



GAO

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United States General Accounting Office  
Washington, DC 20548

Accounting and Information  
Management Division

B-282642

January 14, 2000

The Honorable Jerrold Nadler  
House of Representatives

Subject: Social Security: Actuarial Projections of the Trust Funds

Dear Mr. Nadler:

This letter responds to your request that we review the actuarial projections for the trust funds of the Old Age, Survivors, and Disability Insurance programs (collectively known as Social Security). Specifically, you requested that we determine whether the projections were prepared in accordance with standard actuarial practices. You expressed concern that the Social Security Administration's (SSA) actuarial practices might not comply with the standard actuarial guidelines of the American Academy of Actuaries and that the annual reports on the status of the Social Security trust funds prepared by the Social Security Board of Trustees<sup>1</sup> may overstate the Social Security deficit over the long range. In their 1999 report, which was issued on March 30, 1999, the Trustees reported a deficit for the long range (75 years) of 2.07 percent of taxable payroll, projecting that the trust funds would be depleted in 2034.

We agreed with you to contract with an independent actuary to determine and report on whether the Trustee's

- 1999 long-range intermediate actuarial projections—their best estimates—as presented in the Trustees' 1999 report are based on generally accepted actuarial methods and techniques and include economic and demographic assumptions that contain no material defects because of errors or omissions and are individually reasonable and
- sensitivity tests<sup>2</sup> include all assumptions that could have a significant effect on the projections and are reasonable.

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<sup>1</sup>The Board of Trustees was established under the Social Security Act to oversee the financial operations of the Social Security trust funds and to report annually on the financial and actuarial status of these funds.

<sup>2</sup>Sensitivity tests illustrate the impact on the long-range actuarial balance of the Social Security programs of changes in selected individual assumptions.

We contracted with PricewaterhouseCoopers (PwC), an independent accounting and consulting firm, to make these determinations. This letter highlights PwC's findings and transmits its October 29, 1999, report on its evaluation of the actuarial projections of the Social Security trust funds. PwC's report is presented in the enclosure. In a separate letter dated today, we respond to your questions regarding other aspects of the Trustees' projections.

### **Background**

The Social Security programs provide protection against loss of earnings due to retirement, death, or disability. During fiscal year 1999, Social Security benefits amounted to \$382.8 billion. At the end of the fiscal year, SSA was disbursing monthly benefits to 44.5 million people. Revenue for these programs is primarily generated through payroll taxes from employers and employees. This revenue is deposited to the trust funds from which SSA pays the benefit costs of its programs. This revenue, including that from individual income taxes on benefits, amounted to \$462.7 billion for fiscal year 1999.

As required by section 201(c) of the Social Security Act,<sup>3</sup> as amended, the Trustees annually report on the financial condition of the trust funds. These reports include long-range actuarial projections (75 years) of revenue and expenses. Many demographic and economic assumptions form the bases for these projections. The Trustees are assisted in making the projections by SSA's Office of the Chief Actuary.

Because of the uncertainty inherent in 75-year projections, the Trustees make projections under three alternative sets of assumptions regarding future demographic and economic trends. These sets range from low cost (alternative I) to high cost (alternative III) with alternative II—the intermediate projections—representing the Trustees' best estimates. For the intermediate projections, the Trustees' 1999 report estimates that primarily as a result of changing demographics, cash flow will remain positive until 2014 at which time it will become negative. From then on, interest on the trust funds, and ultimately the trust funds themselves, would be used to pay part of each monthly benefit check. On that basis, the Social Security trust funds would be exhausted in 2034, thereby having insufficient funds to continue paying full benefits unless legislative action is taken. Using these same assumptions, the Trustees projected a deficit for the 75-year period of 2.07 percent of total estimated taxable payroll for those 75 years.

### **Results in Brief**

PwC found that the actuarial methods and techniques used in preparing the long-range intermediate projections of the Social Security trust funds were sound. It also found that the assumptions used in preparing the projections in the Trustees' report were individually reasonable at the time of the projections. Seven months after the

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<sup>3</sup>42 U.S.C. 401(c).

Trustees' 1999 report, on October 28, 1999, the Department of Commerce's Bureau of Economic Analysis (BEA) released revised estimates of gross domestic product (GDP) and other economic indicators<sup>4</sup> for the period from 1959 through the second quarter of 1999. PwC noted that these revisions may affect some economic assumptions. PwC concluded that as a result, some assumptions may no longer be reasonable for future reports. According to SSA officials, SSA actuaries have already begun reviewing the impact of these revisions for the Trustees' 2000 projections. With regard to one of the demographic assumptions—mortality (that is, life expectancy)—the recent Technical Panel report<sup>5</sup> concluded that the long-range cost of the Social Security system as currently designed is likely to be higher than previously projected. The panel based its conclusions largely on indications that life expectancy will increase faster in the next century than currently assumed by the Trustees. In contrast, PwC concluded that in the aggregate, the mortality assumptions used by the Trustees were reasonable.

In addition, PwC found that the sensitivity tests shown in the Trustees' report were reasonable. PwC also suggested several specific improvements of a technical nature designed to improve the methodology used in the development of the Trustees' projections. However, it did not consider these matters to have a significant impact on the overall projections. SSA's Office of Chief Actuary concurred with this letter.

### **Scope and Methodology**

#### Actuaries and economists at PwC

- evaluated certain aspects of the Trustees' 1999 long-range intermediate actuarial projections for the Social Security trust funds;
- met with SSA's Office of the Chief Actuary;
- analyzed SSA's actuarial studies, prior reviews, and other relevant literature;
- held discussions with actuarial and economic experts;
- conducted back-testing (in back-testing, assumptions are compared with emerging experience to evaluate their reasonableness);
- performed benchmarking using actuarial projections of similar social security programs in Canada and the United Kingdom; and
- reviewed practices by two other organizations within the government that make projections (the Census Bureau and the Congressional Budget Office).

PwC's scope did not include an evaluation of the accuracy of the data or computer code used for developing the projections. To enable us to rely on PwC's work, we consulted with the American Academy of Actuaries to ensure that PwC's evaluation was conducted in accordance with standard actuarial practices. We conducted our

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<sup>4</sup>These indicators are included in the national income and product accounts.

<sup>5</sup>Subsequent to our review, in November 1999, a Technical Panel convened by the Social Security Advisory Board issued the results of its evaluation—*1999 Technical Panel on Assumptions and Methods Report to the Social Security Advisory Board*—of the economic and demographic assumptions and the methods used by the Trustees to project the status of the trust funds.

work from March 1999 through December 1999 in accordance with generally accepted government auditing standards. We provided a draft of this letter to the Chief Actuary of the Social Security Administration for his comments.

### **Actuarial Methods and Techniques Are Sound**

Overall, PwC found that the intermediate long-range projections of the Social Security trust funds were developed in a manner consistent with generally accepted actuarial methods and techniques and that they comply with standards of actuarial practice. In making these determinations, PwC compared the methods and techniques used by the Trustees with the methods and techniques used in making projections by similar social insurance systems in Canada and the United Kingdom. PwC determined that the methods and techniques used in developing the long-range projections in the Trustee's 1999 report were based on state-of-the-art practices.

### **Assumptions Used in Preparing Projections in Trustees' Report Were Reasonable at the Time of the Projections**

PwC found that the assumptions underlying the calculations of the long-range actuarial projections included in the Trustees' 1999 report contained no material defects because of errors or omissions and that they were individually reasonable. The underlying economic assumptions reviewed by PwC included potential GDP, average weekly hours, unemployment rate, cost of living, wage growth, retirement rates, interest rates, labor productivity, labor's share of GDP, and earnings share of total compensation. The underlying demographic assumptions reviewed by PwC included fertility, mortality, net immigration, disability incidence and termination, and marital status. With regard to one of these assumptions—mortality—the recent Technical Panel report concluded that projections regarding life expectancy need to be revised, although the report noted that the Trustees' projection methodology is reasonable as a whole. The panel also concluded that the long-range cost of the Social Security system as currently designed is likely to be higher than previously projected. The panel based its conclusions largely on indications that life expectancy will increase faster in the next century than currently assumed by the Trustees.<sup>6</sup> Longer life spans will result in people collecting benefits longer, thus creating higher program costs. As such, the panel recommended that the Trustees increase projections of life expectancy. In contrast, PwC concluded that in the aggregate, the mortality assumptions used by the Trustees were reasonable.

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<sup>6</sup>The Technical Panel also concluded that the real wage differential assumption and the return on government securities should be revised. However, the panel's proposed revisions have no impact on the actuarial deficit because they offset each other.

**Revised BEA Estimates May Affect Economic Assumptions,  
Which May No Longer Be Reasonable for Future Reports**

On October 28, 1999, 7 months after the Trustees' 1999 report, BEA released revised estimates of GDP and other economic indicators<sup>7</sup> for the period from 1959 through the second quarter of 1999. SSA actuaries used BEA's estimates, along with numerous other factors, in preparing the 75-year projections. PwC believes that BEA's revisions may affect some of the economic assumptions that are used in preparing the long-range projections and, therefore, these assumptions may no longer be reasonable for future reports.

In general, the primary economic assumptions used by the SSA actuaries in preparing the long-range projections are derived from secondary assumptions that are based upon historical trends and judgments. Thus, revisions of the historical bases of the secondary assumptions may affect the primary assumptions used in the long-range projections. Table 1 illustrates this relationship between the primary and secondary assumptions.

**Table 1: Link Among Economic Assumptions**

Primary assumptions	Secondary assumptions used in developing primary assumptions
Real GDP growth	<ul style="list-style-type: none"> <li>• Annual growth in weekly hours</li> <li>• Annual growth in labor productivity</li> </ul>
Unemployment rate	<ul style="list-style-type: none"> <li>• Real and potential GDP</li> </ul>
Wage growth	<ul style="list-style-type: none"> <li>• Growth in earnings share of total compensation</li> <li>• Growth in compensation to GDP</li> <li>• Growth in GDP deflator to Consumer Price Index for Un. Wage Earners and Clerical Workers</li> <li>• Growth in labor productivity</li> <li>• Growth in weekly hours</li> </ul>

PwC believes that the labor productivity assumption used for the Trustees' 1999 report would not be reasonable for future reports. Because the BEA-revised estimates indicate a larger improvement in the economy than previously shown, PwC reported that for future estimates, the productivity assumption should be increased accordingly. PwC further reported that the changes in labor productivity estimates could result in an increase in the intermediate long-range actuarial balance of about 0.25 percent of taxable payroll, that is, the actuarial deficit would be reduced by that amount.<sup>8</sup> However, this estimate is independent of other assumptions that could be affected by the revised BEA estimates, and, accordingly, the cumulative effect could be somewhat more or less than PwC's estimate of 0.25 percent of taxable payroll.

PwC believes that the BEA-revised estimates may also affect other secondary economic assumptions such as the earnings share of total compensation,

<sup>7</sup>These indicators are included in the national income and product accounts.

<sup>8</sup>On this basis, the actuarial deficit would be 1.82 percent of estimated total taxable payroll.

compensation to GDP, and GDP deflator to the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W). Because these three assumptions and labor productivity affect the development of primary economic assumptions such as wage growth, unemployment rate, and real GDP, PwC believes that the Trustees should review the effect of the BEA revisions on them as well.<sup>9</sup>

According to SSA officials, SSA actuaries have already begun reviewing the impact of these revisions for the Trustees' 2000 projections.

### **Sensitivity Tests of Individual Assumptions Are Reasonable**

The Trustees' 1999 report included the results of sensitivity tests on the following assumptions: mortality, fertility, net immigration, disability incidence and termination, changes in the CPI, real interest rate, and real wage growth. These sensitivity tests show the effect on the projections of changing the value of one assumption at a time. The values used in the Trustees' sensitivity tests were the values that were used in the high-and low-cost alternative scenarios.

PwC concluded that the sensitivity tests included in the Trustees' report were reasonable and in compliance with generally accepted actuarial principles. For future reports, however, PwC suggested that the Trustees take the following actions: (1) include sensitivity tests on the labor productivity assumption, (2) consider whether sensitivity tests should be conducted on labor force participation, unemployment rates, potential GDP, retirement rates, marital status, average weekly hours, labor's share of GDP, and earnings share of total compensation assumptions, (3) determine whether sensitivity tests could be effectively conducted on combinations of related assumptions to test the impact of a simultaneous change in more than one assumption, and (4) consider using values in sensitivity tests for individual assumptions that differ from the values that are used in preparing the high-and low-cost scenarios.

### **Other Issues**

In addition to its conclusions relating to actuarial methods, assumptions, and sensitivity tests, PwC offered several specific technical improvements that it believes will enhance the methodology of the long-range projections. However, PwC did not consider any of these issues to have a significant impact on the overall projections. PwC also offered a number of improvements to (1) the projection model, (2) various aspects of individual assumptions, and (3) documentation of the long-range assumptions.

For example, PwC suggested that the Trustees enhance future reports to show the expected deterioration in future actuarial balances resulting from the annual computation of the projections. In the subsequent annual preparation of the long-range projections, the 76th year (the year following the previous projection period) is

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<sup>9</sup>The recent BEA revisions were not available in time for PwC to fully evaluate their effect on these assumptions.

added to the projection period for the new projections. Because the cash flow for that year, the last year of the projection period, is expected to be negative (that is, benefit outlays will exceed revenue), the actuarial balance is expected to deteriorate annually. PwC believes that this expected deterioration should be further highlighted in the Trustees' annual reports.

In another example, PwC said it believed that the SSA actuaries should determine whether the assumptions should be revised to reflect the possible effect on the economic environment resulting from significant changes in the financial condition of the Social Security programs, such as when the trust funds could be expected to be depleted during the projection period.

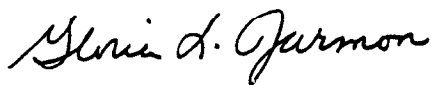
### **Agency Comments**

Officials in the Office of the Chief Actuary stated that they concurred with the letter. They provided technical comments on the letter, which we have incorporated.

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We are sending copies of this report to Senator Charles Grassley, Chairman, and Senator John Breaux, Ranking Minority Member, Senate Special Committee on Aging; Senator Don Nickles, Chairman, Subcommittee on Social Security and Family Policy, Senate Committee on Finance; Senator Mike DeWine, Chairman, and Senator Barbara Mikulski, Ranking Minority Member, Subcommittee on Aging, Senate Committee on Health, Education, Labor, and Pensions; and Representative E. Clay Shaw, Chairman, and Representative Robert Matsui, Ranking Minority Member, Subcommittee on Social Security, House Committee on Ways and Means. We are also sending copies to the Social Security Board of Trustees and the Honorable Kenneth S. Apfel, Commissioner of Social Security. Copies will be made available to others upon request. If you have any questions regarding this report, please contact me at (202) 512-4476 or by e-mail at [jarmong.aimd@gao.gov](mailto:jarmong.aimd@gao.gov).

Sincerely yours,



Gloria L. Jarmon  
Director, Health, Education, and Human Services  
Accounting and Financial Management Issues

Enclosure

**PricewaterhouseCoopers' Report on Actuarial Projection  
of the Social Security Trust Funds**



October 29, 1999

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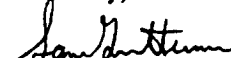
**Subject: Review of Social Security Long-Run Actuarial Projections**

Dear Ms. Sebastian,

We are pleased to transmit our report prepared in response to Task Order 99-07 of the U.S. General Accounting Office, entitled *Actuarial Projections of the Social Security Trust Funds*. If any questions arise with respect to this report, we would be pleased to respond to them. You can contact myself at the above telephone number or at [sam.gutterman@us.pwcglobal.com](mailto:sam.gutterman@us.pwcglobal.com) or Sharon Fitzsimmons at 703-741-1000 or at [sharon.fitzsimmons@us.pwcglobal.com](mailto:sharon.fitzsimmons@us.pwcglobal.com).

Please note our comments regarding last week's announcement of a comprehensive revision of various economic measures made released by the Bureau of Economic Analysis.

Yours truly,

  
Sam Gutterman, FSA, FCAS, Hon.FIA  
Director and Consulting Actuary  
Management Consulting Services

cc: Sharon Fitzsimmons  
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**ACTUARIAL PROJECTIONS OF THE SOCIAL SECURITY  
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**PricewaterhouseCoopers**

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**I. Executive Summary**

At the request of the U.S. General Accounting Office, PricewaterhouseCoopers LLP conducted an evaluation of certain aspects of the actuarial projections as shown in the 1999 Report of the Trustees of the Federal Old Age and Survivors Insurance and Disability Insurance (OASDI) Trust Funds. This report describes the findings of this evaluation. The objectives of this project are (1) "to determine ... whether SSA's 1999 long-term intermediate actuarial projections are based on generally accepted actuarial methods and techniques and include economic and demographic assumptions that contain no material defects because of errors or omissions and are individually reasonable (and (2)) ... to determine ... whether SSA's sensitivity analyses include all assumptions that could have a significant effect (i.e., 0.1% of taxable payroll) on the projections and are reasonable."

During the course of this project primary attention was focused on the evaluation of the Alternative II projections (the "best-estimate" basis for the assumptions).

**Findings with Respect to Methods and Techniques**

With respect to the methodology and assumptions underlying the calculation of the long-range actuarial projections of the OASDI program as shown in the 1999TR:

- Generally accepted actuarial methods and techniques. We found that the projections have been developed in a manner consistent with generally accepted actuarial methods and techniques as they are practiced within the practice area of social insurance.
- Compliance with standards of actuarial practice. Overall, we found that the development of the long-range actuarial projections complies with applicable standards of actuarial practice.
- Comparison with similar actuarial projections. When comparing the methods and techniques used in the development of selected benchmark actuarial projections of similar social insurance systems (Canada and the U.K.), we found that those used in the development of the long-range actuarial projections shown in the 1999TR have been based on "state-of-the-art" practices.
- Documentation. Although not explicitly within the specific scope of this project, we observed that there are a number of gaps in the documentation of current practice. We believe that a comprehensive approach to documentation would serve to benefit others who evaluate or assist in the development of the financial projections of these programs.

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**Bureau of Economic Analysis (Commerce Department) Comprehensive Revision of Economic Statistics**

On October 28, 1999 The Bureau of Economic Analysis (BEA) released revised estimates of GDP and other national income and product accounts (NIPA) series from 1959 through the second quarter of 1999. The BEA carries out comprehensive revisions about every 4 to 5 years in an attempt to improve, modernize and keep pace with an ever-changing U.S. economy. Both the Trustees and the SSA economists rely on these series to assist them in generating their seventy five year projection. In light of the revised economic series, we are no longer able to view several of the long-range economic assumptions as being reasonable.

The BEA revisions impacts the construction of both GDP and wage growth projections. The wage growth assumption relies upon projections of labor productivity, the GDP deflator, the change in labor's share of production, and earnings share of total compensation. The projected growth in GDP will also be influenced by the BEA revisions, primarily because it is a function of productivity. The change in productivity growth is a principle driver of the economic conditions in which the OASDI Trust models are based.

We are unable at this time to recast all of the variables affected by the BEA revisions; however, we can provide an indication of the direction of change. As mentioned above, these revisions will directly impact key factors considered in setting the economic assumptions underlying the projections of real wage growth and potential GDP. The effect of these changes are somewhat offsetting. The BEA revisions will change the projections of real wage growth and potential GDP. The BEA revisions will change the projected values of the input variables in a non-uniform manner. Specifically, for the real wage growth assumption, it is expected that the following input variables will decline due to the BEA revisions – the GDP deflator and the change in labor's share of GDP. It is also expected that labor productivity, an input to both wage growth and potential GDP, will increase. We are uncertain of the impact upon earning share of total compensation. Without the actual data series, we are unable to determine the overall impact of the BEA revisions on two primary economic assumptions – wage growth and GDP growth, both of which are affected by labor productivity.

However, consideration of the labor productivity assumption, independent of the other input variables, is suggestive of the potential influence of the BEA revisions. The Trustees base their productivity assumption upon the past thirty years of economic performance. Only looking at the statistical evidence during this thirty year measurement period, the average productivity growth measured with the revised GDP estimates increases to 1.537 from 1.295 percent. Independent of other variables impacted by the revised BEA measures, the change in projected labor productivity could reduce the expected long-range actuarial deficit by about 0.25 percent of taxable payroll (see page

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136 of the 1999TR). As mentioned above, we are unable to measure the full impact of the BEA revisions in the short time available between the time of their announcement and the date of this report. This is in part due to the lack of sensitivity tests of certain of these economic measures in the 1999TR.

**Other Findings with Respect to Assumptions**

The following are the major findings of our review, in addition to the above, with respect to the assumptions used in the development of the long-term intermediate ("best-estimate") long-range actuarial projections of the OASDI program:

We did not identify any significant contingency that is expected to effect the long-range actuarial projections that represents a material defect because of error or omission that was not considered in the development of the actuarial projections shown in the 1999TR. We did note that, in a number of areas, certain assumptions were made in an implicit rather than explicit manner, due to the time and resources necessary to explicitly incorporate them in the models used by the Social Security Administration's (SSA) actuaries and economists. However, in none of these cases does this treatment introduce a material bias in the long-range projection.

The following are significant findings with respect to the reasonableness of particular assumptions:

- **Labor Productivity.** On October 28, 1999 the Bureau of Economic Analysis (BEA) released revised estimates of GDP and other national income and product accounts (NIPA) series from 1959 through the second quarter of 1999. These revised measures paint an improved picture of the economy and the overall health of the OASDI Trust Funds. It is our opinion that the productivity growth assumption made by the Trustees' should be revised upwards accordingly.
- **Real Wage Growth.** The real wage growth assumption is constructed from the projected values of four economic variables or ratios that are affected by the recent BEA revision: labor productivity, the ratio of worker compensation to GDP, the ratio of labor earning to compensation, and the ratio of the GDP deflator to the consumer price index. Other than labor productivity (discussed above) although we believe that these assumptions are misestimated as a result of the BEA revision, further evaluation is necessary to confirm this opinion.
- **Measurement Period.** Based on current best-estimate assumptions, there is a significant difference between expected cash flows in the year after the end of the measurement period (seventy sixth year) and the average over the seventy five year measurement period. Because of this difference, over the next few decades deterioration in actuarial balance is expected each year. Although this is identified in

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the 1999TR, we believe that it would be appropriate to enhance the report to communicate this expected deterioration in the future. This makes current calculations of the actuarial balance more optimistic than inherent in the projections shown.

