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## **Cohort-Specific Measures of Lifetime Social Security Taxes and Benefits**

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## **Introduction**

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This paper develops estimates of lifetime money's worth and redistributive outcomes under the Old Age and Survivors Insurance (OASI) program for all past, present, and future birth cohorts affected by the program through the cohort born in 2100. The estimates presented in this study incorporate a comprehensive accounting of all OASI taxes and benefits and blend historical administrative data with tax and benefit projections. Projected taxes and benefits are consistent with the detailed intermediate economic and demographic assumptions underlying the 2002 Trustees Report and extended beyond the Trustees Report projection period using an approach consistent with the Trustees Report assumptions. The qualitative conclusions reached in this analysis should be unaffected by the relatively minor changes in key economic and demographic assumptions that characterize subsequent Trustees Reports.

Because the present OASI program is projected to be in long-run deficit, estimates are also developed in this paper under two stylized alternative policies that bring the program into long-run financial balance over the Trustees Report projection period and beyond. The first alternative policy achieves long-run financial balance through a series of proportional benefit award adjustments and the second alternative policy through a series of payroll tax rate adjustments.

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Lifetime outcomes for each birth cohort are examined both from the perspective of cohort members, indicating the extent to which each cohort has received or can expect to receive their “money’s worth” from the program, and from the perspective of the program, indicating the extent of redistribution across the cohorts. These estimates update similar estimates presented in Leimer (1994) and, under certain assumptions, can be used to calculate the “legacy debt” associated with program transfers to early cohorts.

This paper

- describes the methods used in this analysis to develop program and cohort outcomes under the alternative policies,
- describes and analyzes these program and cohort outcomes,
- compares these outcomes with analogous outcomes in the most comparable previous analyses and identifies key differences in assumptions and approaches underlying the different outcomes, and
- presents some concluding observations.

## **Method**

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As indicated, this analysis combines Social Security administrative data for historical years with projections of OASI outcomes under alternative tax and benefit policies conditional on the intermediate economic and demographic assumptions of the 2002

Trustees Report.<sup>1</sup> The historical and projected data include OASI benefits of all types, OASI payroll taxes of all types (including those on employees, employers, and the self-employed), and OASI benefit income tax liabilities.<sup>2</sup> These variables are identified historically and simulated prospectively through the year 2220 both as annual program aggregates and as program participant disaggregates by single year of age (from age 0 through 120, the maximum age assumed for any cohort member). This level of detail permits comprehensive estimates of the balance between lifetime taxes and benefits under the program for all past, present, and future birth cohorts affected by the program through the cohort born in 2100.<sup>3</sup> The rest of this section discusses specifics of the method adopted in this analysis.

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<sup>1</sup> See Board of Trustees of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds (2002) for additional detail on these assumptions. Subsequent Trustees Reports have incorporated relatively small incremental and sometimes offsetting changes in the intermediate economic and demographic assumptions most relevant to lifetime money's worth and redistributive outcomes across cohorts. In the 2006 Trustees Report compared to the 2002 Trustees Report, for example, total fertility rate projections are generally a bit higher but age-adjusted death rate projections are also generally a bit higher, especially for the 65 and over group; projected net immigration in the 2006 Report is initially higher (primarily for other than legal immigration) but identical to the 2002 Report after 2025; the projected growth rate in total employment is very close without a uniform direction of change between the two projections; the projected growth rate of earnings relative to compensation is generally the same while the projected growth rate in average hours worked is generally slightly higher in the 2006 Trustees Report; the projected real wage differential is generally the same in both Reports, as is the ultimate real trust fund interest rate. While details of simulations based on these projections would differ between the 2002 and 2006 Trustees Report, then, the differences in assumptions between the two Reports are relatively minor and should not affect the qualitative conclusions reached in this analysis.

<sup>2</sup> Analogous taxes and benefits for the Social Security Disability Insurance (DI) program are not included in this analysis. Under program provisions, however, DI benefits are "converted" to OASI benefits under certain circumstances, such as the disabled worker's attainment of full retirement age. Such converted benefits are included in this analysis as OASI benefits, since the converted benefits are paid out of the OASI trust fund. See the Annual Statistical Supplement to the Social Security Bulletin for further detail on the treatment of such benefits.

<sup>3</sup> The focus in this paper, then, is on historical and projected outcomes for cohorts as a whole. As such, this analysis includes, as examples, taxes paid by cohort members who for various reasons receive no benefits and benefits received by cohort members who for various reasons paid little or no taxes prior to entitlement. The treatment of cohort-specific taxes and benefits is further clarified in the remainder of this section.

## **Allocation of Secondary Benefits**

Under the OASI program, monthly benefit payments to dependents of a retired worker or survivors of a deceased worker are referred to as “secondary” benefits.<sup>4</sup> In this analysis, secondary benefits are allocated to the birth cohort of the secondary beneficiary. This allocation has been referred to as “individual-specific” and follows the general approach used in the most comparable previous studies.<sup>5</sup> An alternative allocation used in many previous studies has been referred to as the “worker-account” approach and allocates secondary benefits to the birth cohort of the worker on whose account the benefits were earned. These two secondary benefit allocation approaches provide different perspectives on the redistributive and money’s worth effects of the program, with each having advantages and disadvantages depending on the specific questions being addressed.<sup>6</sup> Because the benefit and tax data used in the present analysis are not linked on an individual-record basis, however, they permit the use of the individual-specific approach but not the worker-account approach.

## **Payroll Tax Incidence**

The allocation of payroll taxes in this analysis assumes full backward shifting of the employer portion of the payroll tax to workers in the form of lower wages. Although

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<sup>4</sup> Benefits payable to the insured worker on whose account the benefits were earned are referred to as “primary” benefits.

<sup>5</sup> As discussed below, the most comparable recent studies are Leimer (1994) and Anderson, Yamagata, and Tuljapurkar (2001). Except for benefits received by children, both of these studies allocate secondary benefits to the birth cohort of the secondary beneficiary. Although they use somewhat different empirically-based methods, both studies attempt to allocate child benefits to the birth cohorts of their parents. The present study allocates child benefits to the birth cohort of the child.

<sup>6</sup> The relative merits of the two approaches depend largely, of course, on whether the policy interest of a particular analysis is on program outcomes differentiated by the characteristics of the worker on whose account the benefits are earned or by the characteristics of the beneficiaries actually receiving the benefits. For some characteristics, such as certain family income or other family or household measures, the two approaches may lead to similar conclusions. For other characteristics, including age and gender, the two approaches can lead to different conclusions.

there is disagreement among economists about the incidence of the payroll tax, full backward shifting is the standard incidence assumption in analyses of the redistributive and money's worth effects of the Social Security program.<sup>7</sup>

### **Historical Taxes and Benefits**

The approach used in this analysis to identify historical OASI benefits of all types (all lump-sum and monthly benefit payments), OASI payroll taxes of all types, and OASI benefit income tax liabilities by year and age from Social Security administrative data is identical to the approach used and explained in detail in Leimer (2004). The only difference is that two additional years of historical data were available for the present analysis. A brief summary of the approach is provided here, but interested readers can consult Leimer (2004) for additional detail.

The aggregate OASI payroll taxes paid by workers of each age in each year from 1937 through 2001 were derived from a combination of two Continuous Work History Sample (CWHS) administrative data files.<sup>8</sup> These files contain information on annual Social Security taxable earnings for a random sample of all Social Security numbers and were used to identify OASI taxable wages and self-employment income for each valid record in each year. The associated OASI payroll tax liabilities for each of these observations were then computed using the OASI payroll tax rates and rules for that year,

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<sup>7</sup> While there is empirical support for this assumption, as a practical matter any general assumption other than full backward shifting would greatly complicate the identification of the specific groups bearing the tax. The payroll tax incidence assumption becomes more potentially problematic the greater the number of characteristics by which program participant outcomes are differentiated. In that sense, the incidence assumption should be less potentially problematic in the present analysis, which differentiates program participant outcomes only by birth cohort.

