves.

Method Recommendation M-21: Interest Rate: For calculations involving discounting such as the actuarial balance, the Panel recommends that the Trustees consider using risk-adjusted rates instead of a risk-free real interest rate.

Assumption Recommendation A-17: Equity Premium: The Panel concurs with the choice of equty premium assumed in recent analyses by the Office of the Chief Actuary of proposals involving stock market investments.

Method Recommendation M-22: Equity Premium: In such analyses, the Panel recommends that the Office of the Chief Actuary portray risk-adjusted projections as a neutral risk-adjusted case, not as worst case for average returns.

Other Recommendation O-1: Taxable ratio: The Panel recommends that additional research be undertaken to develop a greater understanding of the implications for trust fund finances of trends in the dispersion of covered wages. That research should aim to provide a stronger basis for projecting the share of covered wages that fall above and below the taxable maximum. In addition, that research should examine the implications of stagnating wages at the lower end of the earnings distribution on the incentives to apply for disability benefits.

Other Recommendation O-2: Taxable ratio: The Panel recommends that the rationale in the Trustees Report for the projection of the share of covered wages that is taxable be made more explicit and should account for the substantial deviation of current trends from previous projections. The Panel recommends that the high and low cost projections of the share of covered wages that is taxable reflect a realistic degree of uncertainty. The long-range sensitivity analyses in the report should include the effect on summarized cost balances of the range of assumptions about the share of covered wages that is taxable.

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