Where appropriate, we compared experience results of previous estimates of significant assumptions via back-testing techniques (validation of previous estimates compared with actual emerging experience). Recognizing the limitations of back-testing of long-range actuarial assumptions which may make its use inappropriate to the review of long-range economic assumptions (as long-range assumptions were developed to cover all parts of economic cycles, rather than short-term fluctuations that could be back-tested), emerging experience has not demonstrated significant divergence from long-range assumptions that would lead us to conclude that any of the experience assumptions are unreasonable.

**Findings with Respect to Sensitivity Tests**

Regarding sensitivity tests currently shown in the 1999TR, although the specific ranges of sensitivity should be continually reevaluated, overall they are not unreasonable. We recommend that the following be considered with respect future Trustees' reports:

1. **Form of sensitivity tests.** In general, values used in sensitivity tests for specific assumptions need not be the same as the values included in the aggregate sensitivity test (Alternatives I and III).
2. **Additional tests.** Perform additional sensitivity tests on labor productivity. Consider the addition of tests on other assumptions, including GDP, marital status, and wage to compensation.
3. **Tests of combination of assumptions.** Identify whether sensitivity tests should be conducted on a combination of related assumptions, particularly economic assumptions.

PricewaterhouseCoopers LLP  
Sam Gutterman, FSA, FCAS, MAAA  
Jack Abraham, FSA, EA, MAAA  
Robert Dunskey, Ph D  
October 29, 1999

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## II. Scope / Objectives

This review of the long-range projections of the Old-Age, Survivors, and Disability Insurance (OASDI) program shown in The 1999 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and the Federal Disability Insurance Trust Funds (1999TR) was conducted under Task Order 99-07, *Actuarial Projections of the Social Security Trust Funds* of the U.S. General Accounting Office. These actuarial calculations were prepared by the Office of the Chief Actuary (OCACT) of the Social Security Administration (SSA), although the responsibility for the assumptions which form the basis for the projections reside with the Board of Trustees (Secretary of the Treasury, Secretary of Labor, Secretary of Health and Human Services, Commissioner of Social Security and two public trustees). References to SSA staff in this report refer to the actuaries and economists of the OCACT.

The objectives of this project are “to determine and report on whether SSA’s 1999 long-term intermediate actuarial projections are based on generally accepted actuarial methods and techniques and include economic and demographic assumptions that contain no material defects because of errors or omissions and are individually reasonable (and) ... to determine and report whether SSA’s sensitivity analyses include all assumptions that could have a significant effect (i.e., .1% of taxable payroll) on the projections and are reasonable.” This report’s purpose is to convey our findings regarding the above objectives.

An evaluation or audit of the accuracy of the data used in the development of these projections, both developed within SSA and by sources external to the SSA such as information developed by the Bureau of Economic Analysis or Bureau of the Census is outside the scope of this report. However, given the identified objectives of this project, we conducted such tests and made appropriate inquiries regarding the data’s overall reasonableness as deemed necessary.

The body of this report describes our findings, specifically as they relate to significant assumptions used in the development of the long-range projections shown in the 1999TR. Appendix II indicates a list of specific issues identified in the individual sections of this report covering specific assumptions in relation to these assumptions that the Trustees and SSA staff may wish to consider in long-range projections developed for use in future Trustees’ reports.

This review, conducted by PricewaterhouseCoopers LLP, was prepared by Sam Gutterman, FSA, FCAS, MAAA, Jack Abraham, FSA, EA, MAAA, and Robert Dunsky, Ph D.

<sup>1</sup> Actuarial Projections of the Social Security Trust Funds, Statement of Work, Task Order 99-07, page 3

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**III. Approach Used and Basis of Evaluation**

The following steps were taken during the course of this project:

1. Several on-site visits to the Office of the Chief Actuary of the SSA in Baltimore and discussions with various SSA staff regarding the long-range actuarial projections shown in the 1999TR.
2. Review of the basis of the assumptions used by SSA staff in the course of the development of the long-range actuarial projections shown in the 1999TR, as documented in a number of Actuarial Studies, publications, other material provided to us by SSA staff, and as described verbally to us.
3. Review of a selection of relevant literature and, in certain cases, discussion with selected experts within the area being evaluated.
4. Review of selected benchmarks for each major assumption used in the course of this review, as well as relevant Actuarial Standards of Practice.

**Reasonableness Criteria**

A significant aspect of this project is to assess the reasonableness of each of the significant assumptions underlying the long-range actuarial projections in the 1999TR, as well as the sensitivity of the projections to possible alternative values for each of a selected set of assumptions. The criteria selected for this determination are those included in the current Actuarial Standard of Practice Exposure Draft of *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*, which is described as follows:

- a. "The assumption is expected to accurately model the contingency being measured."
- b. "The assumption is not anticipated to produce significant cumulative actuarial gains or losses over the measurement period."

According to this criteria, to be unreasonable an assumption must not only be an inaccurate portrayal of the assumption, but the marginal financial impact of the inaccuracy needs to be significant financially as well.

It should be noted that this set of criteria was developed with private defined benefit pension plans in mind and thus should not automatically applied to programs such as OASDI. However, for the purposes of this report, the criteria seem reasonable to use.

**Benchmarks**

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Another significant factor in the determination of reasonableness is whether the assumptions have been determined in a manner consistent with current actuarial practice. Practice in this context specifically refers to long-range forecasting within a social insurance framework. In this regard, the practice of determining assumptions used in long-range forecasting (seventy five years in SSA's case) for nation-wide social insurance plans is currently limited. The long-range actuarial projections conducted in two countries have been selected for actuarial benchmarking purposes. There are national actuarial projections for other countries (e.g., Mexico and Japan); however, based on our knowledge, practice in the following two countries are indicative of best practices in this area:

1. Canada<sup>2</sup> Long-range actuarial projections are developed for the Canadian Pension Plan (CPP) and Old Age Security program (OAS) that provide benefits to residents of all areas within Canada except for Quebec and, where relevant, for the Quebec Pension Plan (QPP). The most recently prepared projections for these programs were made as of 31 December 1997, both published in 1999.
2. United Kingdom<sup>3</sup> Long-range actuarial projections are developed for the National Insurance Fund as of 5 April 1995, published in 1999. These projections were prepared by the U.K.'s Government Actuary's Department (GAD). The demographic projections included in these actuarial projections were also developed by GAD, in consultation with the Registrars General of the U.K.

Other benchmarks exist that have been used in the evaluation of reasonableness of the methodology and assumptions used where deemed appropriate and include:

1. Back-testing. Where applicable, observations with respect to back-testing are made in this report. However, care must be taken in interpreting the results of such testing, as many significant assumptions are set in the context of the long-range nature of the projections, rather than representing expectations of experience of a single year. Actual experience over short periods of time is expected to deviate, in some cases materially, from that over longer-range periods. In particular, it is difficult to back-test long-range economic assumptions due to their very nature, i.e., stable or average values over a long period of time.

Approaches used by other forecasters and expert opinion. Such approaches have been reviewed, to the extent deemed appropriate, in order to assess whether best-practices have been followed. It should be noted that such approaches and opinion

<sup>2</sup> Can be found at [www.osfi-bsif.gc.ca/outgoing/pdf/Actuarial/cpp17re2.pdf](http://www.osfi-bsif.gc.ca/outgoing/pdf/Actuarial/cpp17re2.pdf), [www.osfi-bsif.gc.ca/outgoing/pdf/Actuarial/oldage-e.pdf](http://www.osfi-bsif.gc.ca/outgoing/pdf/Actuarial/oldage-e.pdf), and [www.rrq.gouv.qc.ca/pdf/publications/anaac99F.pdf](http://www.rrq.gouv.qc.ca/pdf/publications/anaac99F.pdf) (abridged English version at [www.rrq.gouv.qc.ca/pdf/publications/anaac99A.pdf](http://www.rrq.gouv.qc.ca/pdf/publications/anaac99A.pdf))

<sup>3</sup> Can be found at [www.inlandrevenue.gov.uk/nifund/qrs.pdf](http://www.inlandrevenue.gov.uk/nifund/qrs.pdf). Note that details of the demographic projections are not available on the internet but can be found in *1996-based National population projections*, Office for National Statistics



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although to a particular variable may not be relevant to OASDI, or may not be appropriate to consider in the development of long-range forecasts.

**Actuarial Standards of Practice**

Although the responsibility for the assumptions underlying the 1999TR lies with the Board of Trustees, it is useful to examine whether the methods and assumptions used are consistent with existing Actuarial Standards of Practice (ASoPs). Relevant ASoPs are those adopted by the Actuarial Standards Board effective for actuarial practice within the U.S. It should be noted that a specific ASoP covering social insurance (number 32) was adopted by the Actuarial Standards Board in January 1998, effective for measurement periods beginning after July 1, 1998. It will thus be effective for the 2000TR. However, it does provide a useful *a priori* guideline to assess practice in this area. It should be noted that the assessment made here indicates our opinion with respect to compliance with these draft standards and does not represent the view of any official actuarial body with respect to such compliance.

The actuarial opinion included in the 1999TR by the Chief Actuary of SSA, Harry C. Ballantyne, ASA, MAAA, is not covered by ASoP No. 32 due to the timing of the 1999TR. Note that his opinion, that follows, does not incorporate an opinion concerning individual assumptions as required in an opinion on OASDI under ASoP No. 32 that will be required for the year ending September 1999 (the 2000TR):

“It is my opinion that (1) the techniques and methodology used herein to evaluate the financial and actuarial status of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds are generally accepted within the actuarial profession; and (2) the assumptions used and the resulting actuarial estimates are in the aggregate reasonable for the purpose of evaluating the financial and actuarial status of the trust funds, taking into consideration the experience and expectations of the program.”

In addition, there are two additional relevant ASoPs (one of which is currently being exposed and has not yet been adopted) that are particularly applicable:

1. ASoP No. 27 – *Selection of Economic Assumptions for Measuring Pension Obligations*. This ASoP is specifically referred to in ASoP No. 32 as being relevant for social insurance practice.
2. Exposure Draft – *Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations*. The current exposure draft was issued in January 1999. Note that it is subject to change and is not in final form; however, the issues discussed are relevant in this context.

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Relevant excerpts from these three adopted or currently exposed ASOPs are included in Appendix I of this report.

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**IV. Overview of OASDI Programs, Actuarial Projections, and Actuarial Assumptions**

The OASI program provides protection against loss of earnings due to retirement or death for eligible retired workers, their dependents and survivors. Similarly, the DI program provides protection against loss of earnings due to disability for eligible workers, along with their dependents and survivors. Revenue for these programs is primarily generated through payroll taxes from employers and employees. Details of the programs, together with a description of sources of income and outgo, can easily be found in a number of sources, including the SSA's website.

OASI has been in effect since 1935 (the DI program was added later) and together constitute a substantial portion of the U.S. federal budget. In addition, they constitute significant promises to the American public. As such, separate trust funds (for the OASI and DI programs) were established and are monitored closely by the Trustees of these trust funds, along with the Office of the Chief Actuary (OCACT) of the SSA.

By law, the Board of Trustees of the OASDI Trust Funds is required to annually report on the financial condition of these trust funds, including their long-range financial condition. To assist them in fulfilling this requirement, the OCACT of the SSA has developed a number of projection models of expected revenue and outgo of these trust funds. The OCACT includes a number of experienced actuaries and economists. Overall, it is our opinion that these individuals are qualified and experienced in the development and management of these models and the assumptions underlying them. The Chief Actuary annually provides an actuarial opinion regarding the financial projections (see section III above); historically, this opinion has related to the methodology and assumptions used in the aggregate. In the 1999TR, this actuarial opinion was provided without qualification with respect to the actuarial projections included in the 1999TR.

Actuarial projections (sometimes referred to as actuarial estimates) are estimates of expected future cash flows associated with the OASDI programs. Although based on current law, the amount of such cash flows are uncertain as a result of the uncertainties involved in determining future economic and demographic conditions during which they will occur. This level of uncertainty is particularly relevant to these projections, as they cover a seventy five year period and involve contingencies that cannot easily be projected. Simply by looking back seventy five years (or even half of such a period), it is obvious that it is quite difficult to predict the events that will significantly affect future OASDI cash flows. In fact, no matter how refined the projection models and assumptions, the degree of uncertainty associated with such long-range assumptions will still remain quite large.

Models used by the OCACT of the SSA are of two types -- short-range and long-range. The short-range models are currently applied to develop estimates for the next ten years

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(a number of years ago, the short-range model was applied only for the subsequent five years). The long-range model is primarily driven by the influence of ultimate assumptions, while the short-range model can be viewed as interpolating likely environments between the current environment and that represented by the long-range assumptions, reflecting inputs from other areas of government forecasting and SSA's best estimates.

It has been common to classify the characteristics of possible future environments into two types – economic and demographic. More will be said about both types later in this report. The 1999TR shows the results and key assumptions used in three alternative sets of assumptions, reflecting three distinct sets of future conditions. This report focuses on Alternative II, the intermediate cost assumptions. This set of assumptions are characterized by the Board of Trustees in the 1999TR as their “best estimates” of future experience. These estimated future cash flows will be assessed in this report on this basis.

The various sensitivity tests shown in the 1999TR (see further comments in section VI of this report) use the assumptions included in Alternatives I and III, the former constituting the costs associated with a “low” cost environment (referred to in the 1999TR as a set of more optimistic assumptions from the standpoint of OASDI financing), with the latter constituting costs associated with a “high” cost environment (referred to in the 1999TR as a set of more pessimistic assumptions from the standpoint of OASDI financing). The cash flows are those expected to be experienced by the OASDI Trust Funds and consist of inflows from revenues generated by the OASDI programs, primarily from payroll taxes and investment income from the Trust Funds, and outflows generated as a result of future benefit payments and the cost of administration.

The basis for actuarial projections for social insurance programs are what is referred to as an open-group basis, reflecting not only current beneficiaries and contributors, but future beneficiaries and contributors as well. Thus, it is necessary to consider future births and net immigration from all demographic groups that are expected to affect the future cash flows of the Trust Funds.

Relevant ASoPs indicate that such projections should be performed under the assumption that current law continues in place. Thus, currently scheduled changes are appropriately assumed, including scheduled future payroll tax rates, benefit formula, and eligibility formulas and rules.

To provide perspective to the actuarial projections, the following table shows projected income and costs of the combined OASDI programs provided in the 1999TR expressed in terms of percent of corresponding OASDI taxable payroll. The actuarial balance is simply the difference between these. It also includes summarized values for entire measurement period that also reflects the initial fund balances in income and one year's anticipated benefits and expenses at the end of the measurement period in cost.

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**Selected Annual Income and Cost Rates for OASDI\***

<u>Calendar Year</u>	<u>Income Rate</u>	<u>Cost Rate</u>	<u>Balance</u>
<b>Historical</b>			
1980	10.16%	10.71%	-0.55%
1990	11.79	11.05	0.73
<b>Projected</b>			
2000	12.65	10.79	1.86
2010	12.75	11.91	0.84
2020	12.91	15.03	-2.12
2030	13.09	17.71	-4.62
2040	13.17	18.18	-5.00
2050	13.22	18.28	-5.86
2060	13.29	19.05	-5.77
2070	13.34	19.63	-6.29
Summarized over 75 years	13.49	15.58	-2.07

\* All values expressed in terms of OASDI taxable payroll

Income rate (annual value) = income from taxes, excluding investment income  
(summarized value) = present value of income from taxes plus initial fund balance

Cost rate (annual value) = benefits plus expenses  
(summarized value) = present value of benefits and expenses plus one year of benefits and expenses at the end of the measurement period

Balance = Income rate - cost rate

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### **V. Assumptions**

We have classified actuarial assumptions into the following two categories, in a manner common with other analyses of similar programs -- demographic and economic. It should be noted that several of these assumptions have characteristics that can be associated with both of them, such as labor force participation. We have made this distinction only for the sake of convenience. In addition, a number of these demographic and economic assumptions are inter-connected, with underlying causes that affect more than just a single assumption.

There are literally thousands of individual assumptions that play a role in the development of these long-range actuarial projections. For example, just for mortality rates for a single type of beneficiary, assumptions are made with respect to current and future levels of mortality, shape of mortality rates by age, relativities between sex, trend by year, as well as the current and future distribution of benefit payments. So, the first step in our analysis was to identify the specific assumptions to evaluate individually.

It is sometimes difficult to distinguish between actuarial methodologies and actuarial assumptions. Typically, methodologies refer to the approach taken to develop a model and the formulas that form the framework from which a model is run, while assumptions are the parameters used as the variables of the model. For the purpose of this report, we will discuss methodologies in the introductory section of the two categories of assumptions, while separately devoting attention to the more significant assumptions.

Not many mortals voluntarily project demographic and economic assumptions for seventy five years. Most professionals, when faced with such a challenge, will revert to analysis either represented by the aggregate assessment of a market (e.g., economic approach to looking at yield curves or fair values) or in historical experience (actuarial approach to looking at demographic trends). As a result, most such estimates are based on a simplified heuristic judgmental basis. Nonetheless, it is still appropriate to consider the appropriateness of the development of a methodology if such exists, whether the method is applied consistently over time, and whether the conclusion satisfies common sense based on what is known and factors that may be considered to likely impact them.

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**VA. Demographic Assumptions - Introduction**

Demographic characteristics of current and future workers and beneficiaries affect both revenue and cost of the OASDI program – the revenue directly through payroll taxes and costs through benefits. Separate short-range and long-range models develop these estimates using different methods. Their results are validated so that a smooth “connection” for each type of beneficiary is achieved. These models incorporate assumptions concerning future workers and beneficiaries through the use of a number of demographic assumptions, including future deaths, births, new disablements, disability recoveries, changes in marital status and time when benefits will begin in the future.

Demographic projections reflect a classification of the population and start with the following components:

1. Current overall population. This is obtained from the Bureau of the Census on an age and sex basis, including estimates of census undercount and restricted to those in the geographical area eligible for OASDI benefits. This is referred to as the Social Security Area Population (SSAP). In addition, others are also included, such as citizens living abroad; however these are quite small in numbers in comparison with those in the SSAP.
2. Current beneficiary population. This is used as a base to estimate benefits for those currently receiving benefits and those expected to continue receiving such benefits.

Estimates of future fertility and net immigration. Future births will later become workers or their dependents and eventually OASDI beneficiaries. The net change from immigration and emigration will also affect the number that will be eligible for benefits.

Since not everyone who currently lives in the SSAP (1 above) is eligible by law to qualify for benefits, covered workers need to be estimated, consisting of those workers who are currently or who are expected to be potentially eligible for benefits. A number of future workers do not currently live in the SSAP – these include those in 3 (above), the number of whom also have to be estimated. But not all future beneficiaries are now currently alive and living in this area; these others include future births and ins and outs resulting from immigration and emigration. Others (survivor and dependent beneficiaries by beneficiary type whose benefits are or will be a function of others' past earnings history) will be estimated based on (the current overall population (1 above) and future births and net immigrants (3 above)), reflecting their estimated age and sex distribution and assumed relationships with past and future workers.

For workers to be eligible for benefits, it is also necessary to determine the percentage who will qualify for OASDI benefits as a result of sufficient work history. Thus, it is then necessary to determine what percentage of the population will be eligible for current or future benefits; as such, unemployment rates have to be reflected. For retirement benefits, this means estimating those with sufficient work experience to be “fully-

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insured” through age-sex specific prevalence rates, while for those collecting disability benefits this means estimating those achieving “disability-insured” status.

For current and future beneficiaries, their (or related worker) earnings are estimated based on current benefits received or on IRS earnings histories and are projected through use of various economic assumptions. These are used to estimate future revenue and benefits.

The following sections describe the major demographic assumptions involved in the actuarial projections of the OASDI program.



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VA1. Mortality

**Definition and Impact**

The mortality assumption represents an estimate of the number of deaths a population can expect to realize in any given year. Age-specific mortality rates are defined as the number of deaths during the year divided by the midyear population of that age. The mortality assumption can be expressed as a future life expectancy from a certain age (usually at birth or age 65, currently the normal retirement for OASI benefits), which can be interpreted as the average future life expectancy for a certain cohort (or the average age at death for a cohort currently age zero).

The mortality assumption is used, among other things, to estimate how long workers contribute payroll taxes to the OASDI Trust Fund and how long retired and disabled workers and their survivors are projected to collect benefits. Because mortality affects both income to and outgo from the trust funds, the age at which death occurs affects both the direction of trust fund cash flows and their incidence. As a result, it can be important to estimate not only the overall level but also the age-specific mortality rates. In the extreme, an improvement in mortality rates may improve trust fund finances if death occurs prior to retirement years or decrease the funds if it occurs at ages after retirement. Thus, it is important to look at age-specific mortality rates.

**Findings**

The mortality assumption contains no material defects because of errors or omissions, is individually reasonable, and is in compliance with generally accepted actuarial principles.

The SSA actuaries' mortality improvement assumption is consistent with current actuarial practice, as the assumption is determined in a manner consistent with assumptions used for social insurance projections in Canada and in the U.K. In addition, the development of the mortality assumption follows relevant current ASOPs and those currently exposed (see Appendix I) and therefore it is determined under generally accepted actuarial principles. In summary, the methods used to develop assumptions are consistent with the selected benchmark social insurance projections and actuarial standards of practice.

However, based strictly on long-term historical comparisons, the overall rates of projected mortality improvement are understated. Other than two periods (1954 to 1968 for males and 1982 to 1996 for females) in the 1900s, rates of mortality improvement have exceeded the ultimate rates of improvement being projected by the SSA actuaries.

Some experts are of the opinion that the level of mortality improvements assumed by the SSA actuaries understates the level of mortality improvement that can be expected. Alternative approaches used by other forecasters have projected mortality improvements

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much larger than the SSA actuaries are currently projecting. For example, Lee and Carter (1992) forecasts a life expectancy for both sexes combined of 86.1 in the year 2065, more than twice the increase in the life expectancy forecast by the SSA actuaries for the same period.

This conclusion is based on consideration of the items presented in the Discussion section.