<sup>8</sup> The last available version (1977) of the 0.1 percent CWHS file, which includes annual taxable earnings back to 1937 for individual records, was used to identify OASI payroll taxes prior to 1951. The 2001 version of the larger 1 percent CWHS file, which includes annual OASI taxable earnings back to 1951 for individual records, was used for later years. See Smith (1989) for a description of the CWHS.

adjusting for complications such as multiple employers and the mix between taxable wages and self-employment income. Aggregate OASI payroll tax liabilities for workers of each age in each year were then calculated from the sample and adjusted proportionally across all ages to sum to the actual aggregate OASI payroll tax liability for that year.<sup>9</sup> In effect, the sample data were used to identify the proportional distribution of aggregate OASI payroll tax liability by age in each year.

A similar approach was used to identify historical OASI benefits by age, except that published summary tables drawn from administrative records on year-end OASI monthly benefit payments by beneficiary type and age<sup>10</sup> were used in place of electronic beneficiary sample data files. The electronic beneficiary sample data files that are available now do not contain complete historical benefit records, necessitating the use of the published summary tables. Accordingly, the proportional distribution by age of aggregate year-end OASI benefit payments from each summary benefit table was used to

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<sup>9</sup> The aggregate OASI payroll tax liability for each year was derived by applying historical OASI payroll tax rates to aggregate annual taxable wage and salary earnings and self-employment earnings (Tables 2.A3 and 4.B2 in the 2002 *Annual Statistical Supplement*). Sample payroll taxes were adjusted to aggregate controls for consistency with the benefit estimation procedure described below and because of evidence that individual wage records tend to underestimate actual taxable earnings each year based on employer reports. The adjustment adopted effectively assumes that the proportional underestimate in a given year is the same across workers of all ages.

<sup>10</sup> These summary tables have been published annually in past issues of the *Social Security Yearbook* and *Annual Statistical Supplement* to the *Social Security Bulletin* based on then available administrative data. Although the format of and specific detail in these tables have varied over time, all of the summary tables except for the years 1940-1942 report monthly benefits in current payment status as of year-end. The summary tables for 1940, the first year that monthly benefits were paid, report benefits awarded during the year. The 1941 and 1942 tables report benefits in force at year-end, where benefits in force represent benefits awarded after adjustment for terminations and other factors. As examples of the tables used, see Tables 25 through 29 in the 1940 *Social Security Yearbook* and Tables 5.A1.1 through 5.A1.8 in the 2002 *Annual Statistical Supplement*. A summary table for 1981 was not published in the *Annual Statistical Supplement*, so the distribution of benefits by age within each beneficiary category in that year was derived by interpolating between the corresponding summary benefit table estimates for 1980 and 1982.



identify the age-allocation of aggregate benefits paid from the OASI trust fund during the corresponding year.<sup>11</sup>

### **Projected Taxes and Benefits**

In this analysis, projected future OASI benefits of all types, OASI payroll taxes of all types, and OASI benefit income tax liabilities by year and age are based on and constrained by the 2002 Trustees Report detailed projections of economic, demographic, and program variables under the intermediate assumption set. These economic, demographic, and program variable projections are extended beyond the Trustees Report projection period, which ends in 2080, by assuming a continuation of patterns of change found in those projections toward the end of the Trustees Report projection period. OASI benefits and taxes by year and age are then projected through 2220 conditional on these extended economic, demographic, and program variable projections. Appendix D provides additional detail on the method used.

As indicated, this analysis simulates program outcomes under present program provisions and under two stylized alternative policies that bring the program into long-run financial balance. When projecting the effects of alternative policies, of course, aspects of the Trustees Report projections that are specific to present program provisions are modified as appropriate.

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<sup>11</sup> More precisely, the published tables allowed historical monthly benefits to be separated into five subcategories for greater accuracy. The largest subcategory includes monthly benefits to entitled retired workers, spouses of retired workers, widows and widowers, and dependent parents. The remaining four monthly benefit subcategories correspond to benefits to entitled children of retired workers, children of deceased workers, widowed fathers and mothers, and special age-72 beneficiaries. Leimer (2004) discusses the rationale underlying the composition of the five monthly benefit subcategories. The proportional distribution by age of aggregate year-end benefits within each of the five monthly benefit subcategories in the summary table for that year was then used to determine the age allocation of aggregate benefits paid from the OASI trust fund for that beneficiary subcategory during that year.

The alternative policies considered in this analysis involve across-the-board proportional adjustments in either payroll tax rates or benefit awards. Many other specific tax, benefit, or benefit award adjustment policies could have been used, of course, to bring the OASI program into financial balance over the Trustees Report projection period and beyond. Payroll tax rate adjustments and proportional adjustments in benefit awards were adopted in this analysis because these policies achieve solvency while maintaining key elements of tax and benefit determination under the present program.<sup>12</sup>

The main criteria used to select the particular tax rate and benefit award adjustment schedules used in this analysis were (1) early implementation, (2) precise attainment of the financial balance targets by the end of the Trustees Report projection period and in each subsequent year, and (3) annual tax rate or benefit award adjustment schedules, depending on the policy, that were as smooth as possible consistent with the first two criteria.<sup>13</sup> The particular tax rate and benefit award adjustment schedules identified by this process and used in this analysis, then, are reasonable, but obviously not unique, solutions. While not unique, these schedules serve to illustrate the general nature of the intercohort redistributive and money's worth effects of program changes required to achieve financial balance consistent with the Trustees Report economic and demographic

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<sup>12</sup> Benefit award reductions instead of benefit reductions across all beneficiaries were chosen as one of the stylized policies in this analysis because proposals to restore solvency to the program generally maintain scheduled benefits for present beneficiaries.

<sup>13</sup> Smooth tax rate or benefit award adjustments that hit the financial balance targets precisely in every year from the end of the Trustees Report projection period and beyond were difficult to identify. A primary source of this difficulty was the effect of prior year adjustments on current year trust fund components, especially the "momentum" associated with unchanged real benefits for those already on the beneficiary rolls in the case of the benefit award adjustment policy. Various optimization techniques were applied in an effort to identify smooth tax rate and benefit award adjustment schedules with the desired financial balance characteristics.

assumptions. Many of the qualitative insights produced by such an exercise, of course, are not dependent on the specific schedule of tax or benefit adjustments.

### **Income Taxation of Benefits**

This analysis incorporates estimates by year and age of a portion of the historical and projected income taxation of OASI benefits that began in 1984. A large portion of the proceeds from the income taxation of OASI benefits is returned to the OASI trust fund as a transfer from general revenues. Over part of the historical and all of the projection period, this portion of benefit income tax liabilities represents a significant source of the income used to finance OASI benefits.<sup>14</sup> As such, the “financial balance” principle of comparing benefits and taxes in the context of a self-financed system requires that redistributive or money’s worth estimates even gross of income taxation in general include an adjustment for the portion of benefit income tax revenues returned to the trust fund.<sup>15</sup> In the present analysis, this is accomplished by defining the total OASI tax liability for each birth cohort as the sum of their OASI payroll taxes and that portion of

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<sup>14</sup> Prior to 1994, all of the proceeds from the income taxation of OASI benefits were transferred to the OASI trust fund. Beginning in 1994, provisions exposing a greater proportion of Social Security benefits to income taxation went into effect, with the associated additional revenues transferred to the Hospital Insurance (HI) trust fund. The additional income tax revenues that are transferred to the HI trust fund do not contribute, of course, to the long-run financial balance of the OASI program. OASI benefit income tax liability excluding the portion transferred to the HI trust fund generally rose as a percent of total OASI benefits from about 1.5 percent in 1984 to about 3.2 percent in 2001.