**SSA Basis**

Mortality projections prepared by SSA actuaries are based on estimates of the most likely course of age-sex-cause specific death rates over the measurement period. Mortality rates in future years are determined by applying an annual percentage reduction to the previous year's mortality rate. For the first twenty five years, the annual percentage reduction is based on the most recent mortality trends observed (period between 1968 and 1996, the period during which cause-specific death rates are available). These rates of reduction gradually merge into what the SSA actuaries deem the "ultimate annual reductions". The ultimate annual reduction is determined by looking at past rates, consulting with experts and the SSA actuaries' professional judgement.

To determine the current rates of mortality, SSA actuaries rely for ages under 65 the number of deaths as tabulated by the National Center for Health Statistics (NCHS), with the estimates of the U.S. resident population as determined by the Bureau of Census. For ages 65 and older, the number of deaths and the population are determined from Medicare records, with NCHS statistics used to determine the number of deaths within each cause of death.

Mortality rates have decreased during most historical periods but have been highly variable. The average annual percentage reductions in the age-adjusted central death rates during various historical periods are as follows:

Period	Annual Percentage Reduction – Male	Annual Percentage Reduction – Female
1900 – 1936	.78	.90
1936 – 1954	1.60	2.47
1954 – 1968	-.21	.77
1968 – 1982	1.78	2.15
1982 – 1996	.82	.47
<b>1900 – 1996</b>	<b>.94</b>	<b>1.30</b>

The rates of improvement have varied significantly, not only by sex and time period, but also by age and cause of death. During most of these periods, the percentage reduction was greater at younger ages than older ages. Thus, similar to the problem of developing economic assumptions, the issue arises regarding which historical periods provide the

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most relevant experience. The SSA actuaries approach this problem by reviewing and projecting the mortality improvements by ten causes of death, as well as by age and sex.

There are diverse opinions amongst demographers and actuaries as to the ultimate life expectancy that might reasonably be expected to be reached. One can point to Japan and Canada, where the expectation of life at birth is approximately 3 to 4 years greater than the U.S. for both males and females to indicate that a significant potential for mortality improvement exists. Other factors that may influence the future life expectancy, are the control of cancer, healthy lifestyles and other medical advances. For example, a reduction in the level of smoking has increased the life expectancy for males and may increase the life expectancy of females in the future; the reduction in smoking levels have already contributed to a recent reduction in male mortality and may in the future contribute to a further reduction in female mortality. Other trends may work to reduce future life expectancies, such as the increasing prevalence of obesity in the U.S. (particularly in the 1990s) or the discovery of currently unknown epidemics (such as AIDS during the 1970s and 1980s). In addition, some demographers believe that a law of diminishing returns applies to death rate reductions at advanced ages, partly because no more than a minority of the population will adopt truly healthy lifestyles.

Between 1996 and 2023, the reductions in the death rates are assumed to change gradually from the average annual reductions by age, sex and cause of death observed between 1968 and 1996, to the ultimate annual percentage reductions by age, sex and cause of death assumed for 2023 and later. The average historical cause of death rates by sex and age grouping between 1968-96 are used as the basis for future cause of death projections. The resulting death rates were assumed to decline at an average annual rate of approximately .6% between 1996 and 2023 (.69% for males and .51% for females, all ages combined). The projected rate of decline in the death rate is assumed to be approximately 73% for males and 39% for females of the actual rate of decline observed between 1900 and 1996.

The following table provides the assumed average annual percentage reductions in age adjusted central death rates for the 1999 TR:

Gender	Age Group	1996 - 2023	2023 - 2073	1996 - 2073
Male	0-14	2.45	1.18	1.63
	15-49	1.22	.60	.82
	50-64	1.23	.62	.83
	65-84	.62	.49	.53
	85+	.19	.53	.41
	65+	.49	.50	.49
	<b>Total</b>	<b>.69</b>	<b>.53</b>	<b>.58</b>
Female	0-14	2.42	1.23	1.65
	15-49	1.36	.54	.83
	50-64	.70	.52	.58

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65-84	.36	.46	.43
85+	.35	.58	.50
65+	.36	.50	.45
<b>Total</b>	<b>.51</b>	<b>.51</b>	<b>.51</b>

Based on the table above, the mortality improvements for the younger ages (less than 65) are assumed to improve at a much slower rate than has been observed in the period 1900 to 1996. The annual rate of improvement for ages less than 65 is approximately 67% for males and 45% for females of the corresponding actual rate of decline observed between 1900 to 1996. At the older ages (age 65 and after), the rate of improvement is approximately 85% for males and 50% for females of the actual decline observed between 1900 to 1996. All else being equal, this pattern of improvement (a shift of the mortality improvement to the older ages) would tend to increase OASDI program costs. Faster mortality improvement at the younger ages tends to improve the financial status of the OASDI Trust Funds, just as increased birth rates do. Thus, the assumption that the ultimate rates of improvement decline greatly at the younger ages would be "conservative" with respect to financial projections.

The SSA actuaries feel that the projected level of mortality improvement should not be as high as past improvements due to certain events that occurred during the 1900 to 1996 period that are not expected to reoccur, such as, but not limited to the following:

1. Improvements from major changes in public health care,
2. Improvements/access to primary health care,
3. Discovery and general availability of antibiotics and immunizations,
4. Rapid rate of growth in the general standard of living, and
5. Growth in the share of GDP consumed by health care.

Due to the nature of AIDS, the SSA actuaries treat this disease as a separate and special cause of death and, therefore, death rates due to AIDS were projected by a different method. AIDS related death rates are assumed to decline over the next ten years, at which point the death rates are assumed to remain relative constant for the remainder of the measurement period. Higher death rates due to AIDS may result in higher cost to the program if most of the AIDS related deaths are at younger ages. A 1980s study completed by the SSA actuaries found that the long range cost of AIDS related deaths to be approximately cost neutral due to many deaths occurring about age thirty.

**Approaches Used by Others**

Other approaches that have been used include:

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- **Canada.** CPP/OAS projections base their mortality assumption on 1990 – 1992 mortality rates indicated in Canadian life tables, taken as representative mortality for 1991, with annual decreases in mortality rates in all future years. After 2001, the decreases are based on a study of mortality rate decreases by age and sex conducted by the SSA staff for the U.S. OASDI program. The results of the study were adjusted for the historical differences between Canada and U.S. in mortality rate reductions. The reductions were graded from the current experience into the ultimate assumption. For the Quebec Pension Plan Actuarial Report of 31 December 1997, the mortality rates were expected to drop continually over the entire measurement period at a rate that are less rapid than the rates observed from 1966 to 1997.
- **U.K.** National Population Projections mortality rates are country (England, Scotland, Wales, and Northern Ireland) specific and complete convergence between the mortality of these countries is not assumed. The projections are based on calendar year 1996 for England and Wales, adjusted at each age for the difference in mortality for Scotland and Northern Ireland (for the 1993 to 1995 period). Mortality improvements were applied to the base rates for each country. Projections were based on the assumption that the large reductions in mortality of the past will not continue indefinitely (similar to the assumption made by the SSA actuaries). Instead, it is expected that a law of diminishing returns will apply and death rates will fall less steeply in the future. Initially, it is assumed that the decline in death rates observed during the period from 1961 to 1995 will continue and gradually reduce (more rapid transition during the earlier years) until a rate of .50% is reached in 2032. Thereafter, the rate of improvement is projected to halve every ten years (i.e., .25% in 2042, etc.). The long-range improvement assumed is less than that assumed in the SSA projections.
- **U.S. Census Bureau.** The Census Bureau projects mortality rates assuming no changes in recent experience (1980 to 1990) will occur in the future. Four conditions were applied to avoid questionable results (no 2050 rate higher than a 1994 rate; no male rate lower than an equivalent female rate; steady increases from ages 25-29 to 100+; and no death rate improvements greater than 3% from 1994 to 2050). Importantly, the mortality experience is separated by age, sex and by five different races (and Hispanic origin within each of these racial groups) and does not assume convergence between the mortality of the races will occur in the future.

Other variables could be included in long-range mortality projections, including explicit assumptions by socioeconomic or marital status.

SSA does not explicitly reflect possible variations among factors such as race, region of the country, economic variables such as income and general state of the economy. SSA has reviewed the possibility of including explicit race-based projections, but has decided against their use because of their assessment that explicitly reflecting these factors would

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not add significant accuracy, while at the same time demanding significant expansion of the complexity of their projection models to segment the future population by such groupings.

A number of demographers have observed that the overall trend in mortality has shown a remarkable stable pattern over the last fifty years. As a result of this, and concerns about the cause-of-death approach used by SSA (e.g., likely future patterns and sources of changes that may not be discernable now, and problems with cause of death coding), they believe that a further extrapolation of these trends would indicate that the rate of improvement in population mortality would be considerably larger than currently projected by SSA actuaries.

The results of a survey conducted at the end on a symposium on this topic sponsored by the Society of Actuaries in 1997 attended by leading actuaries, demographers and other professionals concluded that a consensus overall average annual rate of mortality improvement would be about 0.6%, which is not significantly different than that assumed by SSA actuaries.

**Significant Conclusions of the Last Two Technical Panels**

The following are the significant conclusions of the last two technical panels regarding the mortality assumption:

- 1991 Technical Panel made no suggestions for changing the mortality assumption.
- 1995 Technical Panel felt that the mortality projections should more closely reflect long run past experience. This change would increase life expectancies and increase the projected cost of the program.

**Discussion**

The following significant aspects of the mortality assumption include:

1. The average annual decline in assumed mortality rates for the entire measurement period ranges from approximately half of the actual decline in the mortality rates observed between 1900 and 1996. In addition, the rates of improvement are much lower than the rates provided in by Scale AA used to project the 1994 Group Annuity Mortality tables. The improvements provided for in Scale AA are greater than or equal to .5% at all ages through age 86 (as high as 2% annual improvements at younger ages).
2. The projected mortality rates do not model a number of population-based factors, such as marital status, race, and ethnicity, although these items were considered by the SSA actuaries in setting the mortality assumption. Changes in the population mix

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of these characteristics will tend to influence future overall mortality trends (e.g., marrieds have experienced lower mortality than non-marrieds, Asian-Americans have experienced lower mortality rates than whites who in turn have experienced lower mortality rates than blacks).

3. The projected mortality rates do not explicitly consider socioeconomic status of the beneficiaries, although average projected benefit amounts are adjusted each year to account for this (see section V3C for further discussion). Behavioral factors such as smoking, nutrition, life style, working conditions, pollution, or attitudes and expectations are also not explicitly considered. In addition, biologically based or health care based factors such as the reduction or elimination of particular diseases, the impact of improved biological knowledge from such sources as the human genome project, as well as the rise in antibiotic resistant bacteria other than those included in historical mortality experience, are not explicitly considered.
4. Many actuaries believe that mortality rates are generally affected by changes in real GDP over long periods of time, although it is currently uncommon for actuaries to use changes in GDP directly as a factor in mortality projections. The rationale of this approach rests on the theory that economic productivity and level of standards of living is the overall driving factor for sustained longevity improvements, although others note that changes in standards of living may not necessarily lead to improved nutritional and leisure habits.
5. Education and income are important factors (please note that these factors are not independent) for projecting the mortality assumption. Robust economic projections, such as those in Alternative II, would lead us to believe that the rate of mortality improvements should be in line with that expectation. In addition, if education and income differences are to converge for different races, which may be an implicit assumption being made in the fertility assumption, we would expect the mortality rates to converge as well. In order for this to occur, the overall rates of improvement required would be greater than the current assumption.
6. International evidence shows many countries, particularly Western Europe and Japan, with improvement rates exceeding those of the U.S. Rates of mortality decline in these low mortality countries have shown no evidence of slowing among the elderly. The superior performance of the U.S. economy in general and the use of high technologies and medical research, and the high percentage of the GDP allocated to health care, suggest that the U.S. might be able to achieve the mortality levels of our main competitors in the near future.
7. The 1982 to 1994 period was one of the slowest improvement rate periods for the U.S. population aged 65 and over (especially female) and may be an anomaly rather than an indication of future trends.

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8. The use of cause-specific mortality trends in projecting future mortality is somewhat controversial. A number of demographers believe that their use adds little to mortality projections, as it is quite difficult to predict future cause of death rates, future trends that are likely to be quite different than the past, and cause of death data problems. We believe that such trends can be quite useful to analyze future mortality trends, although their limitations should be noted. In developing a cause of death mortality base (1968-96 for the 1999TR), SSA actuaries averaged these cause-specific mortality rates for each specific cause to serve as a basis for projection. Because significant trends have occurred during this period, we recommend that these trends be reflected in projecting mortality into the future. For example, the most recent trend for males has been an improvement in mortality due to cancer; however, the average cancer mortality rates during the period showed deterioration and thus is inconsistent with the direction of recent trends.

It is not unreasonable to make implicit assumptions regarding population based factors, behavioral factors, biological based factors and other items that affect mortality improvement projections; however, these factors should be considered when determining the most appropriate mortality improvement assumption. In addition, the factors that affect the mortality assumption should be reviewed from time to time to ensure that the factors are being properly reflected in the mortality improvement assumption.

In summary, many factors affect expected levels of future mortality, some which may provide evidence that the SSA actuaries projections do not project as high level of mortality improvements as the "best estimate" rate of mortality improvements (the projected mortality improvements under estimate the program cost). These include:

- Education and income factors that improve under the economic projections,
- Superior mortality levels as well as improvement levels of other industrialized countries,
- The possible convergence of education and income levels by race,
- The high rates of improvement over the last hundred years relative to the mortality rates being projected,
- The high rates of mortality improvement predicted by demographers using statistical models (i.e., the Lee and Carter model), and
- The high rates of improvement built into projection scales used in conjunction with mortality tables developed by the SOA.



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The following factors would suggest that the mortality improvement assumption being used by the SSA actuaries overstates the "best estimate" rate of mortality improvement (the projected mortality improvements overstate the program costs):

- The significant recent upward trend in the prevalence of obesity in the U.S. (from 12.0% in 1991 to 17.9%, especially in 18-29 year-olds and Hispanics)<sup>4</sup>, combined with recent medical research which has indicated a significant link between obesity and higher mortality rates<sup>5</sup> and prior actuarial studies (the 1959 and 1979 Build and Blood Pressure Studies) confirming this same finding.
- The possibility of a future epidemic such as the AIDS epidemic was in the 1980s.
- The continued decline in the marriage rates in the U.S. Studies have shown that married individuals exhibit a lower rate of mortality versus non married participants.

Other factors point to the assumed rates of mortality improvement to be "on the mark". These include the following:

- The results of prior TR projections over the past twenty years show through back-testing that the actual life expectancies have generally been slightly lower than the projected life expectancies under prior SSA assumptions.
- Canada and the U.K. are projecting mortality improvements similar to the SSA actuaries. In the case of the U.K., the ultimate levels of improvement are projected to decline continually to the point of being much lower than the mortality improvement rates projected by the SSA.
- The major improvements in mortality have been due in a large part to reduction in mortality due to certain diseases through the use of antibiotics and treatment of high blood pressure and other treatments that are not expected to reoccur in the future.
- The 1997 survey results mentioned above, where the "consensus" view of actuaries, demographers and economists was that the long-range rate of mortality improvements would be approximately what the SSA actuaries are predicting.

Other factors may have an impact on the level of future mortality improvements, but it is currently unclear how they will effect the rates of mortality improvement. For example, the effect of medical technology in the future may be significantly greater than it has been in the past, or the effect on mortality improvements may decrease. Also, the level

<sup>4</sup> various articles in *The Journal of the American Medical Association*, October 27, 1999

<sup>5</sup> Calle, et.al, "Body-Mass Index and Mortality in a Prospective Cohort of U.S. Adults", *The Journal of the American Medical Association*, October 7, 1999

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of future GDP may have an affect on future mortality improvements, but it is unclear to what extent it effects mortality improvements, and how past GDP relates to the future.

In summary, there are a number of factors that point to possible sources of a higher or lower rate of improvement than currently projected. In addition, difference in opinions, on both sides, exist within the actuarial community and areas of practice. We cannot conclude that there is a high likelihood that significant cumulative actuarial gains or losses will occur due to mortality over the measurement period.

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**VA2. Fertility**

**Definition and Impact**

The fertility rate is defined as the birth rate of a population. Age-specific birth rates are defined as the births during the year to mothers at the mothers' specified age divided by the mid-year female population at that age. The total fertility rate is the sum of the age-specific birth rates for a given calendar year. The total fertility rate can be interpreted as the number of children that would be born to a woman if she were to survive her childbearing years and were to experience those age-specific birth rates throughout her child-bearing years.

The fertility assumption becomes significant in long-range OASDI projections due to the open-population approach used in estimating future revenues and benefits. The higher the fertility rates, the more revenue will be received, offset a long time later by a larger amount of benefit payments when those individuals receive benefits.

**Findings**

The fertility assumption contains no material defects because of errors or omissions, is individually reasonable, and is in compliance with generally accepted actuarial principles.

**SSA Basis**

SSA actuaries develop the long-range total fertility assumption after reviewing the fertility rates in the U.S. since 1917, as well as the most recent information published by the NCHS. The most recent rates available are used as the starting point of the projection. The fertility rates for the cohorts of mothers are projected for the childbearing years that have not yet occurred. This completes the "legs" of each existing cohort's fertility rate. These rates are gradually reduced over time until the ultimate rate is reached. The SSA actuaries assume a smooth transition from the current observed fertility rates until the ultimate fertility rate is reached in 2025.

In order to determine the ultimate total fertility rate, the SSA actuaries also review the latest birth expectations in the Bureau of Census' Current Population Reports. The most recent Report shows current birth expectations to be in the neighborhood of 2.0 to 2.1. These expectations have been remarkably stable for a long period of time. These figures are then reduced slightly because expectations have tended to be higher than actual births in recent years<sup>6</sup>. These fertility expectations are not explicitly reflected in SSA's projections; however, the fact that they have been relatively stable over time has been influential in setting the ultimate fertility assumption.

<sup>6</sup> Bureau of the Census, "Assessing Birth Expectations from Current Population Survey: 1971-1981"

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Due to a number of changes in our society that have occurred over the past twenty years, the SSA actuaries do not expect the higher level of fertility rates to reoccur for reasons including the following:

1. Increased availability and use of birth control methods;
2. Increased female participation in the labor force, although the rates of participation are not anticipated to increase much further in the future;
3. Increased prevalence of divorce;
4. Increased percentage of births to mothers who are not married;
5. Increased postponement of marriage and childbearing among young women; and
6. Shift in perception of the status of children within their families from economic assets to economic liabilities.

A significant characteristic of current U.S. fertility experience is the difference in levels of fertility among racial groups (e.g., white, African-American, Hispanic, Asian). SSA actuaries expect the fertility rates among racial groups to converge to that of the non-Hispanic white population over the long range.

The basis for this convergence assumption is the belief by the SSA actuaries that income level is a key driver of total fertility levels. The SSA actuaries assume that over time, income levels of U.S. population segments will tend to converge. As a result, the fertility rates of those racial groups experiencing higher total fertility rates are assumed to converge to those rates of non-Hispanic whites. Recent calendar year (1997) fertility rates for sizable population groups have been – 1.8 for non-Hispanic whites, 3.0 for Hispanics, and 2.2 for non-Hispanic African-Americans.

SSA actuaries analyze cohort-specific fertility experience, and such experience is explicitly reflected in its assumptions as to future fertility rates. Current fertility rates of most other developed nations are lower, in some cases far lower than that currently experienced in the U.S. Convergence to these lower rates is not assumed in the OASDI projections due to the assumption that cultural differences between countries will remain significant in contributing to a lack of further significant convergence (i.e., reduction) in U.S. fertility rates in the future.

The resulting fertility rates are then compared to the ranges in the projections prepared by the Bureau of the Census. Any discrepancy is assessed to determine whether adjustments should be made.

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Separately, an allocation of the total fertility rate to birth ages of mothers is made. Recent distribution of fertility experience as to this allocation among age-specific birth rates is assumed to continue, i.e., lower birth rates at younger ages (teens and twenties) and higher birth rates at older ages (thirties and forties) than prior periods, reflecting a general trend toward giving birth at older ages.

**Approaches Used by Others**

Other approaches that have been used include:

- **Canada.** The actuarial projections of the CPP/OAS use a total fertility assumption consistent with the one developed by Statistics of Canada, that reflects actual average experience over the last twenty years. Separate assumptions are projected for Canada (non-Quebec) and Quebec. The CPP/OAS actuaries also reviewed a United Nations study that used a slightly higher projected total fertility rate for Canada (but note that current total fertility rates are even lower than the one assumed by the CPP/QPP actuaries). In QPP projections, the beginning total fertility rate used is the average over the last twenty years, projected to increase slightly over time.
- **U.K.** National Population Projections in general reflect fertility rates using the same methods as the SSA. However, these fertility rates are country (England, Scotland, Wales, and Northern Ireland) specific and complete convergence between countries is not assumed. In prior projections, complete convergence was assumed over the long term.
- **U.S. Bureau of the Census.** Census projects fertility rates assuming no changes in recent experience (approximately the last 5 years prior to the projection) will occur in the future. Importantly, the fertility experience is separated into five different races (and Hispanic origin within each of these racial groups) and does not assume any convergence between races will occur in the future. They do reflect the expected change in the adult female population mix in their projections.

In addition, differing assumptions for cohort of females (by year of birth) could also have been made. Cohort-specific fertility trends are now reviewed in the determination of ultimate total fertility rates.

SSA does not explicitly reflect possible variations among factors such as race, region of the country, economic variables such as income, and general state of the economy. SSA has reviewed the possibility of including explicit race-based projections, but decided against using race because they believe that explicitly reflecting these factors would not add significant accuracy, while at the same time demanding significant expansion to their population projection model to segment future population by such groupings.

**Significant Conclusions of the Last Two Technical Panels**

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The following are the significant conclusions of the last two technical panels regarding the fertility assumption:

- 1991 Technical Panel concluded that the ultimate total fertility rate of 1.9 was appropriate for a best estimate assumption, but would also consider 1.8 reasonable.
- 1995 Technical Panel recommended that SSA should continue to monitor trends (especially those among younger age groups) to determine possible effects of birth cohort size on fertility timing, and among baby boom cohorts to identify trends in completed family size. The Panel also recommended that the estimate of the long-range total fertility rate be raised from its current level of 1.9 to 1.95, as well as an increase in the fertility assumption for the short term.

**Discussion**

Significant aspects of the fertility assumption include:

1. The OASDI projections assume a gradual reduction of current experience fertility rates (between 2.0 and 2.1) to 1.9 over the next twenty five years.
2. There is no reason to believe that mothers' birth age will shift significantly over the long term, although a gradual continuation of the trend toward later birth ages is likely to continue.
3. Regarding implicit versus explicit reflection of sub-population differences (e.g., race), it is reasonable to assume that sub-population fertility experience will tend to get closer over time, but complete convergence may never occur, even over the long term. However, the assumption that the higher ultimate fertility rate for certain population segments (mainly Hispanic and African-American) will reduce in the future as income gaps close is reasonable. In addition, it is reasonable to use an aggregate fertility rate assumption (all races combined) as long as the aggregate assumption implicitly considers the differences in fertility among certain racial groups.
4. Although there has been a significant increase in the percentage of multiple births (and this trend could continue as a result of increasing use of enhanced fertility treatment), the percentages of such births are currently not expected to significantly impact the total fertility rate assumption.
5. Cohort-specific trends should continue to be assessed.
6. An assumption of non-convergence of the U.S. fertility rate to experience in other developed countries is reasonable given that the fertility rates have differed

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throughout history (due to cultural differences among other factors) and that the factors used for determining a fertility assumption (race, income levels, etc.) differ between the developed countries.

7. Back-testing. Through back-testing, prior projections over the past twenty years of the total fertility rate have been shown to be close to actual results.

As stated, it is reasonable to make implicit assumptions regarding ultimate aggregate levels of future fertility. The development of models (outside their population projections) to confirm the reasonableness of their aggregate short-range and long-range fertility assumptions based on cohort and population-segments may provide useful insights to the development of aggregate assumptions. Explicit study of the differences in fertility and rates of convergence of the various sub-populations should be conducted to confirm the reasonableness of the implicitly derived fertility assumptions.

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**VA3. Net Immigration**

**Definition and Impact**

Net immigration is defined as the number of persons who come to the U.S. to take permanent residence, less the number of persons who emigrate from the U.S. to take permanent residence in another country. For the purpose of the SSA projections, net immigration includes both legal and non-legal immigrants.

The SSA cost rate decreases with increasing rates of net immigration because immigration occurs at relatively younger ages, thereby increasing the numbers of covered workers prior to the time that the numbers of beneficiaries increase.

**Findings**

The net immigration assumption contains no material defects because of errors or omissions, is individually reasonable, and is in compliance with generally accepted actuarial principles.

**SSA Basis**

The SSA administration develops a net immigration assumption as the net of the following four population movements:

1. Legal immigration under the flexible cap,
2. Legal immigration under the separately set limits (refugees and asylees),
3. Emigration, and
4. Other than legal immigration

The Immigration Act of 1990, which took effect in fiscal year 1992, restructured immigration categories and substantially increased the number of immigrants who may legally enter the U.S. each year. This law set the cap of 675,000 per year for 1995 and later. This cap is "peaceable" because unused visas from prior years and other specially legislated immigrants are not included in these ceilings. The maximum number of refugees is set annually.

Other factors affecting the level of legal immigration that the SSA actuaries reflect, but are not limited to the following:

1. Application processing backlogs,



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2. Shifting of responsibility from the Department of State to the Immigration and Naturalization Service (INS),
3. Economic changes in the U.S. and abroad, and
4. Anti-immigration sentiment in the U.S.

Data on emigration is sparse and largely estimated. INS research (as well as others) has estimated emigration to be in a range of twenty to forty percent of legal immigration. Because emigration for the Social Security area is less than total emigration (in certain cases people can emigrate from the U.S. and remain eligible for benefits), the SSA assumes an estimate of twenty five percent, which is closer to the lower end of the estimated range.

Therefore, based on current law, the number of legal immigrants under the flexible cap is assumed to be 675,000 for all years of the projection. The number of legal immigrants under the separately set limit is assumed to be 125,000 for all years. Many of the separately set limits have "sunset" provisions included, but the SSA has assumed that these provisions will be extended prior to expiration. Emigration is assumed to be 25% of legal immigration, for a net legal immigration of 600,000.

Other than legal immigration is assumed to continue due to limited economic opportunity in the native country of the majority of these aliens. The number of other than legal immigrants is assumed to be 300,000, which is the best estimate the INS has made based on data provided by Bureau of Census surveys.

The age / sex distribution of assumed legal immigration was based on data supplied by the INS since 1978. The age / sex distribution of assumed emigration was based on estimates of foreign born emigration for 1960 to 1970 in "Foreign Born Emigration from the U.S.: 1960 to 1970" by Robert Warren and Jennifer Peck in Demography, February 1980. The age / sex distribution of the other than legal immigrants was based on unpublished Bureau of Census estimates of the undocumented population in the 1980 census.

In total, 900,000 net immigrants are assumed for every year of the measurement period.

**Approaches Used by Others**

Other approaches that have been used include:

- Canada. CPP/OAS projections assume that an immigration rate of a selected percentage of the population (.61% grading to .60%). The assumption was increased from the last report due to the inclusion of emigrants who return to Canada. The reports also assume net migration from Quebec. The assumption is consistent with

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experience over the last ten to fifteen years and reflects the target adopted by the federal government in its 1994 immigration plan. In addition, this assumption is the same as the assumption adopted by Statistics Canada for its "medium" projections.

- U.K. National Population Projections (international migration only) in general reflect data from the International Passenger Survey, for which information has been collected since 1964. The data is available on migration between the U.K. and four different groups of countries. The various time series are projected using a form of exponential smoothing, but with various trends gradually "leveled off" to give constant level projections after ten years.
- U.S. Census Bureau. The Census Bureau projects net immigration (820,000 per year) based on data for the 1991 to 1994 period, with the age, sex, race and Hispanic origin distributions based on recent data provided by INS. Six categories of migration are used, five which increase population and one which decreases population (emigration). The Bureau also makes an adjustment for non-legal immigration. The middle assumption is based on current levels and interpretations of current laws.

**Significant Conclusions of the Last Two Technical Panels**

Both the 1991 and 1995 Technical Panels did not recommend a change in the current procedure used to develop immigration assumptions and concluded that current procedures and levels of assumed net immigration were reasonable.

**Discussion**

If the number or age / sex distribution of immigrants changes, assumptions concerning their impact on FICA tax receipts and OASDI benefits would have to be recognized (only when the proportion differs significantly from historical levels is it necessary to make explicit assumptions about labor force participation, wage rates, and eligibility of immigrants).

No increase in net immigration is assumed in the future. It should be noted that such an increase is possible in the future as a result of a decrease in the growth of future anticipated workforce and fueled by the demand for labor in the U.S. It could be assumed that net immigration would increase as a result. However, it also should be noted that actuarial standards of practice require that no change in law should be anticipated. Thus, any assumed difference would have to be made in the other-than-legal immigration assumption. We do not have a basis from which to conclude that there will be a significant change in this source of immigration in the future and as a result conclude that the current aggregate assumption is reasonable.

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**VA4. Disability Incidence and Termination**

**Definition and Impact**

The number of estimated new disability awards are derived by multiplying the estimated disability incidence (or reward) rates by corresponding estimates of Social Security disability insured population not currently receiving benefits. The number of new awards is estimated by single year of age and sex.

Disability termination rates are applied to the population of disabled beneficiaries to determine the number that will cease being disabled due to death, recovery, conversion (to retired status) at normal retirement, or other reason. The number of disability terminations is separately estimated by reason (death, conversion to retirement benefit status, and recovery), sex, and single year of age.

Disability incidence and termination has a large impact on the DI program cost. The higher the disability incidence rates, the higher the program cost, as more benefits will be paid to disabled beneficiaries. The lower the disability termination rates, the higher the program cost, as a greater number of beneficiaries continue to collect benefits.

**Findings**

The disability incidence and termination assumption contains no material defects because of errors or omissions, is individually reasonable, and is in compliance with generally accepted actuarial principles.

**SSA Basis**

The first step in deriving estimates of future disability incidence and termination rates for the DI program begins with an evaluation of historical trends. Incidence rates have varied a great deal over the past twenty five years. From a historically high level of roughly 7.0 awards per thousand in 1975, rates declined to roughly 3.6 per thousand by 1982. Following a gradual upward trend, rates increased to roughly 5.7 per thousand by 1992 and have since followed a gradual downward trend to an estimated 4.7 per thousand in 1998.

Incidence rates are developed through a series of preliminary projections reflecting judgement of the SSA actuaries as to the expected number of awards from non-HIV related impairments. This forms the baseline projection of award rates. HIV incidence rates are separately projected and added to the baseline termination rates to develop one series of expected award rates for each age and sex. As a final step, the projected awards are modified to reflect any relevant recent legislative changes to the DI program.

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For the long-range assumptions, an adjustment is then made to account for the increase in the normal retirement age beginning in the year 2000. An increase in the number of applications for disability are expected due to the increased normal retirement age while, at the same time increasing the reduction for early retirement; this will move more benefits from OASI to DI.

Overall incidence rates are estimated to increase over the next ten years, attributable in part to a disability insured population more heavily weighted toward higher incidence ages (50-64). Without regard to the scheduled increases in the NRA, rates are estimated to increase from the 4.7 awards per thousand in 1998 to 5.5 per thousand by 2008, with the adjustment for the scheduled increase in the NRA accounting for an additional .4 awards per thousand by 2008. The overall rate is expected to continue to increase until it reaches 7.2 per thousand in 2027 (with an ultimate rate of 7.3 attained in 2071).

Ultimate age-specific rates, assumed to be in effect in years subsequent to 2013, are based on judgement. Experience is expected to be just as much a function of future law and administration changes as a function of the economy, although it is clear that the increase in the likelihood of awards (and decrease in likelihood of recovery) as age increases should continue to hold.

In the short-range, termination rates are projected by termination reason. Two notable developments that may affect termination rates due to mortality are a significant recent reduction in awards due to HIV impairment and elimination of current and future disability benefits for alcoholics and drug addicts. Both of these disability categories have had significantly higher death rates than the overall disability population, but are relatively small in number compared to the total disabled workers in the population.

The pattern of recovery rates reflect the actual or expected number of terminations from return to work and workload estimates supplied by the SSA Office of Disability and Budgetary Constraints affecting the anticipated number of continuing reviews scheduled in the future.

The death rates for those collecting disability benefits reach levels in 2073 used generated by the long-range model are approximately 55% lower for males and 44% lower for females than those experienced by disabled workers during 1977-80, the period which currently is used in the long-range model (a recent study forms the basis of the short-range model). The overall recovery rates for both males and females are assumed to increase until 2013, when they attain ultimate levels which are 50% lower than the rates experienced during the period 1977-80. Projected increases in the recovery rates reflect the estimated effect of the periodic reviews required by provisions of law first enacted in 1980 and amended in 1983, 1984, 1990 and 1996.

**Approaches Used by Others**

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In Canada's CPP and OAS reports, the projected disability incidence assumption reflects recent experience, as well as recent changes in the law that significantly changed the qualification requirements. The disability incidence assumption for the QPP is projected based on experience between 1993 and 1995. The methodology used in the U.K. was not available.

**Significant Conclusions of the Last Two Technical Panels**

The following are the significant conclusions of the last two technical panels regarding the disability assumption:

- 1991 Technical Panel made no recommendations for changing the present disability assumption.
- 1995 Technical Panel recommended (1) periodic updating of the age / sex distribution baseline assumption for disability incidence and termination rates, (2) consideration be given to the use of different categories of disability, and (3) explicit recognition be given in disability analysis and projection to the effect of unemployment and of claims administration.

**Discussion**

Disability incidence and recovery projections and the state of the economy are only linked through labor force participation and unemployment rates as they affect the disability insured population. Although conceptually one would think that they should be directly related, historical experience has not showed this to be the case. Further observation is warranted as experience unfolds to determine whether such links exist.

Unlike mortality, disability incidence and recovery are not projected by cause (other than for HIV). Consideration should be given to evaluate whether such an assumption is warranted.

The data used to develop the age / sex distribution of disability incidence and termination rates is dated (most recent available year is 1984 to 1986 for incidence rates and 1977 to 1980 for terminations).

The disability incidence and termination rates may be affected by future changes to health care coverage provided by the federal government.

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**VA5. Marital Status**

**Definition and Impact**

For the purpose of the SSA projections, marital status reflects both marriage, defined as the combination of a male and a female into a couple, and divorce, defined as the separation of a previously married couple.

Marriage and divorce rates affect the OASDI cost estimates in several ways because various characteristics of the population are assumed to vary by marital status, such as labor force participation rates (especially for women, but also for men at older ages). Also, the levels of marriage and divorce affect the projections of auxiliary benefits (such as non-contributing spouses who are eligible for OASDI benefits on the basis of their spouse's contributions). Divorce rates impact the calculation of auxiliary benefits because, through divorce, one individual may have multiple partners, all of whom may claim OASDI benefits as a result of marriage to an individual if certain conditions are met.

Given current and anticipated labor force participation rates (most married or divorced beneficiaries of the OASDI program are determined by their own earnings and contributions), variations in the marriage and divorce assumptions do not appear to materially affect the OASDI program cost. Note that there are no available sensitivity analyses to confirm this presumption.

**Findings**

The marital status assumption contains no material defects because of errors or omissions, is individually reasonable, and is in compliance with generally accepted actuarial principles.

**SSA Basis**

Data on new marriages is collected from the NCHS in the Marriage Registration Area (MRA) for calendar years 1957 through the most recent date available by age of the husband crossed with age of the wife. SSA actuaries estimate that this data accounts for approximately 90% of all marriages in the U.S. From this data (along with the standard population data provided by the Bureau of Census), the SSA actuaries determine central marriage rates by age of husband and wife. These rates are based on the ratio of the number of marriages to the geometric mean of the number of unmarried males and females for each age combination (in five year age groups).

Because of uncertainty as to whether marriage rates will increase or decrease, the SSA actuaries assume future age-adjusted rates of marriage for the Social Security Area would

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continue to decrease to approximately 95% of the current level in twenty five years and remain constant thereafter.

To obtain the age-specific rates for husband and wife for a projection year, the historical rates were averaged, graduated and proportionally ratioed so as to produce applicable age-adjusted rates. A projection of age-specific marriage rates was not done separately for each previous marital status (single, divorced, widowed).

Data on divorces in the Data Registration Area during calendar years 1979 through 1988, by age group of husband crossed with age group of wife, were obtained from the NCHS. This data was adjusted to reflect the entire Social Security area because the data was estimated to cover half of all divorces in the U.S. Each age group was correspondingly adjusted and ratioed to the number of existing marriages by age of the husband and wife in the Social Security area. The divorce rates were estimated using the 1979 to 1998 data and provisional data estimating the total divorces in the U.S. for 1989 to 1998.

Because the divorce rates have remained fairly constant over the last ten years, the SSA actuaries have assumed the age-adjusted rate would remain close to the level recently experienced for the entire measurement period.

**Approaches Used by Others**

The U.S. Census Bureau projects that the age at first marriage will continue to increase, but at a slower pace than previously. In addition, they expect the leveling off and recent slight declines in the divorce rates to continue into the future. CPP projections incorporate the actual distribution of the Canadian population by age and sex during 1988 through 1997, with some ratioing conducted to match currently reported distribution by marriage status.

**Significant Conclusions of the Last Two Technical Panels**

The following are the significant conclusions of the last two technical panels regarding the marital status assumption:

- 1991 Technical Panel recommended that consideration be given to separate marriage and remarriage rates.
- 1995 Technical Panel recommended that the intermediate estimate of marriage rates should be increased from the current age-adjusted central rate of 5,730 to 6,000 per 100,000 unmarried of each sex. In addition, the panel recommended the intermediate estimate of divorce rate be lowered from the current age-adjusted central rate of 2,140 to 2,000 per 100,000 married couples.

**Discussion**

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Several possible refinements to the methodology used are possible, although it is unlikely for them to make a significant impact on the financial condition of the OASDI program. These include separate assumptions as to marriage and remarriage rates, and rates by population segment such as race. In addition, it may be appropriate to update some of the basic experience data used, as it is becoming dated (e.g., the most recent final data is from 1988). In addition, no justification, other than professional judgement, is provided to reinforce the assumption that current levels of marriage and divorce will continue.



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**VB. Economic Assumptions - Introduction**

The 1999TR identifies five groups of economic assumptions used to develop the long-range forecast of the OASDI Trust Fund. These "primary" assumptions are developed from fundamental economic relationships and structures among a secondary group of variables. The table below summarizes the list of the primary and secondary variables used, reflecting in most cases their estimated ultimate annual rates of growth.

<b>Primary Variables</b>	<b>Secondary Variables</b>	<b>As Reported in TR1999<sup>7</sup></b>
Real GDP Growth		1.3
	Annual Growth in Weekly Hours	-0.1
	Annual Growth in Labor Productivity	1.3
Unemployment Rate		5.5
	Real and Potential GDP	N/A
CPI-W		3.3
Wage Growth (nominal/real)		4.2 / 0.9
	Growth in Earnings to Compensation	-0.17
	Growth in Compensation to GDP	0
	Growth in GDP Deflator to CPI-W	-0.1
	Growth in Labor Productivity	1.3
	Growth in Weekly Hours	-0.1
Interest Rate (nominal)		6.3

The ultimate real growth in gross domestic product (GDP) assumption is determined by a combination of three input variables – the size of the full employment labor force, labor productivity, and average labor hours. The projected size of the full employment labor force reflects projected levels of the unemployment rate, which is reviewed briefly. The evaluations of labor productivity and average weekly hours are contained in separate sections of this report.

Unemployment rates are forecasted from an economic relationship among the change in unemployment and several lags of the ratio of real to potential GDP. The 1999TR does not list short-term values of the ratio of real to potential GDP. However, in the long range portion of their projection, that assumes an economy in equilibrium, the ratio is equal to one.

Changes in the cost of living index due to price movements of consumption goods are measured by the consumer price index for urban wage earners and clerical workers (CPI-

<sup>7</sup>The ultimate rate assumptions are listed in the table.

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W). Unlike other primary variables, the ultimate assumption upon which CPI-W is built from historical evidence and judgment.

The assumed growth in wages is developed from the linkages among labor productivity and four economic variables. Both labor productivity and average weekly hours are used to estimate GDP growth. Growth in the ratio of earnings to compensation and the ratio of compensation to GDP are discussed under the wage growth header. The ratio of the GDP deflator to the CPI-W is considered in the cost of living section with the discussion of the CPI-W.

Similar to the construction of the cost of living assumption, the Interest Rate assumption is built from historical evidence and judgment.

In general, the primary variables are created by assuming functional forms and / or inter-relationships among the secondary variables. Using these assumed relationships and the secondary variables as inputs, the primary variables are then derived. The Trustees base most of the projections of the secondary variables upon historical trends and judgments.

The remaining sections in this introduction consider four separate issues pertaining to the economic assumptions. The first discusses an alternative approach to wage growth estimation. The second section reviews the approach SSA follows to construct the full employment labor force. In contrast to the other economic variables, the full employment labor force is formed from an economic identity; as such, there are no economic assumptions involved in the calculation. The third topic discusses some of the inter-relationships among the economic variables. The final section is the influence of the Bureau of Economic Analysis' comprehensive revision of economic statistics upon the assumptions that the Trustees use as a basis for the long-range projections of the OASDI Trust Funds.

In addition, as economies worldwide become increasingly linked, consideration should be given to enhancing SSA's models to reflect expected the applicable future impacts of developments in foreign countries on the U.S. economy.

**Alternative Approaches to Wage Growth Estimates**

There are two generalized approaches that can be used to develop estimates of wage growth that we characterize as direct and indirect approaches. The SSA economists have traditionally taken the indirect approach. They indicate that since the indirect approach is based on more commonly cited and discussed assumptions, it therefore can provide a better form of comparison with projections developed by other U.S. government agencies and to projections made in the private sector. In contrast, both the U.K. and Canadian actuarial projections take the first, or direct, approach. We do not hold a firm opinion as to the superiority of these approaches. However, we believe that it may be valuable to follow both approaches and determine the superiority of one of the methods based on

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resulting values generated by each in the final derivation of the actuarial projections of the OASDI Trust Funds.

**Full Employment Labor Force**

SSA staff computes the size of the full employment labor force with the aid of a set of computer programs known as Model of Earnings and Employment (MODEEM). The first stage involves forecasting cohort labor force participation rates (LFPRs). The LFPRs are generated from a set of fitted equations for each sex and age or age grouping. The second stage is to forecast the civilian labor force as the product of the LFPRs and the population. Population estimates are those derived from SSA's demographic estimates and are taken as exogenous input into the model. The full employment labor force is formed as the product of the civilian labor force and one minus the unemployment rate. Specifically,

$$E_{fe} = LC * (1 - RU)$$

where  $E_{fe}$  denotes the full employment labor force,  $LC$  is the size of the civilian labor force and  $RU$  is the civilian unemployment rate. The size of the civilian labor force is modeled reflecting the demographics projected by SSA. The construction of the unemployment rate is discussed separately.

**Inter-relationship Among Assumptions**

After reviewing each economic assumption individually, it becomes clear that they are all inter-connected. For example, the four variables/assumptions with characteristics of both demographic and economic variables (labor force participation, unemployment, retirement, and disability) are inter-connected and have an influence on revenue through payroll taxes paid and benefits paid (a function of wage levels and when benefits begin). This both points out the difficulty in deriving projections of these variables and that their inter-actions (and there are obviously more of them) need to be considered when setting the assumptions. This should involve not just setting the assumptions (both ultimate levels and those during the prior period), but also considering whether the resulting assumptions make sense when considered together. By necessity, this also requires a significant amount of sensitivity testing and analysis. While such testing and analysis is currently being conducted, additional testing may contribute to the enhancement of the understanding of these variables and improved future assumption-setting.

**Bureau of Economic Analysis (Commerce Department) Comprehensive Revision of Economic Statistics**

On October 28, 1999 The Bureau of Economic Analysis (BEA) released revised estimates of GDP and other national income and product accounts (NIPA) series from 1959 through the second quarter of 1999. The BEA carries out comprehensive revisions about every 4 to 5 years in an attempt to improve, modernize and keep pace with an ever-

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changing U.S. economy. Both the Trustees and the SSA economists rely on these series to assist them in generating their seventy five year projection. In light of the revised economic series, we are no longer able to view several of the long-range economic assumptions as being reasonable.