<sup>15</sup> An alternative rationale for including the income tax liabilities deriving from OASI benefits would be to provide money’s worth estimates net of income taxation in general. At a minimum, this alternative rationale requires that all OASI benefit income taxation liabilities, including the portion transferred to the HI trust fund, be subtracted from OASI benefits or added to OASI payroll taxes.

their OASI benefit income tax liability that is ultimately returned to the OASI trust fund.<sup>16</sup>

Accurately identifying the incidence of benefit income taxation across birth cohorts in each year would require much more information than was available in the source data used for this analysis. Consequently, the effective rate of benefit income taxation (benefit income tax liability as a proportion of benefits) was assumed to be identical across birth cohorts in any given year.<sup>17</sup> This assumption introduces potential bias into the analysis. The actual effective benefit income tax rate will tend to be higher, *ceteris paribus*, for groups with higher earnings and taxable income. This might suggest that younger retirement age groups, for example, may generally experience higher effective benefit income tax rates than older retirement age groups in any given year. Such effects will tend to balance out to some extent over the lifetimes of most birth cohorts. Differences across beneficiary income groups in the effective benefit income tax rate will also tend to

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<sup>16</sup> For the lifetime net transfers and internal rate of return measures used in this analysis, it does not matter whether benefit income tax liabilities are added to payroll taxes or subtracted from gross benefits. In contrast, the interpretation of the lifetime benefit/tax ratio measure used in this analysis is affected by the inclusion of benefit income tax liabilities in the total OASI tax liabilities for each birth cohort. Specifically, contrasting gross benefits in the numerator to the sum of payroll and benefit income taxes in the denominator of the lifetime benefit/tax ratio implicitly provides a measure of the gross program benefits that are funded by all tax sources associated with the program. If, instead, benefit income tax liabilities were subtracted from gross benefits in the numerator of the ratio and compared to payroll taxes in the denominator, the lifetime benefit/tax ratio could be interpreted as a measure of the net benefits funded solely by payroll taxes under the program.

<sup>17</sup> Historically, the effective benefit income tax rate in each year from 1984 on was identified from Department of the Treasury estimates of the aggregate OASI income tax liability in that year that was ultimately transferred back to the OASI trust fund divided by aggregate OASI benefit payments in that year. For example, U.S. Department of the Treasury (2001) reports estimates for calendar years 1994–1996 based on an analysis of tax returns in those years. Unpublished final Treasury estimates were used for calendar years 1997–1999. Unpublished preliminary Treasury estimates were used for calendar years 2000–2001. Prospectively, the effective benefit income tax rate in each year was derived from the Trustees Report projections of benefit income tax transfers to the OASI trust fund as a proportion of the corresponding projections of aggregate OASI benefit payments.

diminish over time because the income thresholds beyond which benefit income taxation applies are fixed in nominal terms.

### **Interest Rate Series**

The money's worth and redistributive present value estimates<sup>18</sup> in this analysis are calculated for four alternative interest rate series. These four series correspond to (1) a nominal interest rate equal to the rate of inflation (a zero real interest rate); (2) the rate of return earned on OASI trust fund assets; (3) the total rate of return to an index of large company stocks; and (4) an interest rate equal to the growth rate in aggregate OASI taxable earnings.<sup>19</sup> The appropriate interest rate series to use in analyzing Social Security program outcomes depends on the particular questions being addressed and on how the analysis takes into account risk differentials among retirement asset types. The particular questions being addressed are defined by such issues as the nature of the alternative to

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<sup>18</sup> By way of explanation for less technical readers, the present value of a tax or benefit stream as of a selected evaluation date is equal to the sum of all the tax or benefit payments in that stream after each payment is first discounted or accumulated from the time of the payment to the selected evaluation date using a particular interest rate series. As an example, if the interest rate applicable during the period between two payments is 5 percent, the second of the two payments would be discounted by (that is, divided by) 1.05 to derive its present value evaluated at the time of the first payment, and the present value of the two-payment stream evaluated at the time of the first payment would equal the first payment plus the discounted value of the second payment.

<sup>19</sup> The historical inflation rate series and large company stock index series correspond respectively to the Consumer Price Index for all urban consumers (not seasonally adjusted) and the S&P 500 Composite index with dividends reinvested; these series can be found in Ibbotson (2003). The estimated effective annual interest rates earned historically by the OASI trust fund were taken from Kunkel (1997) for the years 1940–1988; unpublished estimates for the years 1989–2001 with additional significant digits were provided by Jeffrey L. Kunkel of the Office of the Chief Actuary of the Social Security Administration. The OASI trust fund rate for the years 1937–1939 was assumed to be the same as the rate for 1940. The historical growth rate in aggregate OASI taxable earnings was derived from the corresponding series reported in Table 4.B1 of the 2002 *Annual Statistical Supplement*. The projected inflation rate series, OASI trust fund interest rate series, and OASI taxable earnings growth rate series were taken from the intermediate assumptions of the 2002 Trustees Report and extended beyond the Trustees Report projection period by assuming a continuation of patterns of change found in those series toward the end of the Trustees Report projection period. The annual rate of return for the large company stock index series was projected to maintain the same constant proportional relationship to the OASI trust fund interest rate series prospectively as was exhibited between those two series over the last five-year historical period available for this analysis (1997–2001). This assumption leads to an ultimate nominal large company stock annual rate of return of slightly over 10 percent.

which the Social Security program is explicitly or implicitly compared and the perspective of the evaluation, whether from a program, program participant, or societal standpoint.<sup>20</sup>

Using the interest rates at which the OASI program was or is projected to be able to actually transform funds over time through trust fund saving and dissaving, for example, can be interpreted as identifying redistribution from the perspective of the program. The present value of lifetime benefits less taxes for each birth cohort, calculated using the interest rates earned by the trust fund, is a measure of the cost to the fund of those net transfers. That is, this present value reflects the amount by which the trust fund would have been different as of a selected valuation date had those specific net transfers not occurred.<sup>21</sup>

Alternatively, the interest rate series used in this analysis can be interpreted from a money's worth perspective. A complicating factor from this perspective is that the "investment" and "return" stream corresponding to lifetime Social Security taxes and benefits does not have a direct market equivalent, since the program is financed primarily on a pay-as-you-go rather than a funded basis. An individual or collective evaluation of that stream, then, requires the identification of an interest rate series that most closely reflects the perceived characteristics, including relative risk, of the Social Security

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<sup>20</sup> Money's worth and redistributional analyses often fail to rationalize their choice of interest rates despite the critical dependence of analysis conclusions on that choice. See Leimer (1995) for further discussion of some of the issues involved.

<sup>21</sup> This measure of redistribution from a program perspective abstracts from a number of complicating factors including the potential effect of large net transfers on market interest rates and therefore indirectly on the trust fund interest rate. Other complicating factors discussed more fully below include the treatment of administrative expenses and the policy basis of the trust fund interest rate determination.

“investment.” As such, the appropriate interest rate series depends in large part on the perceptions of the evaluator(s).

Standard portfolio analysis offers a clarifying perspective on this issue, with the Social Security “investment” viewed as another available portfolio asset.<sup>22</sup> The interest rate series associated with a fungible market asset effectively equates the present values of the investment and return streams expected by the market for that asset. The analogous interest rate for a mature, pure pay-as-you-go social insurance program is the rate of growth in the tax base used to finance the program. That is, the rate of growth in the underlying tax base represents the major component of the rate of return to program participants generated on average in a mature, sustainable pay-as-you-go social insurance retirement program.<sup>23</sup> Society can collectively gain access to this pay-as-you-go

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<sup>22</sup> Previous Social Security money’s worth and redistributive analyses generally have not adopted this perspective. Some analysts have argued on a theoretical basis for the use of higher interest rates based on riskier market investments, as discussed below; a more common approach has been to use an interest rate based on relatively safe market investments, such as the rate of return to U.S. Treasury securities, but this approach has generally been based more on convention than on any rigorous rationale.

<sup>23</sup> In this context, “mature” implies an existing program, past its startup period, with benefits financed by a temporally constant tax rate on the economic aggregate that serves as the program’s tax base; “pure” implies that benefits are financed solely by taxes under the program, without a trust fund; “sustainable” implies that lifetime benefit adjustments of some type are automatically or episodically applied as required to maintain the solvency of a mature program over time in response to changing economic and demographic conditions. Relaxing these program characteristics can generate corresponding changes in the rate of return to affected program participants. The investment returns to a contingency or partial trust fund, for example, can affect the overall program rate of return as can the use of episodic tax adjustments to maintain program solvency. Such effects are discussed and illustrated in Leimer (2005a). Over the long-run, however, the rate of growth in the tax base necessarily represents the major component of the rate of return to a mature, sustainable program financed predominantly on a pay-as-you-go basis. Despite misstatements about program sustainability sometimes encountered in the current Social Security policy debate, pay-as-you-go programs can be designed to achieve guaranteed sustainability analogously to funded programs, with the degree of difficulty in both cases depending on program characteristics such as redistributive goals and the pooling of various types of economic and demographic risks. See Leimer (2005b) for additional discussion.

retirement “asset” with historically attractive risk and return characteristics<sup>24</sup> by establishing a mandatory public retirement program financed on a pay-as-you-go basis. Assuming that the size of a pay-as-you-go program is consistent with the share of the program in the optimal retirement portfolio,<sup>25</sup> then, the growth rate in the program’s tax base represents a logical choice for the interest rate series used to evaluate lifetime taxes and benefits under the program. Consequently, the growth rate in aggregate OASI taxable earnings is included as one of the interest rate series in this analysis.

Various other characteristics of the program, however, can require adjustments to the appropriate interest rate series for evaluating program outcomes. Some features of the Social Security program can reduce overall portfolio risk for program participants; other features of the program are “market-improving” in the sense of addressing various deficiencies of private insurance and annuity markets. Some examples include the automatic inflation adjustment of benefits after entitlement without default risk, the effective provision of actuarially fair annuities without the inefficiencies of adverse selection, insurance against various types of human capital and earnings risk, and advantageous retirement portfolio intercorrelations.<sup>26</sup> These potential market-improving

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<sup>24</sup> Leimer (2005b) provides additional discussion of this point in the context of the present Social Security policy debate. There is a growing literature concerning the potential welfare gains associated with pay-as-you-go retirement programs in the context of stochastic asset returns. As examples, see Leimer and Richardson (1992); Leimer and Pattison (1998); Dutta, Kapur, and Orszag (2000); and Matsen and Thogersen (2004). Krueger and Kubler (2006) also provide support for the potential portfolio-enhancing welfare gains of an unfunded social security system but conclude that the potential capital crowding-out effects of such a system may overturn these gains. Leimer (2005b), however, discusses ways in which the portfolio-enhancing welfare gains of a social security system can be captured without these potential capital crowding-out effects.

<sup>25</sup> Again, see Leimer (2005b) for further elaboration of this qualification.

<sup>26</sup> See Leimer and Richardson (1992) for a discussion of some of the associated theoretical issues, empirical estimates from the perspective of program participants, and references to other contributions in the literature. A potentially important implication of their empirical estimates is that consumers may even use a negative real interest rate when discounting expected Social Security taxes and benefits.



and portfolio-enhancing features of the program suggest the use of an interest rate lower than the tax base growth rate to evaluate program outcomes, since such features lower the overall risk of the Social Security “investment” below that represented by the program’s financing basis. Alternatively, some analysts argue on a theoretical basis that the program is subject to demographic, economic growth, and political risks that justify the use of a higher interest rate in money’s worth analyses.<sup>27</sup> In short, different evaluators have different perceptions of the appropriate interest rate to use in analyzing lifetime outcomes under the Social Security program.<sup>28</sup>

In this context, the zero real interest rate series can be interpreted as incorporating a downward adjustment from the OASI taxable earnings growth rate series to adjust at least in part for various portfolio-enhancing and market-improving characteristics of the Social Security program. Alternatively, the OASI trust fund interest rate series can be interpreted as a proxy for a government bond rate series<sup>29</sup> that prospectively incorporates an increment to the OASI taxable earnings growth rate series that is slightly larger than

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<sup>27</sup> As examples, see Browning (1985) and Caldwell, Favreault, Gantman, Gokhale, Johnson, and Kotlikoff (1999). Issues central to the relative riskiness of the Social Security “investment” are discussed in greater detail in Leimer (1994, 1995, 2005b); Geanakoplos, Mitchell, and Zeldes (1999); Mariger (1999); and Diamond and Orszag (2005).

<sup>28</sup> As such, identification of the interest rate effectively used by program participants is an empirical issue deserving additional investigation.

<sup>29</sup> Over nearly all of the historical period, the rates of return on the special Treasury obligations held by the trust funds were based on the rates for marketable Treasury obligations sold to private investors. The mean and sample variance of the real annual rate of return to OASI trust fund assets over the 1940–2001 period both lie between the corresponding statistics for the Ibbotson (2003) intermediate-term government bond series and U.S. Treasury bill series. See Kunkel (1997, 1999) for further information on the determination and history of the rates earned on trust fund assets.

the decrement represented by the zero real interest rate series.<sup>30</sup> Since a few studies have used even higher interest rates to evaluate the Social Security program, estimates using the large company stock series are also included in this analysis, providing a comparison with a private investment alternative that has exhibited both higher risk and higher return, on average, than a government bond series over the historical period.<sup>31</sup>

The various interest rate series and redistributive and money's worth measures included in this analysis, then, are intended to facilitate comparison with previous analyses and to increase the range of questions to which the results can be applied. Two fundamental implications of this analysis are that (1) the evaluation of program outcomes, whether from a program, participant, or societal perspective, depends critically on the interest rates used in the analysis and (2) in a stochastic world where retirement saving alternatives have different risk and return characteristics including crucial intercorrelations, the choice of an appropriate risk-adjusted interest rate to evaluate program outcomes is difficult and controversial.

### **Administrative Expenses**

The redistributive and money's worth measures presented in this paper do not adjust for the costs of administering the program. Some of the taxes collected under the program are used to cover the expenses of administering the program, which necessarily creates an

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<sup>30</sup> Under the 2002 Trustees Report projections, the geometric mean of the nominal OASI taxable earnings growth rate series over the prospective 2002-2080 period is about 1.5 percentage points larger than the geometric mean of the nominal inflation rate series, while the geometric mean of the nominal OASI trust fund interest rate series is about 1.7 percentage points larger than the geometric mean of the nominal OASI taxable earnings growth rate series over the same period.