The BEA revisions impacts the construction of both GDP and wage growth projections. The wage growth assumption relies upon projections of labor productivity, the GDP deflator, the change in labor's share of production, and earnings share of total compensation. The projected growth in GDP will also be influenced by the BEA revisions, primarily because it is a function of productivity. The change in productivity growth is a principle driver of the economic conditions in which the OASDI Trust models are based.

We are unable at this time to recast all of the variables affected by the BEA revisions; however, we can provide an indication of the direction of change. As mentioned above, these revisions will directly impact key factors considered in setting the economic assumptions underlying the projections of real wage growth and potential GDP. The effect of these changes are somewhat offsetting. The BEA revisions will change the projections of real wage growth and potential GDP. The BEA revisions will change the projected values of the input variables in a non-uniform manner. Specifically, for the real wage growth assumption, it is expected that the following input variables will decline due to the BEA revisions – the GDP deflator and the change in labor's share of GDP. It is also expected that labor productivity, an input to both wage growth and potential GDP, will increase. We are uncertain of the impact upon earning share of total compensation. Without the actual data series, we are unable to determine the overall impact of the BEA revisions on two primary economic assumptions – wage growth and GDP growth, both of which are affected by labor productivity.

However, consideration of the labor productivity assumption, independent of the other input variables, is suggestive of the potential influence of the BEA revisions. The Trustees base their productivity assumption upon the past thirty years of economic performance. Only looking at the statistical evidence during this thirty year measurement period, the average productivity growth measured with the revised GDP estimates increases to 1.537 from 1.295 percent. Independent of other variables impacted by the revised BEA measures, the change in projected labor productivity could reduce the expected long-range actuarial deficit by about 0.25 percent of taxable payroll (see page 136 of the 1999TR). As mentioned above, we are unable to measure the full impact of the BEA revisions in the short time available between the time of their announcement and the date of this report. This is in part due to the lack of sensitivity tests of certain of these economic measures in the 1999TR.

The following sections discuss the major economic assumptions involved in the actuarial projections of the OASDI program.

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**VB1. Potential Gross Domestic Product (GDP)**

**Definition and Impact**

Potential GDP or “Full Employment” GDP is defined by SSA as the output (GDP) in constant dollars that the economy would produce with the existing (or expected) plant and technology under assumed conditions of high but sustainable use of the factors of production – labor, capital and natural resources.

Potential GDP impacts forecasted unemployment rates. Greater separation between potential GDP and actual GDP during the initial years of the projection leads to greater changes in the unemployment rate. Beyond the short-range, it is assumed that the economy is operating in equilibrium (i.e., with no economic cycles); actual GDP is thus equal potential GDP. Long-range estimates (post 2008) of real GDP growth contained in the 1999TR are potential GDP growth rates. OASDI revenues are positively related to GDP; however, the secondary variables used to form GDP and wage growth have a greater impact upon the overall forecast of the future financial condition of the OASDI Trust Funds.

**Findings**

The potential GDP assumption contains no material defects because of errors or omissions, is individually reasonable, and is in compliance with generally accepted actuarial principles.

**SSA Approach**

Potential real GDP is constructed as the product of the full employment labor force, average hours per worker, and average rate of labor productivity. More specifically,

$$Q_{fe} = E_{fe} \left( \frac{\text{Hours}}{\text{\#Working}} \right) \left( \frac{\text{ActualGDP}}{\text{Hours}} \right)$$

where potential GDP is  $Q_{fe}$ , the term  $E_{fe}$  measures the size of the full employment labor force, and the ratio of hours worked in the economy (Hours) to the number of employed workers (#Working) captures the average hours per worker in the economy. The ratio of actual GDP to hours is a measure of labor productivity. To generate the growth rate of potential GDP, the Trustees assume the growth rates of average hours per worker and the growth rate in labor productivity, while SSA forecasts the rate of change in the size of the full employment labor force. The growth rate in average hours and labor productivity are considered separately below.

**Approaches Used by Others**

Other approaches that have been used include:

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- Canada. The CPP/OAS projections use GDP as basis for comparison of OAS cost, since benefits are financed through general revenues and not on the basis of employment earnings. Historical GDP is compared to historical total employment earnings for Canada for the period 1966 to 1997. Such a comparison reveals that on average GDP has been, over that period, about 2.04 times total projected employment earnings. For this reason GDP was projected as total employment earnings multiplied by an experience adjustment factor. This adjustment factor is graded from its 1997 level to an estimated ultimate level over 5 years.

**Significant Conclusions of the Last Two Technical Panels**

Prior Technical Panels did not make separate significant conclusions regarding the GDP assumption.

**Discussion**

Forecasts of potential GDP by the Congressional Budget Office (CBO) for the year 2009 are in contrast with the SSA projection for the same year. The CBO projection for 2009 is 2.8 percent for growth in potential GDP while the SSA projection is 1.8 percent growth. Years prior to 2009 are not comparable since SSA does not report potential GDP during their "short range." A comparison of the projections for years beyond 2009 is not possible since CBO does not report projection of potential after 2009. Although an in-depth analysis of the differences between these projections is beyond the scope of this report, we have identified two general differences between the two approaches:

1. In contrast to the aggregate approach taken at SSA, the CBO has built their projections from a sectoral approach. Employing a sector approach may make more refined projections possible.
2. The CBO methodology explicitly includes capital, while the SSA methodology implicitly includes capital. Under the assumption that factor productivity is constant in the long run, the importance of explicitly including capital is a less tenuous assumption. However, the theoretical construct of the long run may be less appropriate when applied in a policy setting beginning in the tenth year of a projection.

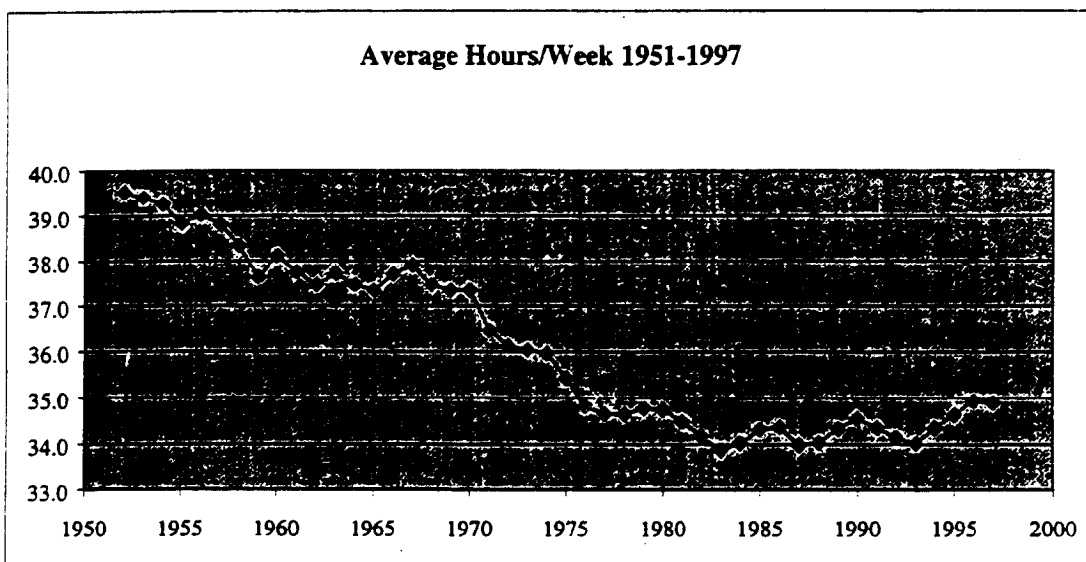
In summary, the SSA projection of potential GDP could be refined with a more explicit role for capital, as well as adopting a sectoral approach.

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**VB2. Average Weekly Hours**

**Definition and Impact**

Average weekly hours are computed from aggregate annual data. Nationwide aggregate hours worked is divided by the sum of civilian employment and military personnel to generate average annual hours. This measure is then divided by 52 weeks to arrive at a weekly measure. A larger number of average weekly hours result in greater potential GDP and real wage growth.



Source: OCACT of the SSA (Annual Hours/Annual Civilian & Military Employment)\*(1/52)

**Findings**

The average weekly hour assumption contains no material defects because of errors or omissions. Although we believe that it is unlikely that average hours will decline at a rate of 0.1 percent annually for the next 75 years, the assumption is reasonable by the criteria used in this report, as the assumed decline in the average work-week does not contribute to significant actuarial gains or losses. Therefor we see that the average weekly hours assumption as reasonable, although we would have preferred either a smaller decline or a decline for a shorter time period.

**Approaches Used by Others**

Other approaches that have been used include:

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- Canada. It appears that the CPP/OAS projections utilize a similar methodology.
- U.K. There is no indication that an average weekly hours assumption is used for the National Insurance Fund Long Term Financial Estimates.

**Significant Conclusions of the Last Two Technical Panels**

The following are the significant conclusions of the last two technical panels regarding the average weekly hours assumption:

- 1991 Technical Panel did not investigate in detail the average hours assumption; however, they did recommend that more research into the assumption would be appropriate.
- 1995 Technical Panel did not evaluate the average weekly hours assumption in detail.

**Discussion**

Historically, the average number of hours worked per week and the implied growth rate in hours is neither stable nor linear. The series experiences multiple structural breaks. During the past twenty five years the length of the work-week fluctuated between 34 and 35 hours. During this period the change in the average work-week approximates zero. The late sixties to the mid-seventies experienced a steep decline in hours. Inclusion of pre-1976 observation into the trend calculations will produce a smaller trend. Clearly, the measurement observation horizon determines the ultimate assumed value.

The assumption of a linear decline (constant annual reduction) in the workweek leads to a seemingly unrealistic projection. The Trustees assumption of a 0.1 percent annual decline is applied to a baseline of thirty five hours per week in 2008, would result in an average work week of thirty four hour average work-week – a fifty year historic low as observed in 1983. Continuing into the future, by 2063 the workweek would have shrunk one more hour to 33 hours per week. In the final year of the forecast, the Trustees expect the average workweek to equal 32.7 hours. Alternative non-linear projection methods, such as splines (separate linear trends for periods separated by structural breaks) should be considered.

Additional research is required to better understand the changes in the average duration of the work-week. By construction, the measure of average weekly hours is sensitive to the prevalence of part-time work in the economy. Identifying the factors that lead to transitions from full-time work to part-time work, as well as part-time work to full-time work could aid in refining the average weekly hours projection. Current efforts should include building the average weekly hours assumption on an age and sex basis by full-time and part-time status.



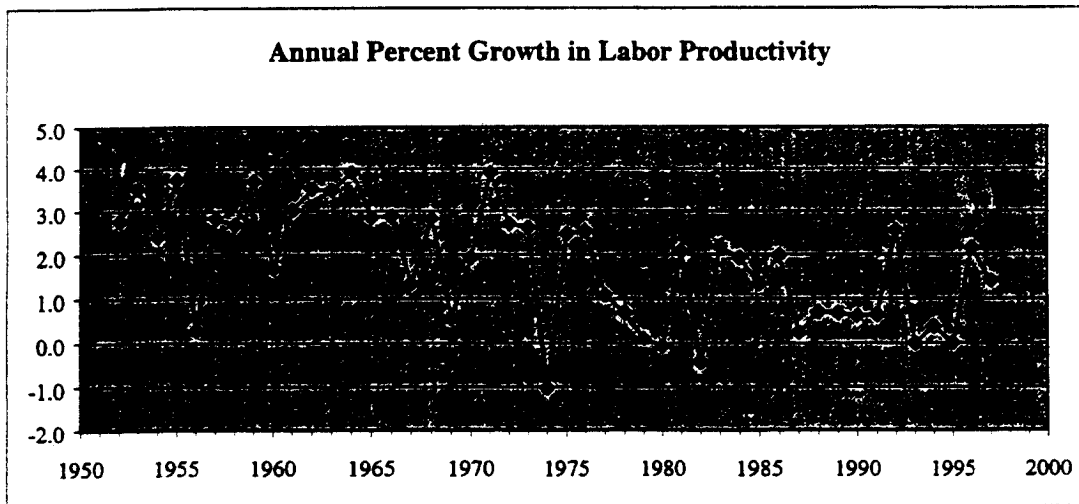
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**VB3. Labor Productivity**

**Definition and Impact**

Labor productivity is defined as the average dollar amount of real GDP produced per hour of labor input (real GDP/hour). The Trustees assume that the ultimate growth rate in labor productivity is 1.3 percent per year. The growth rate is calculated as the annual change in the ratio of real GDP to hours worked. The labor productivity measure is quite important in its impact on both the potential GDP and the wage growth assumption. Wage growth directly influences revenues, which in turn affects future benefits.

Historically, the maximum annual labor productivity growth rate has been about four percent, with a historical low of -1.0% in the 1973-1974 period. The Trustees assume that the past thirty years of labor productivity growth rate closely reflects the rate during the period 2008 to 2075. The choice of a thirty year period over which to average labor productivity growth is purely subjective.



Source: OCACT of the SSA

**Findings**

The labor productivity assumption included in the 1999TR contained no material defects because of errors or omissions at the time of its determination and is in compliance with generally accepted actuarial principles. On October 28, 1999 the Bureau of Economic Analysis (BEA) released revised estimates of GDP and other national income and product accounts (NIPA) series from 1959 through the second quarter of 1999. These revised measures paint an improved picture of the economy and the overall health of the

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OASDI Trust Funds. It is our opinion that the productivity growth assumption made by the Trustees' should be revised upwards accordingly.

**Approaches Used by Others**

Other approaches that have been used include:

- Canada. The CPP/OAS reports suggest that a similar methodology was used.
- U.K. There is no indication that a labor productivity assumption is used in the development of the National Insurance Fund Long Term Financial Estimates.

**Significant Conclusions of the Last Two Technical Panels**

The following are the significant conclusions of the last two technical panels regarding the labor productivity assumption:

- 1991 Technical Panel recommended that the methodology employed in building the labor productivity projection consider the recent past more heavily than the distant past. The Panel recommended a weighted, rather than a simple, average to measure average labor productivity growth.
- 1995 Technical Panel offered a split opinion on labor productivity. One view was that the experience of the previous twenty years is the best forecast of the experience to be expected over the next seventy five years. The other view presented was that the 1973-93 period was an aberration and that the economy would return to a higher growth path over the long term.

**Discussion**

The Trustees' choice of a thirty year historical average lacks methodological justification. Ideally, in choosing the period over which to average or base a trend upon to approximate the long run steady state rate of labor productivity, one might wish to discount observations during rare events or structural breaks. During 1973-1974, a structural break occurred, resulting in pre-1973 and post-1974 labor productivity growth rates that are inconsistent. Inclusion of pre-1973 years into the average increases the ultimate rate while exclusion of those years tends to decrease the ultimate rate. The post 1973-74 average is closer to 1.0 percent, rather than 1.3 percent including that period. The choice of time interval, as well as whether or how much weight is given to more recent observations, are both important when choosing a trend.

The Trustees' use of an aggregate nation-wide labor productivity growth trend in contrast to building a labor productivity measure from the underlying sectors overlooks important dynamics of the economy. A weakness of projecting the aggregate labor productivity

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trend based solely upon aggregate data is that trends in secular growth are assumed to equal the average. Actually, the economy is composed of several economic sectors, each contributing a different percentage of the economy's output (GDP). Labor productivity growth differs across sectors and through time. Through time, growth in each sector as well as the labor productivity rates can be expected to change. Building the labor productivity growth rate from the sectoral approach is more heuristic and common in the economic literature. For example, using a sectoral approach, the CBO projects annual 1998-2009 labor productivity growth at 1.7%<sup>8</sup>.

Basing the labor productivity growth rate upon historical information in the absence of expected future demographic shifts lacks foresight. The expected demographic shifts will certainly impact labor productivity growth. As the baby boomers exit the workforce, secular changes in the economy will follow. For example, on the demand side, health care consumption could increase at the expense of durable goods. This could lead to an increase in the size of what has been generally accepted to be a less productive health care sector and a reduction in the size of the more productive manufacturing sector. On the other hand, a relatively smaller workforce could increase efficiency. Additional research is needed to evaluate the impact of the demographic shifts upon labor productivity.

The Trustees' economic methodology used as a basis of choosing the ultimate labor productivity growth rate of 1.3 could be enhanced. As indicated above, the choice of an appropriate period to define the trend is purely arbitrary. The aggregate approach clearly misses dynamic aspects of the macro-economy. And the consideration of the expected demographic tilt lacks qualification. Enhancements of the model used in these areas would refine the calculation of the productivity measure.

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<sup>8</sup>CBO, "The Economic and Budget Outlook: An Update, July 1, 1999"

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### VB4. Unemployment Rates

#### Definition and Impact

The unemployment rate is calculated for forecasts until 2008 as the difference between total civilian labor force and total civilian employment. This calculation is altered to include age and sex adjustments for the remainder of the forecast period. Independent of the other economic variables and the economy on the whole, lower levels of unemployment would increase the number of workers in the economy and increase OASDI revenues (and later, benefits). However, unemployment below the equilibrium rate will tend to increase inflationary pressures. Overall, the long range unemployment rate assumption has relatively little effect on the cost of the program, primarily due to the assumption of a long-range economy operating at an equilibrium level.

#### Findings

The unemployment rate assumption contains no material defects because of errors or omissions, is individually reasonable, and is in compliance with generally accepted actuarial principles.

The Trustees assumption of an ultimate 5.5 percent of unemployment is reasonable.

#### SSA Basis

Unemployment rates are forecasted from an economic relationship between the change in unemployment and several lags of the ratio of real to potential GDP. This methodology is in the spirit of Okun's Law (1962). Okun considered the relationship between actual output (GDP) and unemployment. SSA staff has modeled unemployment as a function of the ratio of real to potential GDP. Specifically, the change in unemployment is modeled as a function of changes in real GDP to potential GDP defined as:

$$\Delta(RU_t) = \beta_1\Delta(RTP_t) + \beta_2\Delta(RTP_{t-1}) + \beta_3\Delta(RTP_{t-2}) + \beta_4\Delta(RTP_{t-3}) + \beta_5(1986\_1987\_dummy)$$

where  $\Delta$  is the difference operator, such that  $\Delta(RU_t) = RU_t - RU_{t-1}$ , and  $RU_t$  is the civilian unemployment rate at date  $t$ . The variable  $RTP$  is equal to the ratio of real GDP to potential GDP for the current time period and lagged for three-quarters of a year, and the 1986-87 dummy is used to capture an unexpected event in 1986-1987.

SSA uses several data sources to estimate the above equation. Unemployment rates are from the Bureau of Labor Statistics, Employment and Earnings. The real constant dollar GDP92 is from the Bureau of Economic Analysis, Survey of Current Business, and the potential GDP series is from Congressional Budget Office, Unpublished Data. The relationship is estimated by age and sex cohorts – for each cohort, the dependent variable reflects the change in unemployment for that cohort, while the independent variables remain the same. The weighted sum of the coefficients for each of the age / sex cohorts is approximately fifty. The proportion of each cohort in 1998 to the total labor force

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defines the weights. For a decline in RTP of 0.01, the unemployment rate will increase by 0.5 percentage point. For example, if RTP changes from 1.02 in the first year to 1.01, and the initial unemployment rate is 4.0, then the forecasted unemployment rate would equal 4.5.

The change in unemployment from 1999 to 2000 is imputed by entering both known and forecasted values of RTP into the fitted equation. Notice that in the  $\Delta(RU_t)$  equation, there are three lagged values of RTP required to compute the change in unemployment. Therefore, the change in unemployment from one year to the next year only requires imputing past values of RTP. Known values of actual GDP are from the BEA (NIPA), and known values of potential GDP are from the CBO. In the following year, calculating the change in unemployment requires both known (or past) values and future values. The forecasted values of potential GDP are computed by SSA's potential GDP model, and the forecasted "actual" GDP values are from OMB's forecast.

#### **Approaches Used by Others**

Other approaches that have been used include:

- **Canada.** According to the documentation of the CPP/OAS projections, unemployment rates are calculated directly from employment rates. In this manner, employment levels are reflected in the actuarial projection through the assumption made regarding the proportions of the population, by age and sex, who have earnings in a given year.
- **U.K.** According to the projection methodology used in the U.K., projecting unemployment rates are not necessary.

#### **Significant Conclusions of the Last Two Technical Panels**

The following are the significant conclusions of the last two technical panels regarding the unemployment assumption:

- 1991 Technical Panel did not review the unemployment assumption.
- 1995 Technical Panel evaluated the employment assumption, and recommended maintaining the current unemployment rate assumption.

#### **Discussion**

As the economy moves toward its long run equilibrium level, the ratio of real to potential GDP approaches unity and the computed change in the unemployment rate moves toward zero. The amount of time it takes the economy to move toward its steady state is

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determined by the initial difference between real to potential GDP. If the economy is operating at the level where real output equals potential GDP, then SSA's methodology could arrive at the ultimate in as few as three years. Arriving at the full employment unemployment rate early in the seventy five year projection is a weakness of this methodology. Under this condition, the business cycle component in the model is nullified during the short-range measurement period.

The SSA short-range unemployment forecasts are in line with other government agencies.

<u>YEAR</u>	<u>SSA</u>	<u>CBO 10/15/99</u>	<u>OMB-2000 Budget</u>	<u>CBO-From OMB 2/99</u>	<u>Mid Session</u>
1999	4.6	4.3	4.8	4.6	5.0
2000	4.9	4.2	5.0	5.1	5.2
2001	5.1	4.5	5.2	5.4	5.4
2002	5.3	4.8	5.3	5.6	5.4
2003	5.4	5.1	5.3	5.7	5.4
2004	5.4	5.3	5.3	5.7	5.4
2005	5.5	5.4			
2006	5.5	5.5			
2007	5.5	5.5			
2008	5.5	5.5			

The OMB forecasts are from the 2000 Budget (released in February 1999) while both the estimates from SSA and OMB contain additional quarters of information. Further, much of the difference among the estimates is explainable due to differences in the methodology applied. SSA builds their unemployment estimates from a bottom up methodology; recall that the Okun equations are estimated for several age / sex cohorts, while the other agencies' approaches reflect a more aggregate approach.