<sup>31</sup> Over the 1930-2001 period, for example, the mean and standard deviation were respectively about 0.087 and 0.200 for the Ibbotson (2003) real large company stock rate of return series compared to the corresponding statistics of 0.023 and 0.071 for the Ibbotson intermediate-term government bond rate series.

imbalance between taxes and benefits. Analogous and potentially higher expenses would be associated with private alternatives to the retirement saving, annuity, and survivors insurance features of the OASI program.<sup>32</sup> Estimated negative values for lifetime benefits less lifetime taxes, then, do not by themselves suggest that the corresponding groups of program participants are net redistributive losers from a program perspective<sup>33</sup> or fail to receive their money's worth under the program from a participant perspective.<sup>34</sup>

## **Analysis**

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This section presents and analyses OASI program outcomes simulated under present law provisions and under the two stylized alternative policies that bring the program into long-run financial balance consistent with the underlying Trustees Report projections. Program outcomes that are simulated by applying the OASI benefit and tax provisions now scheduled under present law are denoted in the discussion as “present law” outcomes.<sup>35</sup> The two alternative policies adopted in this analysis to restore solvency

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<sup>32</sup> A common deficiency of redistributive and money's worth analyses is that they ignore the administrative costs of the alternative to which the Social Security program implicitly is being compared, biasing the comparison against Social Security. To the extent that they can be identified, of course, the administrative costs of specific alternatives to the Social Security program could be incorporated into such analyses. Administrative costs, operating expenses, and loading charges in private markets in part reflect marketing costs, adverse selection, and the inability to exploit the economies of scale enjoyed by a compulsory, nearly universal, public program.

<sup>33</sup> Because administrative expenses represent a necessary cost associated with the provision of the retirement saving, annuity, and survivors insurance features of the program, net redistribution from a program perspective might be defined as the accumulated value of a group's benefits plus the accumulated value of their allocated share of administrative expenses less the accumulated value of their taxes.

<sup>34</sup> There are, of course, a variety of other reasons why money's worth measures may not accurately reflect the value of the program to participants, including the failure of money's worth measures to adjust for market imperfections, general equilibrium effects, and individual preferences regarding risk and other program characteristics. Some of these effects are discussed more fully below. See Leimer (1995) and Geanakoplos, Mitchell, and Zeldes (1999) for additional discussion.

<sup>35</sup> Because the program is projected to be out of long-run financial balance under present law provisions, however, the “present law” simulations imply the need for program revenue transfers that are not included in those simulations.

consistent with the Trustees Report projections are referred to in the discussion as the “balanced budget” award and tax adjustment policies. The discussion first identifies the benefit award and tax rate adjustments adopted to achieve solvency<sup>36</sup> and then examines the associated lifetime money’s worth and redistributive outcomes for past, present, and future birth cohorts under the alternative policies.

### **Benefits and Taxes under the Policy Alternatives**

**Balanced Budget Award Adjustment Policy.** The balanced budget award adjustment policy adopted in this analysis employs a series of annual proportional adjustments in benefit awards, beginning in 2015, that bring the OASI program into financial balance over the Trustees Report projection period through 2080 as well as in all subsequent years. These award adjustments effectively extend the drawdown of the OASI trust fund so that the trust fund/expenditure ratio gradually declines until equaling 1.0 in 2080. Beyond 2080, the benefit award adjustments are derived endogenously as those required to maintain an annual trust fund/expenditure ratio of 1.0 in each year. Financial balance is defined in this instance, then, as the attainment and maintenance of a trust fund equal to annual expenditures by 2080 and beyond.<sup>37</sup> This balanced budget award adjustment policy can be conceptualized as a series of annual proportional adjustments to all of the marginal “replacement rates” in the present law benefit formula, with the effect that

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<sup>36</sup> Leimer (2005a) displays and discusses projections of other annual program variables under the present law and balanced budget policies.

<sup>37</sup> A trust fund reserve equal to annual expenditures is the contingency reserve target used in determining long-run solvency in the annual Trustees Report. See, for example, the definition of the “summarized cost rate” on page 195 of the 2002 Trustees Report.

initial benefit awards in a given year across all beneficiary types and ages experience the same proportional adjustment.<sup>38</sup>

A wide variety of benefit adjustments, including the type of proportional award adjustments simulated in the present analysis, are available to meet specific cost objectives. The choice among these alternatives depends, of course, on the desired adequacy, equity, and efficiency goals of the program.<sup>39</sup> The particular award adjustment policy adopted for this analysis is not intended to convey any special merit relative to those goals and was identified primarily on the basis of the technical criteria described above.<sup>40</sup>

The adjustment factor applied in each simulation year to present law OASI benefit awards under the balanced budget award policy is displayed in Chart 1. This chart illustrates rather dramatically the extent of the award adjustments required to maintain solvency at present tax rates under the extended Trustees Report assumptions. The award adjustment factor in Chart 1 represents aggregate benefit awards in each year under the

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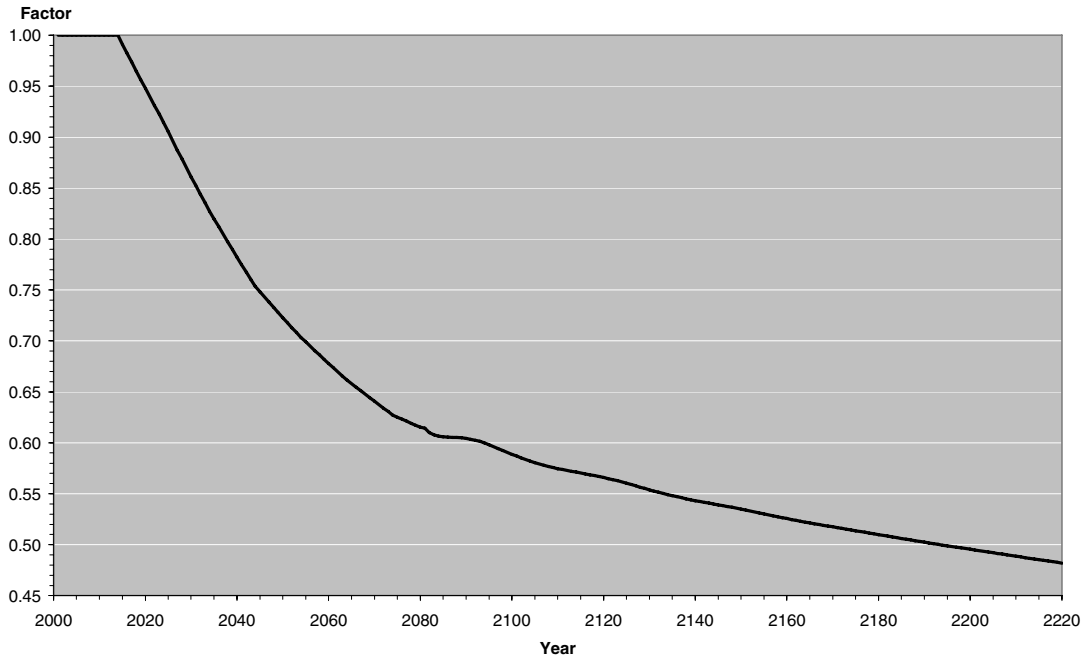
<sup>38</sup> See the *Annual Statistical Supplement to the Social Security Bulletin* for details of the determination of benefit awards under the present program. For the most part, monthly benefit awards on the account of a given worker, whether primary or secondary benefits, are derived under present law by applying proportional adjustments to the “primary insurance amount,” or “PIA,” calculated for that worker. The PIA is derived by applying a series of declining “replacement rates” (as given, for example, in Table 2.A11 in the 2002 *Annual Statistical Supplement*) to a measure of the lifetime taxable earnings for that worker denoted as “average indexed monthly earnings,” or the “AIME.” There are three AIME brackets in the PIA benefit formula, with successive marginal replacement rates of 90 percent, 32 percent, and 15 percent for the three brackets. The three AIME bracket thresholds or “bend points” are increased each year in the same proportion as the increase in a measure of the national average wage level, the same average wage measure used to index lifetime taxable earnings in the AIME calculation.

<sup>39</sup> Leimer, Hoffman, and Frieden (1978) and Leimer (1979) discuss the various components of the Social Security benefit structure and the roles of these components in achieving the desired intracohort and intercohort adequacy and equity goals of the program.

<sup>40</sup> While the focus in this study is on money’s worth and redistributive effects across cohorts, policies that incorporate future reductions in average benefit awards may (depending on societal preferences) require strengthening the progressivity of the benefit formula within cohorts to preserve or enhance benefit adequacy for lower lifetime earners or address other equity concerns. This is particularly important if projected increases in longevity do not result in a narrowing of differential mortality by economic status.

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**Chart 1.**  
**OASI benefit award adjustment factor under the balanced budget award policy, by year**



SOURCE: Author's calculations.

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balanced budget award policy as a proportion of the aggregate benefits that would have been awarded in that year under present law. Benefit awards under the balanced budget award policy equal those under present law through 2014, then decline to about 62 percent of present law benefit awards by 2080, and then generally decline further at a more gradual pace to about 48 percent of present law benefit awards by the end of the extended projection period in 2220. This continuing decline in benefit awards under the balanced budget award policy relative to present law is attributable to the projected

continuing improvements in mortality under the Trustees Report and extended projections.<sup>41</sup>

The data displayed in Chart 1 reflect benefit award reductions relative to those scheduled under present law, not relative to benefit awards in preceding years. The average nominal benefit award to new retirees under the balanced budget award policy increases in every year despite the reductions relative to present law. The average real benefit award to new retirees does decline in some years under the balanced budget award adjustment policy during the period of steepest declines relative to present law toward the start of the policy.<sup>42</sup> Benefits after entitlement are automatically adjusted for inflation in each subsequent year under the balanced budget award policy (and under the balanced budget tax policy), just as under present law.

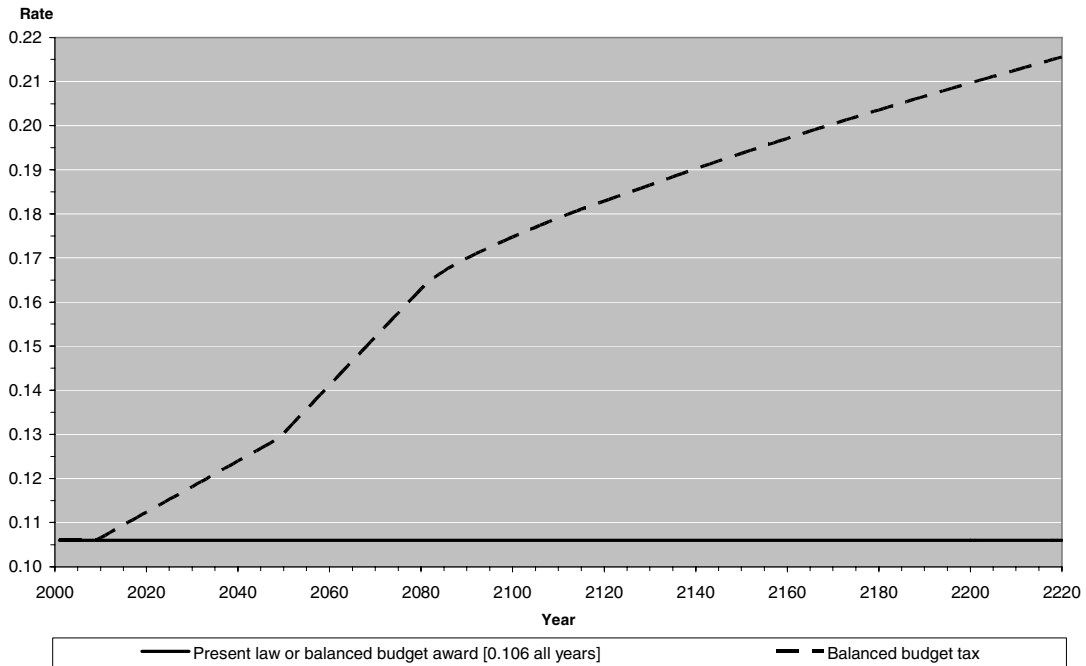
**Balanced Budget Tax Adjustment Policy.** The combined employer and employee payroll tax rate under each of the three policies simulated in this analysis is displayed in Chart 2. The combined tax rate under the balanced budget award policy remains at 10.6 percent, the same rate scheduled under present law.

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<sup>41</sup> The primary factor driving the growing divergence over time between projected expenditures and non-interest revenues under present law is the continuing declines in mortality rates underlying the Trustees Report and extended projections. See Leimer (2005a) for additional discussion of this result and its policy implications.

<sup>42</sup> Over the entire 2015-2220 simulation period affected by the policy, the real average benefit award to new retirees declines from the preceding year in 15 years. All of these real declines occur in the 25 years from 2017 through 2041 and are under one percent in all but two of those years, with the largest real decline from the previous year being 1.78 percent in 2022. In practice, additional constraints could be placed on a balanced budget award adjustment policy to preclude, for example, any reduction in the real average benefit between successive years. Again, the stylized policies simulated in this analysis are simply intended to illustrate the general effects of policies of this type.

**Chart 2.**  
**OASI combined payroll tax rate, by policy and year**



SOURCE: Author's calculations.

Under the balanced budget tax policy, the combined payroll tax rate increases linearly each year beginning in 2010<sup>43</sup> until reaching about 12.9 percent in 2049 and then increases annually at a faster linear rate until reaching about 16.3 percent in 2080. This tax rate schedule has the effect of extending the drawdown of the OASI trust fund so that the trust fund/expenditure ratio gradually declines until equaling 1.0 in 2080, analogous to the corresponding pattern under the balanced budget award policy.

<sup>43</sup> A tax increase policy can generally be effected with less lead time between the policy announcement and implementation dates than an award reduction policy—an award reduction policy must generally give workers additional time to adjust their retirement plans. The stylized policies simulated in this analysis illustrate this difference by adopting an implementation date for the award adjustment policy that is 5 years beyond the implementation date for the tax adjustment policy.



Financial balance is defined for both of the balanced budget policies as the attainment and maintenance of a trust fund equal to annual expenditures by 2080 and in all subsequent years.<sup>44</sup> The tax rates displayed in Chart 2 beyond 2080 for the balanced budget tax policy, then, are derived endogenously as the tax rates required to maintain an annual trust fund/expenditure ratio of 1.0 in each of those years. As such, this policy illustrates the extent of the tax rate increases required to maintain solvency with present law benefit provisions under the extended Trustees Report assumptions.

Primarily because of the projected continuing improvements in mortality, the payroll tax rates required to maintain an annual trust fund equal to annual expenditures continue to increase over the full simulation period, reaching a combined rate of nearly 21.6 percent by 2220, the last simulation year. Continuing increases in contributions to maintain financial balance in response to continuing mortality improvements are equivalent to a continuing succession of small program expansions. As a consequence, such a policy is not sustainable over the very long-run. At some point, further increases in contributions would cause the program to grow beyond its optimal size. This general increasing contribution or benefit reduction consequence of continuing mortality improvements applies to any retirement program, regardless of its ownership or funding basis (whether publicly or privately owned, whether fully funded, partially funded, or funded on a pure pay-as-you-go basis).<sup>45</sup>

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<sup>44</sup> This definition of financial balance results, of course, in different trust fund levels and interest earnings between the two balanced budget policies corresponding to their differences in annual expenditures. Leimer (2005a) provides a more complete discussion of these trust fund differences and their policy implications.