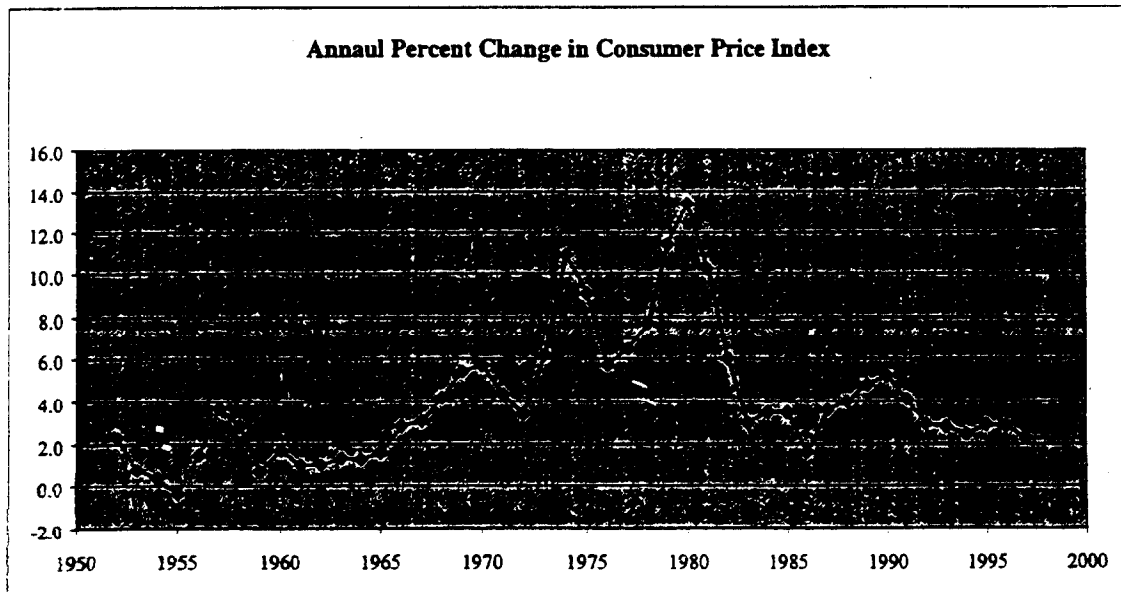
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**VB5. Cost of Living**

**Definition and Impact**

Changes in the cost of living index due to price movements of consumption goods is measured by the consumer price index for urban wage earners and clerical workers (CPI-W). Benefit payments are linked to the CPI-W, in addition, changes in the CPI-W influence the projection of real wage growth. The Trustees assume that the inflation rate increases gradually from the current 2.9 percent CPI-W to the ultimate annual rate of 3.3 in 2007.

The SSA actuaries are faced with the challenging task of developing projections of future price movements -- the inflation rate. The Trustees project the GDP price deflator to be 0.1 percentage point lower than the CPI. Given this assumption, the CPI-W can be derived backwards. Historical averages of the CPI-W can be used to observe trends. However the Federal Reserve's position can strongly influence both current and future inflation rates. The Trustees report that the effect of each 1.0 percentage point increase in the rate of change assumed for the CPI is an increase in the long range actuarial balance of about 0.23 percent of taxable payroll.



Source: OCACT of the SSA

**Findings**

The cost of living assumption contains no material defects because of errors or omissions, is individually reasonable, and is in compliance with generally accepted actuarial principles.

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**Approaches Used by Others**

Other approaches that have been used include:

- Canada. Price increases are measured by changes in the Canadian Consumer Price Index (CPI). According to the CPP review, the long-range outlook for inflation is forecasted based on historical trends and judgement. The rates of price increase are assumed to increase uniformly from 1.0% in 1998 to their ultimate level in 2003. The QPP did not offer insights into the projection of inflation rates.
- U.K. The U.K. actuarial report did not discuss the methodology used in developing their inflation rate projections, other than they were based on historical experience and judgement.

**Significant Conclusions of the Last Two Technical Panels**

The following are the significant conclusions of the last two technical panels regarding the inflation assumption:

- 1991 Technical Panel offered two suggestions. The panel suggested that private sector estimates of inflation should be used to ensure objectivity. In addition, they stated that it is important to develop assumptions on the basis of a relatively objective process.
- 1995 Technical Panel evaluated several measurement issues within the CPI. Although measurement biases were identified and believed to, on net, change the inflation rate, the Panel suggested no change overall.

**Discussion**

The Bureau of Labor Statistics (BLS) frequently modifies its methodology to compute the CPI. Although SSA attempts to recast the CPI-W to account for these methodological changes, any lag in the SSA's efforts impacts the projection. If and when SSA fails to recast the series given revisions in the series, the historical average is incorrect. Further, BLS announces modifications well in advance of the actual change to the series. Incorporation of this information into the Trustees' projections should follow. In some cases, the timing of BLS revisions do not permit incorporation into the Trustees' reports. If this is the case, textual notification of the expected revisions should be included in the report.

The Trustees report a 0.2 percent reduction in their projection due to the methodological change in measuring the CPI-W as mentioned by BLS in 1998. In the 1999 Economic



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Report of the President several revisions to the CPI-W since 1995 are listed -- in total equaling a reduction of -0.44 percent in pre-1999 and -0.24 percent decrease in the CPI for the years 1999 and beyond.

SSA adjusted their ultimate projection for CPI growth in 1996. Approximately 0.2 percentage point reduction was made for methodological changes at BLS. In addition, the assumed future rate of growth in the CPI has been reduced by 0.3 percentage point based on historical analysis and expected future trends by SSA. In total, SSA decreased their ultimate inflation rate by 0.5 percentage point in 1997. In the 1999TR, the inflation rate was reduced by a further 0.2 percentage point as discussed above. The overall reductions incorporated by SSA equals 0.7 percentage points since 1996. This closely approximates the changes mentioned in the 1999 Economic Report of the President.

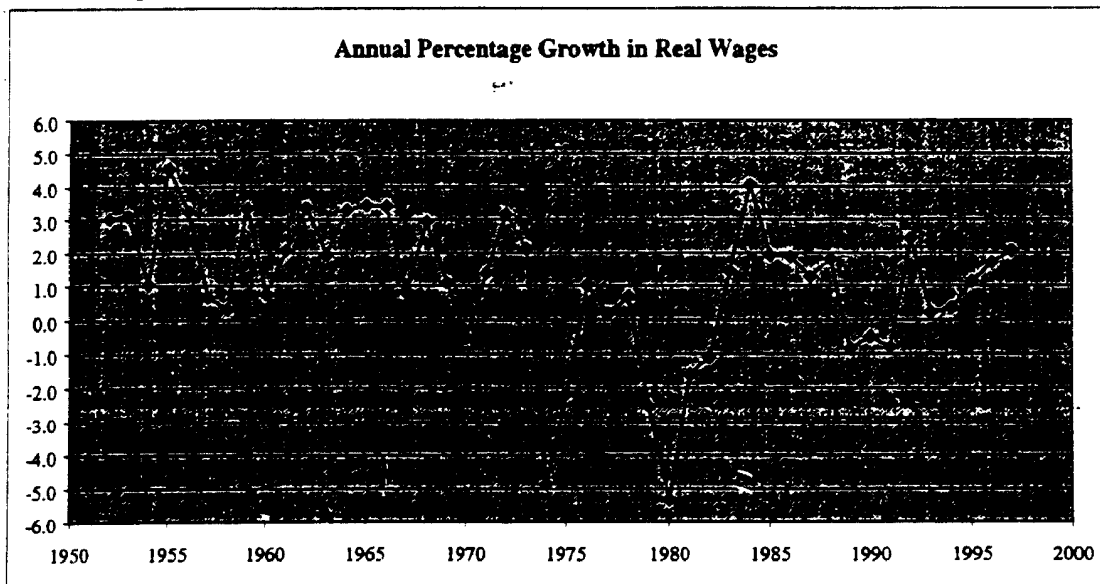
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**VB6. Wage Growth**

**Definition and Impact**

Growth in wages is defined as the annual rate of change in the average wage in covered employment. The Trustees assume a decrease from the estimated 5.7 percent increase for 1998, to a projected rate of increase of 2.9 percent for 1999, both in nominal terms. During the period 1999 to 2008, wage growth is assumed to average 3.7 percent nominally. The ultimate nominal rate of 4.2 percent, or 0.9 percent in real terms, is reached after 2010.

Wage growth generates increasing levels of revenues into the OASDI program followed after a number of years with wage-related benefits. Increasing values of wage growth also tend to increase inflationary pressures. In an attempt to hold constant the inflationary impact of wage growth, the real-wage differential metric of growth is used. The real-wage differential is the difference between the percentage increases in the average annual wage in covered employment and the average annual CPI<sup>9</sup>. According to the 1999TR, each 0.5 percent increase in the assumed real-wage differential increases the long-range actuarial balance by about 0.51 percent of taxable payroll.



Source: OCACT of the SSA

**Findings**

<sup>9</sup>The differential is defined as  $[(1+\text{wage growth rate}) \cdot (1+\text{inflation rate}) - (1+\text{inflation rate})]$ . Therefore, the assumed numerical value of the differential implies a slightly smaller numerical value of the real wage growth rate.

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The wage growth assumption contains no material defects because of errors or omissions, is individually reasonable, and is in compliance with generally accepted actuarial principals.

The Trustees assume that the average annual real wage growth is equal to 0.9 percent. In light of the above comments on the linkages to real wage growth the Trustees' projection is somewhat below our best estimate.

**SSA Basis**

There are two methods employed to determine wage growth. The first method projects wage growth directly from historical average real covered earnings for all workers, wage and salary workers, and the self-employed. The second method estimates the growth in labor productivity and then the "linkages" between labor productivity and wage growth. SSA considers both methods, yet focuses more attention upon the labor productivity/linkage method.

In the labor productivity method, average real earnings are computed as the product of several variables, namely,

$$\text{Real weekly earnings per worker} = \text{Prod} * \text{Comp2GDP} * \text{Earn2Comp} * \text{AveHWk} * \text{GDPd2CPI}$$

Where the terms in this equation are defined as follows:

- Prod (labor productivity) is the ratio of real GDP to average labor hours
- Comp2GDP (labor's share of output) is the ratio of worker compensation to real GDP
- Earn2Comp (earnings share of total compensation) is ratio of wage earnings to total compensation
- AveHWk is the average hours working per week
- GDPd2CPI is the ratio of the GDP deflator to the CPI-W.

Although many of these data series are reporting in annual terms, weekly averages are formed by dividing by fifty two weeks.

From this constructed historical series of linkages the annual growth rate of change is computed. In addition, wage growth is approximated as being the sum of the growth rates of the linkages. Actuarial Study 108 (Table 10) reports the residual or difference between historical wage growth and the implied wage growth from the above equation for selected periods as close to zero.

Labor productivity, average hours worked per week and the ratio of the GDP deflator to the inflation measure CPI-W are discussed in prior sections of the review. The following

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sections evaluate the two remaining assumptions and the final assumption of real earnings growth.

**Approaches Used by Others**

The methodology used in actuarial projections of our two benchmark countries:

- **Canada.** The CPP projections assume Canada's real-wage differential will experience an increasing trend until 2003 when it reaches 1.0% (for QPP, it was 1.2%), which is somewhat below its long-term historical average, which has demonstrated a pattern similar to that in the U.S. – over the last seventy four years it was 1.54%, the last fifty years it was 1.57%, and the last twenty five years it was 0.29%. The selection for both the CPP and QPP programs were based on judgment and historical experience, also similar to the basis for the OASDI projections.
- **U.K.** The U.K. directly projects real wage growth based on a study of historical real wage growth within the country. The GAD has found that historical experience in U.K. leads to the conclusion that such growth has been more stable than a measure such as growth of GDP. Thus, the study of their country's experience has led them to the conclusion that this more direct approach provides a better methodology than going the route of the multiple number of estimates involved in projecting GDP growth and related linkages necessary to project real wage growth indirectly.

**Significant Conclusions of the Last Two Technical Panels --** See the discussion on the components to the wage growth assumptions elsewhere in this report.

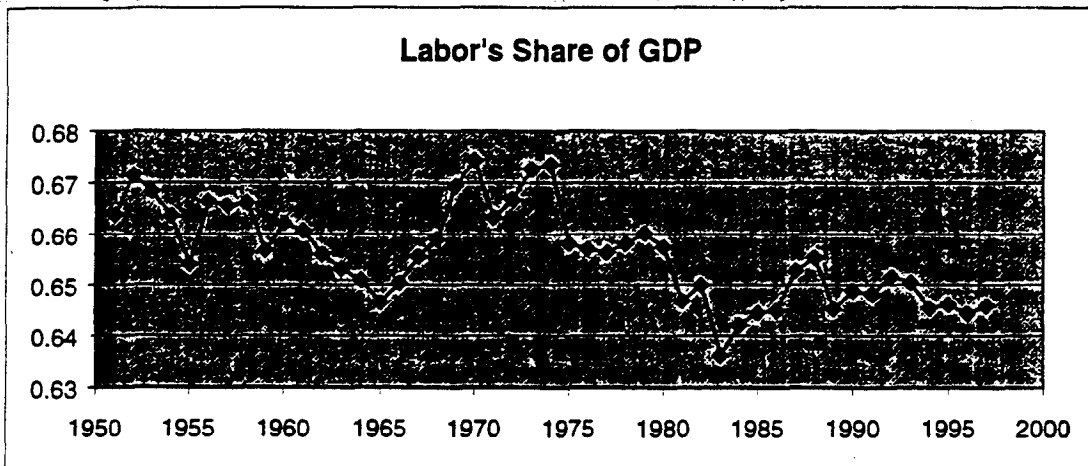
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VB7. Labor's Share of GDP

**Definition and Impact**

Labor's share of GDP is defined as the ratio of total labor compensation to GDP. Total labor compensation includes wage and salary income plus sole proprietor farm and non-farm income. Increasing growth in labor's share of GDP could increase OASDI revenues. The Trustees assume a zero rate of change in labor's share of compensation. Historically, labor's share peaked in the 1970s at greater than 67%, and declined to a low of 63.5 percent during the early 1980s.



Source: OCACT of the SSA

**Findings**

The labor's share of GDP assumption contained no errors or omissions at the time of its determination and is in compliance with generally accepted actuarial principles. On October 28, 1999 the BEA released revised estimates of GDP and other NIPA series from 1959 through the second quarter of 1999. The labor's share of GDP assumption is influenced by the October BEA revisions. Labor's share is expected to decline due to the upward revision in the BEA GDP series. However, without further empirical work, we are unable to determine the impact upon the growth rate in labor's share of total compensation. Further, the growth rate in labor's share directly influences the wage growth assumption. Thus, we are unable to fully evaluate the impact upon the wage growth assumption due to the BEA revisions.

**Approaches Used by Others**

Other approaches that have been used include:

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- Canada. Since neither the QPP nor the CPP projections require this assumption to develop their projections, no explicit assumption with regard to labor's share of GDP was made.
- U.K. This assumption is not required for their projections.

**Significant Conclusions of the Last Two Technical Panels**

Prior Technical Panels did not reach specific conclusions on the labor's share of GDP assumption.

**Discussion**

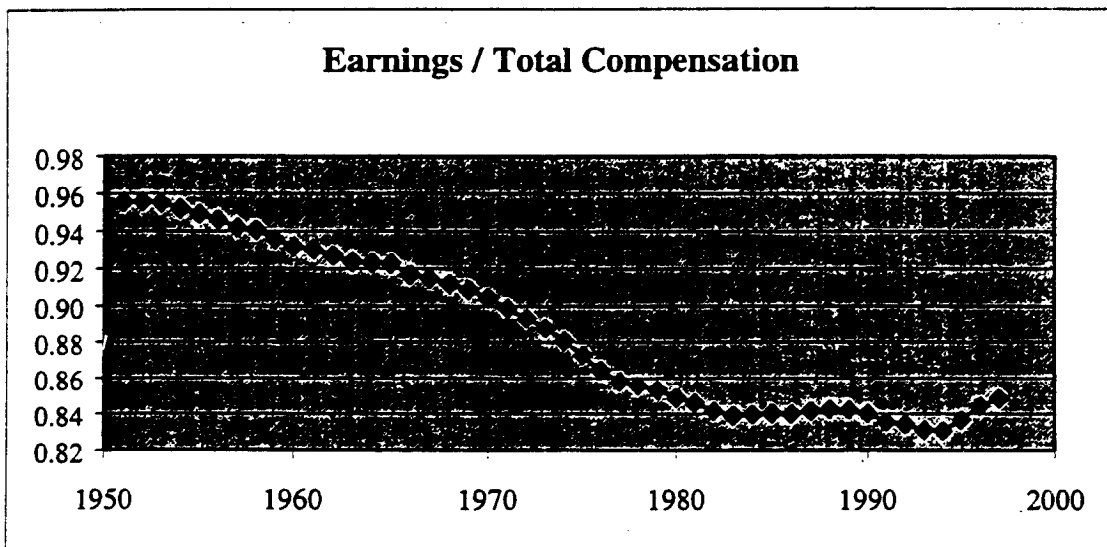
The average year to year change in labor's share over the 1950 to 1997 period is less than 0.0004. Some economists attribute the recent decline in labor's share of total GDP to growth in the housing sector (low labor share) relative to the government sector (high labor share). Although labor's share of total GDP is not mathematically constant, the assumption of zero change is a common economic assumption.

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**VB8. Earnings Share of Total Compensation**

**Definition and Impact**

Earnings (wages) share of total compensation is assumed to decline by 0.17 percent annually. Growth in fringe benefits relative to wages is well documented. Non-wage compensation consists of employer contributions to health insurance, private pensions and the employer's share of FICA taxes.



Source: OCACT of the SSA

**Findings**

The earning share of total compensation assumption contained no errors or omissions at the time of its determination and is in compliance with generally accepted actuarial principles. On October 28, 1999 the BEA released revised estimates of GDP and other NIPA series from 1959 through the second quarter of 1999. This assumption is influenced by the revisions in these economic series. Earnings' share of total compensation is used to forecast the wage growth assumption. Currently, we are unable to fully evaluate the impact of the revisions upon earning's share of total compensation and therefor the real wage growth assumption.

The recent up-tick in the earning share to total compensation ratio may have been due to a few years of below historical average medical insurance cost growth, which is expected to change. Without additional research, the Trustees' assumption of a 0.17 annual percent decline is difficult to disagree with, excluding the above-mentioned re-measurement issue. Given innovations to both compensation practices and the changing face of the U.S. health care system, recent observations should be weighted more heavily

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than pre-1980 observations; if this were done, a smaller decline should be anticipated, therefore increasing real wage projections, but most likely not by a material amount.

**Approaches Used by Others**

Other approaches that have been used include:

- Canada. Since neither the QPP nor the CPP projections require this assumption to develop their projections, no explicit assumption with regard to labor's share of GDP was made.
- U.K. This assumption was not required for their projections.

**Significant Conclusions of the Last Two Technical Panels**

The following are the significant conclusions of the last two technical panels regarding the growth in earnings share of total compensation assumption:

- 1991 Technical Panel did not investigate this assumption in detail; however they did suggest that more research relating to fringe benefits would be useful.
- 1995 Technical Panel did not offer specific conclusions on the earning to compensation assumption.

**Discussion**

Innovations in compensation and changes in health insurance directly influence this ratio. Projecting the change in earnings to compensation is complicated further by the increasing use of stock option plans by employers to retain employees. The delay in exercising options can generate potential timing differences in measuring earnings to compensation. In conjunction with the increasing prevalence of more flexible pay (e.g. the use of bonuses and pay for performance), liquidity constrained employees may exercise their stock options to smooth out earnings. This would tend to increase the earnings to compensation ratio. Due to the likelihood that stock options are permanent additions to compensation packages, and the increasing prevalence, this aspect of the earnings share of total compensation may merit further exploration.

Although the 1999TR is written in a policy constant framework, fringe benefits are perhaps more sensitive to federal income tax policy than OASDI taxes. Easing of income tax rates could potentially reduce the participation rate in some fringe programs -- specifically when the firm offers matching contributions.



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**VB9. Retirement Rates**

**Definition and Impact**

Retirement rates are used to determine when workers begin collecting OASI retirement benefits. Those collecting DI benefits begin receiving retirement benefits at their normal retirement age (NRA), which is currently 65 and will gradually increase to 67 in the year 2030 for those attaining age 67 in 2027.

Because actuarial adjustments are made to the benefit amounts if retirement is either before (minimum of age 62) or after the NRA, the significance of possible variations in retirement ages are reduced.

**Findings**

The retirement rate assumption contains no material defects because of errors or omissions, is individually reasonable, and is in compliance with generally accepted actuarial principles.

**SSA Basis**

SSA estimates future retirement rates on the basis of age and sex in relation to the number of fully insured persons who are eligible for such benefits. Workers who are disability beneficiaries automatically convert to retirement status upon achieving their NRA; as a result, during the period while the NRA is increasing, the number of beneficiaries collecting DI benefits will increase, while the number of beneficiaries collecting OASI benefits will change in a corresponding manner.

A trend toward retirement at earlier ages has been a long-range trend, although age-related incidence rates of retirement have stabilized recently. SSA has assumed that the current age distribution will generally remain at current levels, except that it anticipates a delay in retirement rates at ages 65 and 66 during the next few decades as the NRA gradually increases from age 65 to 67.

The upcoming scheduled changes in NRA and the actuarial early retirement adjustment and delayed retirement credit, both of which are scheduled to gradually change until stabilizing in 2030 are reflected. These adjustments reduce the financial impact to the OASI Trust Fund of changes in the incidence of early or late retirement rates. As a result, changes in these rates are not as material to the size of the ultimate level of the Trust Fund as would otherwise be the case. Of course, year-to-year cash flow results would vary if retirement patterns would change, as would be the likely total payroll tax rates.