<sup>45</sup> See Leimer (2005a) for additional discussion of the policy implications of continuing mortality improvements over the long run.

## **Money's Worth and Redistributive Measures by Birth Cohort**

The remaining charts and tables in this section present various money's worth and redistributive measures of lifetime outcomes by birth cohort under present law and under the two stylized balanced budget policies. Appendices A through C present corresponding estimates in table form by single-year birth cohort under each of the policies.

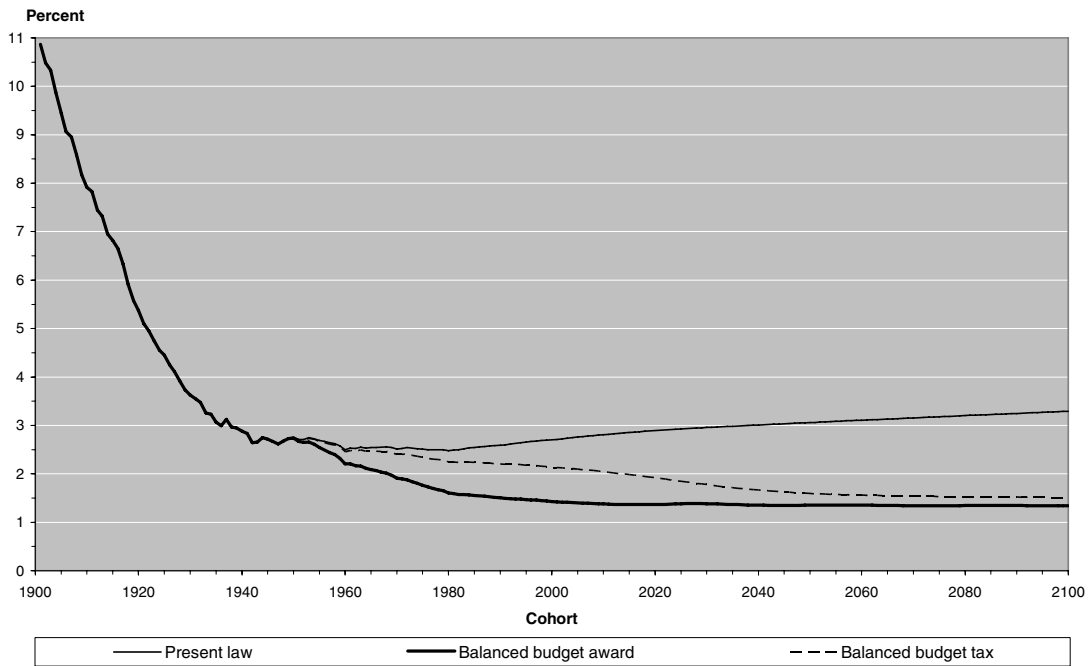
**Real Internal Rate of Return.** One measure of the relative balance between taxes and benefits for each birth cohort is the internal rate of return. The real internal rate of return<sup>46</sup> for each annual birth cohort considered in this analysis is displayed in Chart 3 under the three alternative policies. One striking feature of Chart 3 is the steep decline in internal rates of return across the early birth cohorts, following the expected general pattern for a maturing pay-as-you-go social insurance program that grants generous benefits to early cohorts that have not contributed to the program over full working lives. The real internal rate falls from 18.37 percent for the collective cohort group born through 1900 to about 2.71 percent for the 1945 single-year birth cohort under each of the policies considered.<sup>47</sup> Lifetime outcomes for these early cohorts are largely unaffected by the prospective policy changes considered in this analysis, but the rates of return begin to diverge more noticeably across policies for cohorts born after about 1950.

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<sup>46</sup> The real internal rate of return is defined in this application as the constant interest rate that equates the present values of benefits and taxes for each birth cohort as a whole, where the cohort benefit and tax streams are first converted to constant dollars (that is, indexed to remove the effects of measured or projected inflation). Multiple internal rates of return are possible given the nature of the lifetime net transfer flows under the OASI program. The internal rate of return algorithm adopted in this analysis searches first for the positive root closest to zero and then similarly searches the negative domain if no positive root is found. A positive root was found, however, for all of the cohorts considered in this analysis.

<sup>47</sup> The results displayed in Charts 3 through 11 begin with the 1901 single-year birth cohort. Results for the collective cohort group born prior to 1901 are reported in the text and in the appendix tables.

**Chart 3.**  
**OASI real internal rate of return, expressed as a percent, by policy and cohort**



SOURCE: Author's calculations.

Because award reductions affect earlier cohorts than tax increases when instituted at about the same time, the internal rates of return in Chart 3 are lower for earlier affected cohorts under the balanced budget award policy than under the balanced budget tax policy. For later cohorts, internal rates remain higher in Chart 3 under the balanced budget tax policy than the under the balanced budget award policy in large part because the balanced budget tax policy effectively incorporates a succession of small program expansions in response to declining mortality rates.<sup>48</sup> For the most distant cohorts, the

<sup>48</sup> As indicated above, the trust fund and associated interest earnings are somewhat larger under the tax adjustment policy than under the award adjustment policy given the balanced budget criteria and fixed economic assumption set adopted in this analysis; these larger trust fund earnings contribute further to the higher internal rates of return under the balanced budget tax policy. These factors have analogous effects for the other money's worth and redistributive measures under the alternative policies, but are not discussed further in this analysis. See Leimer (2005a) for a more complete discussion.

projected internal rates of return in Chart 3 are about 1.34 percent under the balanced budget award policy and about 1.51 percent under the balanced budget tax policy.

Clearly, the earliest cohorts have gotten much more than their money's worth from the OASI program as indicated by their very high internal rates of return. Whether all present and future cohorts will continue to receive their money's worth from the program is a much more difficult question to answer because of disagreement over the appropriate rate of interest to use for comparison. If a risk-adjusted real interest rate less than about 1.35 percent is deemed appropriate, as suggested by some research,<sup>49</sup> then the estimates displayed in Chart 3 indicate that even the most distant birth cohorts are projected to receive their money's worth from the OASI program under either of the balanced budget policies considered. If instead a risk-adjusted real interest rate of 2 percent or above is considered appropriate,<sup>50</sup> then the estimates displayed in Chart 3 indicate that no cohort born after about 2015 is projected to receive their money's worth from the program under either of the balanced budget policies considered.

While internal rates of return under all three policies are included in Chart 3 for expositional convenience, it should be noted that it is inappropriate to compare money's

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<sup>49</sup> As noted above, Leimer and Richardson (1992) found evidence that the appropriate interest rate from the perspective of consumers may even be negative. More generally, Leimer and Pattison (1998) found that, based on historical rates of return for broad asset classes, a pay-as-you-go retirement program with an earnings-related tax base can effectively create a retirement saving "asset" that increases expected portfolio returns over a substantial range of risk. Such results can be interpreted as suggesting that the rate of growth in the pay-as-you-go program's tax base represents an upper bound for the risk-adjusted rate of return that is appropriate for evaluating program outcomes over that range of risk subject to the constraint, of course, that the program size remains at or below a level consistent with an outward shift of the retirement asset portfolio efficiency frontier.