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**Approaches Used by Others**

The methodology used in long-range actuarial projections in the selected countries include:

- **Canada.** QPP projections determine the basis for retirement age in a manner consistent with their assumption as to labor force participation during the early 60s; the retirement rate is expected to decrease from 49.5% for men age 60 in 1998 to 21.8% and for women from 57.5% to 30.0%. The reasons given are a stabilization of the overall labor force. CPP/OAS estimates are based on the consideration of historical trends in retirement rates on an attained age-based model and labor force participation and on a cohort-based model that reflect lifetime employment factors
- **U.K.** Estimates of the distribution of retirement age are based on an examination of historical trends in retirement by both age and sex, in a manner somewhat similar to that used by SSA. It is assumed that actuarial adjustments in retirement income levels reduce the financial impact of changes in these levels.

There is a vast literature on retirement rates, what motivates people to retire, and trends in retirements. However, a limited number of approaches are currently used to develop long-range forecasts of the timing of future retirements.

**Significant Conclusions of the Last Two Technical Panels**

The following are the significant conclusions of the last two technical panels regarding the retirement rate assumption:

- The 1991 Technical Panel recommended no change in the retirement rate assumptions.
- The 1995 Technical Panel called for further study of this area, indicating some concerns relating to the independence of the labor force participation rates from the retirement rate assumption. They indicated that some of their questions with respect to retirement rates were not completely addressed by the time that their report was due. Although actuarial adjustments were made in benefit payments, the panel expressed concern relating to the fact that the seventy five year measurement period did not permit full realization in actuarial assessments of actuarial equivalent cash flow streams. In addition, they noted that different retirement age patterns could affect the program's overall income and benefit levels.

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**VB10. Interest Rates and Discount Rates**

**Definition and Impact**

The interest rate considered in the 1999TR is the nominal interest rate, which is compounded semiannually, for special U.S. Government obligations issuable to the Trust Funds in each month of the year. The real interest rate is defined to be the annual (compounded) yield rate for investments in these securities, adjusted by the growth in the CPI. Real interest rates are used to accumulate the OASDI Trust Funds. As long as Trust Fund values are positive, higher interest rates will result in larger Trust Fund balances. Conversely, if Trust Fund values are assumed to be negative, it is assumed that the Funds can borrow from general revenue at long-term equilibrium rates (such a position is only assumed to occur after estimated ultimate interest rate levels have been achieved) in a manner consistent with actual experience during periods in which inter-fund transfers have occurred. As noted under Section V2 of this report entitled *Affect of Social Security and Related Programs on the Economy*, no explicit impact of a negative Trust Fund balance on the economy and in turn on the experience of OASDI has been reflected in OASDI Trust Fund projections.

Discount rates are only used to derive summarized income rates and cost rates over the measurement period and actuarial balance values. They do not affect expected cash flows. The greater the discount rates, the less long-range estimates are weighted in the determination of summarized cost values.

**Findings**

The real interest (and corresponding discount) rate assumption contains no material defects because of errors or omissions, is individually reasonable, and is in compliance with generally accepted actuarial principles.

The projected nominal interest rates are in line with current economic expectations on future interest rates, as well as the Treasury's benchmark thirty-year bond.

Discount rates have been derived in a manner consistent with applicable ASoPs, consistent with the assumed asset earned rates, and thus are deemed appropriately established.

**SSA Basis**

In SSA's short-range model (first ten years of the measurement period), monthly asset and investment flows are projected, based on estimated cash flows, reflecting current assets and their expected maturities, and new investments consisting primarily of special U.S. Treasury securities, rates of which are fixed by formula, reflecting an interpolation

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between current new money rates (after adjusting for current CPI) and the ultimate interest rate selected by the Trustees.

Estimates of the ultimate real interest rate and corresponding expected change in CPI are selected by the Trustees, based on judgment, reflecting current interest rates and various average historical interest rate measures. Interest rates for the long-range model are applied to cash flows on the basis of an average point in time during each year (for the remainder of the average period during that year). Annual equivalent interest rates are solved for during the short-range period based on estimated interest earnings and the time of average Trust balances. The ultimate interest rate is reached in 2007, for the prior years are based on an interpolation between the "solved-for" short-range effective rate and the ultimate rate.

Estimated nominal interest rates are simply the sum of the real interest rates plus corresponding changes in CPI. Discount rates are the same as the annual effective rates as derived as described above.

**Approaches Used by Others**

The methodology used by other countries include:

- **Canada.** In CPP projections, future real interest rates (for new investments) are based on judgment, reflecting a number of considerations, including the following: average current yield on the fund, real yields in the last twenty five years on a sample of large private pension plans, historical real yields over the last fifty years on a hypothetical diversified portfolio and current indexed federal bonds. The ultimate value is based on judgment. Interest rates are not reflected in OAS analysis. Ultimate QPP real interest rates (nominal after cost of living adjustments, with ultimate levels reached after twenty two years) are developed separately for each class of asset, reflecting both current rates and a generally reducing schedule to reflect a degree of uncertainty associated with future yields.
- **U.K.** The U.K. long-range projections do not reflect interest earnings as no segregated fund is accumulated. Determination as to adequacy of contribution rates relative to benefit payments are evaluated on a cash flow basis only reflecting taxes collected compared with benefits and corresponding expenses are paid. As a result, no comparable assumption is made.

None of the plans present summarized average costs on a discounted basis. As a result, no comparable methodology exists in our benchmark projections to compare discount rate methodologies.

**Significant Conclusions of the Last Two Technical Panels**

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The following are the significant conclusions of the last two technical panels regarding the interest rate assumption:

- The 1991 Technical Panel suggested the use of a higher real interest rate than was being used (2.8% compared to 2.0%). The panel recommended the use of a weighted average (geometric weights of .95, thus placing more weight on recent experience), a longer grading period to ultimate (fifteen as opposed to ten years), and that current yield curves should be considered in setting a long-range forecast of future interest rates.
- There was disagreement on the 1995 Technical Panel as to a recommended rate. The difference, in part, was due to different perceptions as to probable levels of future savings. There was also disagreement as to how much historical rates should be relied upon, due to specific shocks to interest rates that are not considered likely to reoccur such as oil price increases. The panel agreed that further research on real interest rate projections was needed.

**Discussion**

A number of methodologies are used to develop estimates of future real interest rates (most relate to nominal rates, but these can easily be adjusted to real rates). One approach is to base future interest rates on the yield curve structure on current government bonds, assuming that financial markets are the best judge of estimates of future interest rates. Another is to use a mean reversion approach – however, the primary issue is what level of interest rates constitute the rate to which they will revert. Often, stochastic modeling will be used, sometimes together with econometric analysis (stochastic modeling will be covered in more depth under the topic of sensitivity testing later in this report).

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**VC. Other Assumptions / Factors**

There are a number of assumptions that can not neatly be described as specifically related to either the demographic or economic conditions within which the OASDI programs operate. We have chosen three such factors to separately comment upon: (1) measurement period, (2) impact of OASDI and related programs on the economy, and (3) distribution of wage levels. They in turn affect a number of the assumptions or their combination. An additional factor that we have chosen not to discuss is the cost of administration of the OASDI program, due to its size in relation to total revenue and expense of the program.

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VC1. Measurement Period

**Definition and Impact**

The Measurement Period over which the OASDI trust funds are projected has been seventy five years since 1965. Prior to that time, the aggregate excess after the last year specifically measured was assumed to be applicable for all years thereafter. During the 1990s, as a result of a change in the definition of long-range actuarial balance to include a provision at the end of the seventy fifth year into the future, estimated cash flows were calculated for a seventy sixth year; while the cash flows for that year are not explicitly shown in the 1999TR, they are reflected in the determination of long-range actuarial balance.

This seventy five year period was selected as "it serves no useful purpose to present estimates as if they had validity in perpetuity. A period of seventy five years would span the lifetime of virtually all covered persons living on the valuation date and is as long a period as can be expected to have a realistic basis for estimating purposes. When costs are reassessed at frequent intervals, as has always been the practice, seventy five year projections allow sufficient time to adjust to new and changing experience as it emerges."<sup>10</sup>

The 1999TR projects significant deficits near the end and after the measurement period. This deficit results in a significant reduction in actuarial balance each year (.08% of payroll over the seventy five year period in the 1999TR). If the projections are reasonably accurate after this period, this limitation to seventy five years tends to underestimate the deficit in the current actuarial balance with an even greater underestimation in the high cost scenario.

**Findings**

Although the measurement period per se is typically not looked at as an assumption (it is not a contingency nor an uncertain aspect of future demographic or economic conditions), we have listed it as such because its use annually contributes to a material deterioration in the actuarial balance of the OASDI Trust Funds. As such, its effect does not literally fall outside the bounds of the reasonableness criteria selected over the measurement period. However, we have identified it as an unreasonable assumption due to its annual contribution to the deterioration in the actuarial balance. As indicated above, as long as a significant cash flow imbalance is expected immediately after the end of the period and current interest rates are expected to continue, the annual deterioration in the actuarial balance will continue to occur.

<sup>10</sup>1965 Quadrennial Social Security Advisory Council

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Several factors weigh against this conclusion: (1) the use of a seventy five year measurement period is reasonably consistent with that used by the benchmark non-U.S. social security programs reviewed (note that for a large number of worldwide social insurance programs, no such long-range projection has been made), (2) the seventy five year period should provide policy decision-makers plenty of time to make changes to the program, and (3) according to ASoP No. 32, significant differences between program income and cost toward the end of the measurement period are noted, as required.

It is also not desirable for the financial condition of the Trust Funds to be overwhelmed in significance by the very uncertain experience after the seventy fifth year. However, even though the deficit at the end of the period is noted in a number of places within the 1999TR, the expected continued impact of such differences on the actuarial status in future valuations should be noted.

Even if no change in experience assumptions is made, as long as there exists a substantial estimated "cash deficit" during the last years of the measurement period in excess of the discounted average deficit over the seventy five year period, a deterioration in the actuarial balance of the Trust Funds will annually result. Thus, although the impact of adding a new year to the measurement period is disclosed, it may not be clear to readers that this situation is expected to continue for a long time. At the minimum, even if a method is not agreed upon as to how to quantify this impact so the annual deterioration does not occur, expanded disclosure would be appropriate; otherwise, it provides the users of the Trustees' reports a potentially misleading indication of the size of the actuarial balance of OASDI.

#### **Other Long-range Actuarial Valuations**

The only benchmarks available to determine appropriate actuarial practice with regards to measurement period are two other social insurance retirement schemes are the subject of long-range actuarial projections, the U.K. and Canada. In the U.K.'s most recent actuarial valuation, the measurement period was 66 years (through March 2061). In the CPP valuation (covering Canada, other than Quebec), the measurement period is 103 years (through 2100), while in the QPP valuation (Quebec), the period is 53 years (through 2050). Thus, the seventy five year period is within a reasonable of benchmark practices. It is important to note that neither of these programs is projected to have such a large negative position at the end of the measurement period.

#### **Relevant Actuarial Standards of Practice**

In 3.7 of ASoP 32, it is stated that "The actuary should note any significant differences between program income and cost toward the end of the measurement period. Further, the actuary should disclose the expected impact of such differences on the actuarial status in future valuations."



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The 1999TR clearly shows the differences between program income and cost throughout the measurement period. Although the expected impact of such differences after the seventy fifth (actually seventy sixth) year period is not quantified nor is an indication provided of the continued effect of the anticipated experience after the end of the measurement period, the existence of this difference is highlighted in the report.

**Discussion**

The amount of the currently anticipated deficits after 2074 is significant. Although not quantified, it is clear that under the assumptions underlying the estimates, the deficits would, if anything, gradually increase over time. If these deficits were included, even on a discounted basis, they would serve to increase the actuarial deficit of the OASDI Trust Funds.

However, it may be inappropriate to overly weight these deficits, as is stated by the 1965 Council. At this time and under the current set of assumptions, the use of the seventy five year period does not change the overall conclusions reached with respect to the actuarial balance of the Trust Funds; however, it does affect the absolute level of the balance and the change in the balance from year to year. On the other hand, the constant change in actuarial balance calculations each year (addition of a very "bad" 76<sup>th</sup> year under current forecasts) indicates a change in the actuarial balance that is not realistic. As a result, either a methodological change or added disclosure is called for.

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**VC2. Impact of Social Security and Related Programs on the Economy**

**Definition and Impact**

Actual economic and demographic experience has been and will be dynamic in nature, that is, the factors that make up the economic and demographic environment will affect each other as time passes. In many ways, many of the underlying assumptions used in the SSA projections are also dynamic (as opposed to static) in nature. However, explicit feedback loops have not been incorporated into the projection models to reflect the possible future impact on the economic environment resulting from significant changes in the financial results of the OASDI (or HI) program themselves.

An example of such a feedback loop situation would occur if the OASDI trust funds turn significantly negative. Depending on how long this situation is allowed to occur, significant economic events might happen. The 1999TR does not explicitly consider the impact of such economic forces, as it assumes that long-range economic equilibrium period continues nonetheless. If this would occur, in the absence of future OASDI legislation, general revenue funds could be used to bridge the gap, with possible further adverse OASDI financial results. Depending on the amount of resources needed, a sizable increase in federal government budget deficits and the economic maladies of the 1980s could reoccur. Markets would likely react with higher interest rates, resulting in a slow down of economic growth and probable deterioration of the trust funds even further.

Other approaches could be taken to avoid this situation, including a decrease in benefits or a reduction unemployment taxes. However, according to relevant Actuarial Standards of Practice, current law should be assumed to continue unchanged. As a result, it is appropriate that the currently scheduled rates of tax and benefits be assumed to continue, as is done in the 1999TR. If they would be changed, the state of the economy would change. Then, either the cost of production would increase or employee salaries would be reduced, or a combination of both. This would result in a decrease in personal consumption, an increase in consumer debt, or an increase in inflationary pressures. In sum, many of the long-range equilibrium economic assumptions included in the 1999TR currently contemplated during the latter parts of the measurement period would no longer be appropriate.

**Findings**

The lack of an OASDHI economic feed back loop as described is not reasonable in the circumstance in which significantly different adverse (or favorable) OASDHI financial conditions are anticipated in the future than in the experience period from which base economic statistics are relied upon. It should be noted that determination of the impact of such events might be difficult to model. In addition, it could be expected that some type of political action would be taken prior to that period to obviate the situation. Thus,

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although we recommend that the projections be modified if a significant adverse condition is expected, the adjustment made may take the form of increased disclosure of such possible economic circumstances and implicit reflection of such expected conditions, rather than explicit changes in the long-range projection models.

Although we recommend that such a feed-back loop process be recognized and included in future projections, we cannot conclude the 1999TR assumptions have been unreasonably determined as a result of the lack of recognition of this effect.

**Approaches Used by Others**

No such feedback mechanism is explicitly reflected in either the Canadian or U.K. social security projections. However, it should be noted that they do not project the significant deficit situation at the end of their measurement period. Thus, the fact that they have not addressed this potential problem may not be relevant.

**Discussion**

We believe that if such a feedback mechanism was incorporated in the projections, either (1) explicitly as part of the model, (2) implicitly through recognition of the probable outcome of the projection, or (3) as part of a two stage projection process (setting an initial set of long-range equilibrium assumptions and then revising them once the resulting projections are evaluated), more adverse best-estimate projections would likely result.

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VC3. Distribution of Wage Levels

**Definition and Impact**

Most of the assumptions underlying the long-range actuarial projections reflect the use of averages. In a number of areas, the distribution of wages are specifically reflected, including the estimation of payroll taxes through macro-simulation techniques (particularly in the projection of benefits, because they are not strictly a common percent of payroll) and benefits (e.g., due to the offset of income in the early retirement years).

In some areas, experience would be expected to tend to vary by wage levels. For example, it has been shown that mortality and fertility tend to be higher for lower income families. To the extent that historical experience is gathered on the basis of individual lives, rather than on the basis of the dollar impact on trust fund cash flows, the application of such experience may bias the projection of future financial performance of the OASDI Trust Funds. Moreover, if the historical distribution of wages in the population is different than in the future, to the extent that historical experience is relied upon for actuarial projections, such a change should be reflected in future projections.

**Findings**

The wage level distribution assumption contains no material defects because of errors or omissions, is individually reasonable, and is in compliance with generally accepted actuarial principles.

Adjustments have been made in the major areas of demographic assumptions to reflect the impact of the distribution in wages. We recommend that all demographic-related assumptions be reviewed to assess the appropriateness of future assumptions that are influenced by the distribution of wages. In addition, the use of micro-simulation modeling should add significant value to the analysis of the effect of this assumption, along with certain other aspects of the projection methodology. However, it should be noted that additional personnel resources at the OCACT is called for in order to effectively implement and maintain such approaches effectively. Such additional resources may be prove to add significant value in the development of more refined projection methodology in this and other areas.

**SSA Basis**

The distribution of wages for use in revenue and related benefit calculations are based on information provided through IRS wage histories. Based on the description of the approaches used, this is reasonable. Certain aspects of the estimates are based on the assumption that the historical demographic characteristic mix of the population remains similar in the future.

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**Approaches Used by Others**

We could not identify any references to the impact of wage distributions in either Canadian or U.K. actuarial social insurance projections.

**Significant Conclusions of the Last Two Technical Panels**

This assumption has not been explicitly addressed by either of the two technical panels.

**Discussion**

At least through an intermediate future, differential experience by wage level should be expected to continue. Changes in this distribution of income may influence future financial performance of the OASDI Trust Funds. For example, average benefits for each cohort of worker beneficiaries classified by age and sex is adjusted by a factor that ranges from .3% to .8% annually to reflect historically observed changes. The use of this post-entitlement adjustment may be more significant than the uncertainties associated with future mortality. An additional fact to consider is that survivor beneficiaries tend to have a higher average benefit as well, as a result of differential mortality. The reasons for this change and its effect should be explicitly explored to determine whether the impact of this assumption should be assumed to continue in all future years.

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**VII. Sensitivity of Assumptions -- Introduction**

In any actuarial report addressing projections of future uncertain cash flows, it is important to identify the degree and source of the uncertainty involved. The users of the projections should have available information regarding the sensitivity of the projections (due to the methodology and assumptions used as well as probable alternative scenarios) in order to understand this uncertainty. As is stated in ASoP No. 27, "The actuary should perform an analysis of the sensitivity of the program's cost or financing method under reasonable, alternative scenarios that are different from expected experience. When the data used in setting actuarial assumptions have limited credibility or applicability, or when the projected costs or the program's actuarial status is particularly sensitive to the assumptions, greater sensitivity testing is indicated. The intended use of the report, or the sensitivity of the program cost or financing method to the choice of the assumptions, may be considered in determining the amount of sensitivity testing to be performed."

Section 3.5 of ASoP 32 states that "In addition to using actuarial judgement in selecting assumptions, the actuary should state in an actuarial report that the results depend on the assumptions used and that actual experience is likely to differ from expected. The actuary should perform an analysis of the sensitivity of the program's cost or financing method under reasonable, alternative scenarios that are different from expected experience."

The 1999TR explicitly states that the results presented depend on the assumptions and that actual experience is likely to differ from expected (i.e., page 11 of the 1999 Trustees' report states "...no definite assurance can be given that this [results falling within the Alternative I to III range] will occur because of the uncertainty of the projections of this type and length."). The 1999TR also points out that more confidence can be placed in the short range assumptions, but goes on to state "Nonetheless, even for the earlier years, the estimates are only an indication of the expected trend and potential range of future program experience."

Two types of sensitivity tests with respect to the long-range actuarial projections are shown in the 1999TR: (1) with respect to certain selected individual actuarial assumptions and (2) with respect to the impact of the alternative set of all assumptions. The latter type of test is, in essence, the Alternative 1 and 3 scenarios. The assumptions used in the individual tests are identical to those used in the all-assumption aggregate tests, except that in the individual tests all other assumptions are those relating to the Alternative 2 "best-estimate" set of conditions.

In most cases, the best-estimate is directly in the middle of the range of sensitivity test values. Although this may be appropriate in a number of cases, an even more relevant indicator of reasonableness is that the extreme points in the selected range are estimated to be equally likely. Ideally, the tests should provide the user an indication of the estimated likelihood that these conditions are expected.

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In order to assess the reasonableness of the sensitivity tests, it is important to recognize the use for which the tests will be used. In order to do this, it would be appropriate to identify who the users of the information are. In this case, although a primary audience is decision-makers in Congress and the Administration, the potential audience is significantly wider than this and thus the development of a single set of sensitivity tests is made more difficult.

Because many users are unlikely to be actuaries or economists, it is important to make these tests as user-friendly as practical. Thus not only should the best-estimate assumptions/conditions be expressed in a manner that is easy to understand, but the range of assumptions used in the sensitivity tests should also be simply expressed and if possible the range shown should be consistent with the values that the user is interested in.

At least two types of sensitivity tests are in general use. The first is based on a deterministic approach, using a specified set of assumed conditions. The second is based on multivariate stochastic projections, reflecting estimated probabilities of a range of possible conditions. Either approach may be reasonable; in the future, more of such testing will either use stochastic projections or the specific set of assumed conditions used will be based on analysis of stochastic tests. We recommend increased use of stochastic methods in order to better understand the uncertainties involved in the long-range projections and to enhance the ability to determine reasonable sensitivity test levels.

Although quite difficult, it may be useful to be able to judge the relative sensitivity of marginal effects of various assumptions. Unfortunately, it is now, for example, difficult to compare the uncertainty in mortality and real wage growth trends. The most that can be expected is to disclose as much relevant information, with the constraint of avoiding information overload problems. Further research as to degree of uncertainty in different assumptions would be appropriate, most likely involving stochastic testing of alternative scenarios. Note that great care to set the assumptions that are used in stochastic testing is required involving cross-discipline consensus is necessary to come to appropriate conclusions.

In addition, in some cases it may be useful for the reader to understand that future projections are not particularly sensitive to changes in particular assumptions. One example might be retirement rates as a result of actuarial adjustments. Demonstration of the lack of such sensitivity, or at the minimum inclusion of a statement that sensitivity tests have been conducted with regard to variations in a specific assumption and the assumption has been found not to influence significantly the actuarial projections can be as important as showing the results of sensitivity tests themselves. This aspect of communication should be further explored.

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Currently, the 1999TR shows the results of sensitivity tests on three of the economic assumptions – inflation, the real-wage differential and the interest rate. Mathematically, the primary variables (see section IVC – Introduction) should reflect all of the information assumed in the input variable set. Further, a sensitivity test of the primary variables should act as an overall summary of the explicit and implicit assumptions. However, the core assumptions made by the Trustees are based upon the explicitly determined ultimate levels of the secondary variables. It seems reasonable that the sensitivity analyses should be extended beyond the current set of assumptions to include most or a combination of the secondary variables.

**Possible Additional Tests**

Without determining the degree of sensitivity of the long-range projections to a specific assumption, it is impractical to firmly recommend the use of particular assumptions not currently included in the specific tests included in the 1999TR. It would be appropriate to conduct tests of the degree of such sensitivity to additional variables.

**Specific and Aggregate Tests**

It is unlikely that the same degree of uncertainty in a given assumption should be used in a specific sensitivity test and in an aggregate test. Thus in reality it is more likely that one assumption behaves “favorably” with respect to trust fund performance, while another assumption behaves “unfavorably”. In fact, a report evaluating the current CPP actuarial projections<sup>11</sup> states that “The simultaneous occurrence of all the high-cost assumptions at the same time may, therefore, be highly unlikely. ... the high-cost and low-cost “combined” (Alternatives I and III) estimates should be developed independently of the one-parameter-at-a-time sensitivity tests. Each high-cost and low-cost “combined estimate should represent a plausible combination of assumptions and lead to a meaningful estimate, and not be just a combination of all of the one-parameter-at-a-time sensitivity tests.” We concur with this assessment and recommend that the range used in the specific and aggregate tests should be evaluated separately based on the intended purpose. For the purpose of the aggregate test, consideration should to the relationship each of the assumptions (the assumptions should be individually reasonable as well as reasonable in the aggregate).

We concur with the conclusions of the previous Technical Panels that an objective and comprehensive approach to the determination of the aggregate (Alternatives I and III) tests be rigorously constructed. Presumably they would be constructed reflecting stochastic analysis of possible future demographic and economic environments.

**Combined Tests**

<sup>11</sup> Review of the Seventeenth Actuarial Report on the Canadian Pension Plan, conducted by the CPP Actuarial Review Panel, March 31, 1999, M. David R. Brown, Robert C. Dowsett, and James G. Paterson.



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The CPP prepares one sensitivity test that reflects the marginal effect of two assumptions simultaneously – variations in changes in real-wage differential and CPI. This approach recognizes that it is unrealistic to hypothesize the change in one variable alone, but rather, it may be more reasonable to test the impact of a simultaneous change in more than one assumption at one time. We have no recommendation at this time as to specific combinations that may be appropriate to test in combination. However, we recommend that this approach be evaluated to determine whether (or which) additional tests might add value to future Trustees' Reports.

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**VI2. Sensitivity – Specific Findings**

All of the sensitivity tests of individual assumptions shown in 1999TR are conducted at the same level as is included in the aggregate Alternative I and III tests. As indicated in the prior section, testing at this level may not always be appropriate. The following comments cover the sensitivity of specific assumptions:

- **Mortality**

Sensitivity of the projections to the variations in the mortality assumption was developed by varying the rates of mortality improvement assumed to occur during the period 1998 – 2073 by age, sex, and cause of death. The decreases assumed over this entire period, summarized as changes in the age-sex adjusted death rate, are about 16%, 34% and 54% of the corresponding rate at the beginning of the period as assumed in Alternatives I, II and III, respectively. The reductions do not apply uniformly to all ages.

The SSA actuaries' alternative assumptions for mortality improvement are reasonable alternative scenarios from the "best estimate" Alternative II scenario assumption as they provide the user the sensitivity of the cost results to the mortality improvement assumption. In addition, a further aggregate measure of change in mortality, a ten percentage point aggregate ultimate change in mortality trend is also given, that adds to the reader's understanding of sensitivity of this assumption so that the reader can come to her or his own conclusions.

The mortality assumption is quite complicated. As a result, it is difficult to give a simple single measure that conveys both the significance of the assumption and plus or minus twenty five percent around the mortality improvement. The approach selected to communicate the sensitivity test results is reasonable as it provides the user with enough information to understand how the mortality improvement assumption affects the long-range cost projections of the OASDI Trust Funds. In addition, more sensitivity should be provided to show the impact of the mortality assumption developed by alternative approaches (e.g., the rates of improvement projected by the Lee and Carter method).

- **Fertility**

Sensitivity to the fertility assumption was primarily developed by varying the ultimate total fertility rate assumption in the range 1.6 and 2.2, rather than the 1.9 best-estimate assumption. The rates are assumed to change gradually from the current level and to reach the various ultimate values by 2023.

This approach to sensitivity is reasonable as it provides the user with enough information to understand how the fertility rate assumption affects the long-range cost

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projections of the OASDI Trust Funds. Because of the low total fertility rate of other developed countries, it might be useful to show the effect of such an alternative total fertility rate assumption.

- Net Immigration

The sensitivity analysis provided in the 1999 TR provides three alternatives for the net immigration assumption – 750,000, 900,000 and 1,150,000 under Alternative III, II and I, respectively.

This approach to sensitivity is reasonable as it provides the user with enough information to understand how the net immigration assumption affects the long-range cost projections of the OASDI trust funds.

- Disability Incidence and Termination

The “best estimate” level of disability incidence is approximately 25% higher for males and 47% higher for females than the annual rates experienced during the base period 1984 – 1986. The disability incidence assumption for Alternative I is at approximately that of the base period for males, with an increase of 17% over the base period for females. Alternative III has the disability incidence rates at approximately 50% higher for males and 76% higher for females.

Alternative II disability termination rates are approximately 45% for men and 55% for women of the base period (1977-1980) termination rates as of the end of the seventy five year projection. The Alternative I and III projections are assumed to spread gradually from the Alternative II assumption until the rates are 61% and 31% respectively for males and 75% and 37% respectively for females.

The approach to sensitivity used is reasonable and the values selected are not unreasonable, as they provide the user with enough information to understand how the disability incidence and termination assumptions affect the long-range cost projections of the OASDI Trust Funds.

- Marital Status

No sensitivity test covering marital status is provided in the 1999TR. The future event that may be most likely to affect the distribution of marital status a tax law change affecting the current marriage “penalty”. Although according to actuarial standards of practice it would not be appropriate to reflect a change in this law, it may prove useful to some users to show estimates of the sensitivity of OASDI resulting from such a change.

- Potential GDP

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No sensitivity test covering GDP is provided for in the 1999TR. A sensitivity test on GDP would offer an overall measure of the impact of the structural and input variables assumptions. In addition, since GDP measures are so widely known, it would be valuable to show how changes in this measure affect the future financial condition of the OASDI Trust Funds. However, the various other aspects of the U.S. economic condition are more important determinants to the financial health of the OASDI Trust Funds.

- Average Weekly Hours

No sensitivity test covering average weekly hours is provided for in the 1999TR, although it would be useful to find out the significance of probable variations in future average weekly hours.

- Labor Productivity

No sensitivity test covering labor productivity growth is provided for in the 1999TR. Owing the great importance of this assumption, sensitivity tests upon the labor productivity assumption should be reported on.

- Unemployment Rates

No sensitivity test covering the unemployment assumption is provided for in the 1999TR, although it would be useful to find out the significance of probable variations in future unemployment rates.

- Cost of Living

The sensitivity test to the Consumer Price Index (CPI) assumption shown is the effect of an increase and decrease in the estimated annual change in the CPI of one percent. This provides a reasonable indication of the impact of a change in CPI.

- Wage Growth

Sensitivity to the real-wage differential<sup>12</sup> assumption is provided in increments of 0.5% (0.4 to 1.4%). This range is convenient and informative.

- Labor's Share of GDP

<sup>12</sup>The real wage differential is the difference between the percentage increases in the average annual wage in the covered employment and the average annual CPI.

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No sensitivity test covering labor's share of GDP is provided for in the 1999TR, although it would be useful to find out the significance of probable variations in this assumption.

- Earnings Share of Total Compensation.

No sensitivity test covering the earning to compensation assumption is provided in the 1999TR, although it would be useful to find out the significance of probable variations in the earnings share of total compensation.

- Retirement Rates

No sensitivity test relating to the rates of retirement is provided in the 1999TR. Due to the lack of sensitivity testing available to them, the 1995 Technical Panel indicated that they could not assess the sensitivity of the financial projections to changes in this assumption. Whether or not OASDI Trust Funds are sensitive to this assumption, it would be useful to show the degree of their sensitivity to probable variations in future retirement rates.

- Interest Rates and Discount Rates

A range of 0.5 percent in ultimate real interest rates are provided in the 1999TR. This approach to sensitivity is reasonable as it provides the user with enough information to understand how the real interest rate assumption affects the long-range cost projections of the OASDI Trust Funds based on a convenient measure.

- Measurement Period

Although a sensitivity test in the traditional sense would not be appropriate, the cost indications inherent in the aggregate cost deficits of Alternatives I and III at the end of the measurement period provide a useful indication of its importance, particularly if supplemented by some indication of the present value of the deficits after this period.

- Impact of Social Security and Related Programs on the Economy

No sensitivity test is performed for this assumption. Until an approach is developed to indicate the importance of the feed-back loop to the financial condition of the OASDI program, it is too early to discuss the sensitivity of possible alternative financial impacts of this concept.

- Distribution of Wage Levels

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No sensitivity test is performed for this assumption in the 1999TR, although it would be useful to find out the significance of probable variations in future distribution of wage levels.

**1999TR Sensitivity Tests**

As indicated above, the following assumptions were subject to tests of the sensitivity of the financial condition of the OASDI Trust Funds to variations in these assumptions that correspond to those assumptions in Alternatives I and III and are shown in the 1999TR:

1. Mortality rates
2. Fertility rates
3. Net immigration
4. Disability incidence
5. Disability termination
6. Changes in CPI
7. Real interest rate
8. Real wage growth

**Sensitivity Tests Used in Other Countries**

With respect to the reports prepared for our benchmark countries, the assumptions used in specific sensitivity tests are the following:

- CPP (ultimate years of each assumption)
  - Total Fertility Rate
  - Net migration
  - Mortality
  - Disability incidence
  - Unemployment rate
  - Real-wage differential
  - Rate of change in prices
  - Real rate of return on new fund investments
- OAS – in addition to those in the CPP report, the following are also included:
  - Combined effect of the three economic assumptions
  - Changes in legislation affecting wage indexation
- QPP – in addition to those in the CPP report, the following are also included:
  - Labor force participation
- U.K.
  - Fertility
  - Mortality

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- Real wage growth
- Percentage of employment self-employed
- Unemployment.

As can be seen, many of the assumptions used in specific sensitivity tests are fairly similar.

**Findings**

Based on the above, and the guidelines for sensitivity testing provided in the ASoP on Social Insurance, the sensitivity analyses included in the 1999TR are reasonable and in compliance with generally accepted actuarial principles.

It would be appropriate to also include a number of additional tests, particularly labor productivity. The sensitivity of a number of other assumptions should be reviewed to determine the meaningfulness of inclusion, including labor force participation, potential GDP, retirement rates, and marital status. In addition, further work should be conducted to determine whether it would be appropriate to combine a number of economic variables that are significantly related to determine whether additional tests should be included in future Trustees' reports.

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**APPENDIX 1: Relevant Passages from Actuarial Standards of Practice**

The following are extracts of relevant passages from two Actuarial Standards of Practice (32 – Social Insurance and 27 – Selection of Economic Assumptions for Measuring Pension Obligations) and one Actuarial Standard of Practice currently in exposure draft form (Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations). They are ASoPs either adopted by the Actuarial Standards Board or are in its exposure process. ASoP 32 will be effective during the upcoming fiscal year.

**Actuarial Standard of Practice No. 32 – Social Insurance**

- 2.1 Actuarial Assumption – The value of a parameter, or other choice, having an impact on an estimate of a future cost, income, or other actuarial item of a program under evaluation.
- 3.2 Coverage and Program Features – The actuary should take into consideration all relevant program features ... In particular, consideration should be given to the ongoing nature of the program, based on current legislation and regulation.
- 3.4 Actuarial Assumptions – 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. The actuary should consider the actual past experience of the social insurance program, over both short- and long-range periods, also taking into account relevant factors that may create material differences in future experience.
- 3.4.1 Demographic Assumptions – Demographic assumptions are those that relate to the projections of the numbers and characteristics of individuals that are covered or potentially covered by the program, contribute to the program, or receive benefits from the program. The actuary should pay particular attention to the rates of entry into and withdrawal from the covered population, as well as the beneficiary population, assuring that assumed future rates are reasonable. Where the numbers of covered individuals and beneficiaries are projected using current participant data only, the actuary should consider using data from the broader population in order to check reasonableness.
- 3.4.2 Other Factors – In choosing assumptions the actuary should take into consideration the actual operation of the program. For example, the rates of actual retirement may differ from the rates of receipt of the retirement benefit. The actuary should take care that assumptions include the effects of behavioral changes induced by the availability and level of benefits. The administrative costs of the program should also be considered in cases where program income finances the program’s administration.



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- 3.5 Sensitivity Testing – ... The actuary should perform an analysis of the sensitivity of the program’s cost or financing method under reasonable, alternative scenarios that are different from expected experience.

When the data used in setting actuarial assumptions have limited credibility or applicability, or when the projected costs or the program’s actuarial status is particularly sensitive to the assumptions, greater sensitivity testing is indicated. The intended use of the report, or the sensitivity of the program cost or financing method to the choice of the assumptions, may be considered in determining the amount of sensitivity testing to be performed.

- 3.7.1 Valuation Period – The actuary should note any significant differences between program income and cost toward the end of the valuation period. Further, the actuary should disclose the expected impact of such differences on the actuarial status in future valuations.

**Actuarial Standard of Practice No. 27 – Selection of Economic Assumptions for Measuring Pension Obligations**

- 2.1 Best-Estimate Range – For each economic assumption, the narrowest range within which the actuary reasonably anticipates that the actual results, compounded over the measurement period, are more likely than not to fall.
- 3.1 Analysis of Issues and Recommended Practices, Overview – Because no one knows what the future holds with respect to economic and other contingencies, the best an actuary can do is to use professional judgment to estimate possible future economic outcomes based on past experience and future expectations, and to select assumptions based upon that application of professional judgment. Therefore, an actuary’s best-estimate assumption is generally represented by a *range* rather than one specific assumption. The actuary should determine the best-estimate range for each economic assumption, and select a specific point from within that range.
- 3.3 General Considerations – The actuary should consider the following factors when identifying which types of economic assumptions to use for a specific measurement and when selecting those economic assumptions that will be used:
- a. the purpose and nature of the measurement;
  - b. the characteristics of the obligation to be measured (measurement period, pattern of plan payments over time, open/closed group, materiality, volatility, etc.);
  - c. materiality of the assumption to the measurement ... and
  - d. appropriate recent and long-term historical economic data.

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- 3.5 Sensitivity Testing – ... The actuary should perform an analysis of the sensitivity of the program's cost or financing method under reasonable, alternative scenarios that are different from expected experience.

When the data used in setting actuarial assumptions have limited credibility or applicability, or when the projected costs or the program's actuarial status is particularly sensitive to the assumptions, greater sensitivity testing is indicated. The intended use of the report, or the sensitivity of the program cost or financing method to the choice of the assumptions, may be considered in determining the amount of sensitivity testing to be performed.

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- 3.3 General Considerations – The actuary should consider the following factors when identifying which types of economic assumptions to use for a specific measurement and when selecting those economic assumptions that will be used:
- a. the purpose and nature of the measurement;
  - b. the characteristics of the obligation to be measured (measurement period, pattern of plan payments over time, open/closed group, materiality, volatility, etc.);
  - c. materiality of the assumption to the measurement ... and
  - d. appropriate recent and long-term historical economic data.

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As stated above, the actuary should consider recent economic data. However, the actuary should not give undue weight to recent experience. For example, if the recent investment return was largely attributable to a significant change in bond yields or inflation, it may be unreasonable to assume that such investment returns will continue over the measurement period.

- 3.3 General Selection Process – The general process for selecting economic assumptions for a specific measurement should include the following steps:
- a. identify components, if any, of each assumption and evaluate relevant data;
  - b. develop a best-estimate range for each economic assumption required for the measurement, reflecting appropriate measurement-specific factors; and
  - c. further evaluate measurement-specific factors and select a specific point within the best-estimate range.

With respect to some (or all) of the components of an economic assumption, the actuary is not required to identify the explicit best-estimate range before selecting the specific point, provided that the actuary is satisfied that the selected point would be within the best-estimate range had such range been explicitly identified.

After completing steps (a) through (c) for each economic assumption, the actuary should review the set of economic assumptions for consistency.

- 3.7.2 Individual Assumptions – For each economic assumption selected by the actuary should individually satisfy this standard.
- 3.10 Consistency among Economic Assumptions Selected by the Actuary – With respect to any particular measurement, each economic assumption selected by the actuary should be consistent with every other economic assumption selected by the actuary over the measurement period, unless the assumption, considered individually, is not material, ...
- 3.14.2 Other Considerations, Cost Effectiveness – The actuary also needs to establish a balance between refined methodology and cost effectiveness. While all material economic assumptions must be reflected, more refined methodology is not required when it is not expected to produce materially different results.

**Actuarial Standard of Practice \_\_ [Exposure Draft, issued January 1999] -- Selection of Demographic and Other Noneconomic Assumptions for Measuring Pension Obligations**

- 3.1 Overview – The actuary should select reasonable demographic assumptions. A reasonable assumption is one that is expected to accurately model the contingency being measured and is not anticipated to produce significant cumulative actuarial gains or losses over the measurement period. For any given measurement, the

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actuary may be able to identify two or more reasonable assumptions for the same contingency.

3.1.1 Identify the Types of Assumptions – The actuary should consider the following factors when identifying which types of demographic assumptions to use for a specific measurement:

- a. the purpose and nature of the measurement;
- b. plan provisions or benefits and factors that will affect the timing and value of any potential benefit payments;
- c. the characteristics of the obligation to be measured (such as measurement period, pattern of plan payments over time, open or closed group, volatility);
- d. the contingencies that give rise to benefits or result in loss of benefits;
- e. the materiality of each assumption; and
- f. the characteristics of the covered group.

It is not necessary that every contingency should give rise to a separate assumption.

3.3.5 Evaluate Reasonableness of the Selected Assumptions – The actuary should evaluate the reasonableness of each material demographic assumption selected. Unless facts and circumstances clearly warrant otherwise this criteria should be based on the following criteria:

- c. The assumption is expected to accurately model the contingency being measured. For example a reasonable retirement assumption for a plan with a large number of retirements expected to occur at different ages instead of at a single age. In contrast, for a plan where a significant portion of the liability is attributable to a single individual, a single retirement age may be appropriate.
- d. The assumption is not anticipated to produce significant cumulative actuarial gains or losses over the measurement period.

3.4 Individual Assumptions – Each individual demographic assumption selected by the actuary should satisfy this standard.

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**APPENDIX II: Specific Recommendations**

The following is a list of weaknesses with regards to the assumptions incorporated in the long-range actuarial projections as shown in the 1999TR:

1. **Documentation.** There exists a general need for enhanced current documentation, particularly in the areas of the economic assumptions and the long-range model.
2. **Historical economic measures.** Research should be conducted as to the effect of the recently announced BEA revisions to historical measures of economic performance on long-term projections of the OASDI Trust Funds.
3. **Measurement period.** Consider reflecting estimated costs after the end of the measurement period in a way to reduce the impact of the annual change in actuarial balance in the years covered in the measurement period.
4. **Additional resources.** In order to effectively develop enhanced documentation and enhancements to projection methodology (such as micro-simulation modeling or enhanced analysis of the level of uncertainty involved in the projections and sensitivity testing performed as a result mentioned in this report and various Technical Panels), it would be appropriate to expand the resources available to the OCACT to perform such necessary additional functions and analyses.

Other issues in which the Trustees and the OCACT of SSA should consider in their future development of assumptions used in the long-range actuarial projections include the following:

1. **Fertility.** Outside the general fertility model, assumptions regarding reasonable convergence of racial differentials should be tested.
2. **Mortality.**
  - a. **Cause of death probabilities.** Trends of cause of death probabilities within the initial base period should be conducted in projecting future trends.
  - b. **Overall trends.** Significant alternative projection hypotheses exist regarding long-term mortality trends. This area should be continually reviewed to update the methodology of mortality projections, particularly trends by age and sex regarding fundamental drivers of mortality, including smoking, cancer and obesity trends.
3. **Disability statistics.** It would be appropriate to update the DI mortality rates used in the long-range projections and the age-sex baseline rates of incidence and termination to reflect more up-to-date experience.

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4. **Wage growth.** Fully test the alternative approach to directly model real-wage differential, rather than relying solely on a linked-GDP modeling approach.
5. **Potential GDP.** Reflect in future models the role of capital and the effect of economic sectors in projection of potential GDP. Efforts should be made to reconcile CBO and SSA potential GDP projections. Although the CBO methodology is not designed for a seventy five year forecast, some of the CBO model's strength could be adopted to refine the medium range period of the projection.
6. **Average weekly hours and earning share of total compensation assumptions.** Additional research is appropriate for both of these assumptions. Although relatively small in impact, the ultimate values (in 2073) of both of these assumptions appear somewhat lower than our best-estimates based upon future knowledge. Both variables directly influence projected wage growth together with projected program revenues.
7. **Feedback loop.** After initial projections are made, we recommend that the OCACT determine whether the assumptions should be modified if the resulting projected environment would prove that the initial assumptions made are no longer appropriate. One example is if OASDHI Trust Fund Balances become significantly negative during the measurement period.
8. **Structural breaks.** A consistent approach to identification and reflection of structural breaks in historical experience used as a base for development of assumptions used in long-range projections.
9. **Impact of global economy.** As economies worldwide become increasingly linked, consideration should be given to enhancing SSA's models to reflect expected future developments in foreign countries.

Regarding sensitivity tests, we recommend the following:

1. **Form of sensitivity tests.** In general, values used in sensitivity tests for specific assumptions need not be the same as the values included in the aggregate sensitivity tests (Alternatives I and III).
2. **Additional tests.** Perform additional sensitivity tests on labor productivity. Consider the addition of tests on other assumptions, including GDP, marital status, and wage to compensation.
3. **Tests of combination of assumptions.** Identify whether sensitivity tests should be conducted on a combination of related assumptions, particularly economic assumptions.

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