<sup>50</sup> As indicated above, some analysts argue for the use of higher interest rates in Social Security analyses because of such factors as the demographic, economic growth, and political risks potentially affecting the future level of taxes and benefits. It should be kept in mind, however, that all private and public pension programs are affected by such risks, including political risks associated with possible changes in the regulatory provisions or tax treatment of such programs and associated investments.

worth and redistributive outcomes across policies that have different unfunded liabilities.<sup>51</sup> In the context of the present analysis, policies with different unfunded liabilities likely also have different macroeconomic effects and related behavioral responses<sup>52</sup> that are inconsistent with the fixed economic and demographic assumption set upon which the analysis is based.<sup>53</sup> As such, analyses based on an essentially fixed set of economic and demographic assumptions are best suited to examining the redistributive effects of a given policy or of alternative policies with equal unfunded liabilities where it might reasonably be assumed that the policies are consistent with the fixed assumption set.<sup>54</sup> The present analysis consequently focuses on the intercohort money's worth and redistributive effects of a given policy conditional on the extended Trustees Report demographic and economic assumption set, although differences in

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<sup>51</sup> See Leimer (2005a) for a more complete discussion of this issue. A “closed group” concept of unfunded liability is intended here, reflecting the expected net present value cost of the benefit and tax “promises” made under a given policy to the affected population, less the value of the trust fund assets that can be applied to meet those promises. For the affected population at a given time, this unfunded liability definition represents the amount by which the trust fund falls short of a fully funded level.

<sup>52</sup> An alternative perspective that has been proposed (see Barro (1974, 1978, 1989)) is that (1) the intercohort transfers effected by the Social Security program may simply substitute public transfers for private transfers that would have occurred otherwise and that (2) any Social Security transfers in excess of those that would have occurred privately may be offset by increased private transfers back to younger generations to compensate them for the associated increased unfunded liability of the program. To the extent that these arguments hold, the money's worth and redistributive estimates presented in this paper become interesting accounting measures with little policy relevance—the redistribution identified by these estimates would have either occurred privately in the absence of the OASI program or been negated by offsetting private transfers. A companion implication is that the program would have no macroeconomic effects under such conditions because of these offsetting private responses.

<sup>53</sup> The approach of using an essentially fixed economic and demographic assumption set to analyze the effects of policies with different unfunded liabilities might be justified in the context of a small open economy, but such a context is unrealistic for the U.S. economy. Alternatively, attempts to justify such an approach by effectively assuming other, offsetting, policies or behavioral responses in the public or private sector sufficient to maintain the validity of the fixed assumption set have the problem that the detailed effects of those offsetting policies or responses are not included in the analysis, leaving a partial and misleading representation of the total effects of the policies under those assumptions. Leimer (2005a) provides a more complete discussion of this issue.

<sup>54</sup> This latter application implicitly requires that the unfunded liabilities be identical between policies at every point in time and abstracts from other macroeconomic effects arising, for example, from different microeconomic distributions of the aggregate unfunded liabilities and different public perceptions of implicit and explicit government debt. In practice, of course, these omitted macroeconomic effects may also be important.

estimated outcomes across the policies are explained in the context of this fixed assumption set.<sup>55</sup>

In addition, outcomes under present law are not discussed for the remaining money's worth and redistributive measures considered in this analysis because the present program is projected to be out of long-run financial balance. For money's worth and redistributive measures to be meaningful, the analysis must include all of the funding sources that are required to finance the benefits included in the analysis, a requirement that the present program fails to satisfy without further assumptions about how the long-run deficit in the program will be resolved.<sup>56</sup>

**Lifetime Benefit/Tax Ratio.** Another relative money's worth measure is the lifetime benefit/tax ratio, defined here as the ratio of the present values of lifetime benefits and taxes for each birth cohort as a whole using a particular interest rate series. A lifetime benefit/tax ratio of one, then, indicates that the estimated present values of lifetime benefits and taxes are equal for the cohort as a whole. Ratios greater (less) than one indicate that lifetime benefits are estimated to be greater (less) than lifetime taxes for that cohort.

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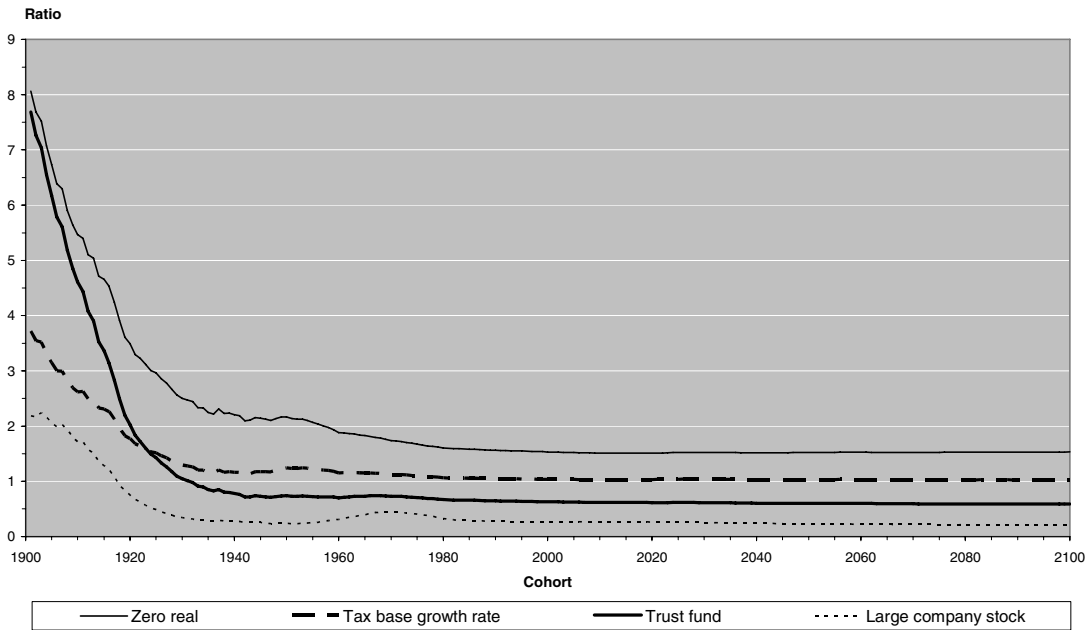
<sup>55</sup> In addition to the broader economic effects discussed in this paragraph, alternative policies can have other effects that are not captured by relatively narrow lifetime money's worth and redistributive measures. In addition to the market-improving and portfolio-enhancing effects discussed above, these other effects can include increased capital market access for some in a funded program; potential administrative cost reductions and freedom-of-choice tradeoffs in a mandatory program; and differences in the political feasibility of alternative financing approaches. Articles that discuss these general issues include Leimer and Pattison (1998), Geanakoplos, Mitchell, and Zeldes (1999), Mariger (1999), Diamond and Orszag (2005), and Leimer (2005b).

<sup>56</sup> Estimates of the various money's worth and redistributive measures by birth cohort under present law are included in Appendix A for comparison purposes, but these estimates should be interpreted with the understanding that they include unfunded benefits.

The estimated OASI lifetime benefit/tax ratio across birth cohorts for each of the four interest rate series considered in this analysis under the two balanced budget policies are displayed in Charts 4 and 5. Both charts exhibit a relatively rapid decline in the lifetime benefit/tax ratio across the early cohorts, analogous to the decline in internal rates of return across those cohorts. Under each of the balanced budget policies, the lifetime benefit/tax ratio for the collective cohort group born through 1900 ranges from 12.04 under the OASI trust fund interest rate assumption to 3.21 under the large company stock total rate of return series. By the 1945 single-year birth cohort, these ratios are lower under all of the interest rate assumptions, ranging from 2.14 for the zero real interest rate series to 0.26 for the large company stock series. As with the real internal rate of return measure, the lifetime benefit/tax ratios begin to diverge more noticeably between the two balanced budget policies for cohorts born after about 1950, as projected benefits and taxes begin to play a more important role and historical outcomes a less important or nonexistent role. For the most distant cohort (born in 2100) simulated in this analysis, the lifetime benefit/tax ratio ranges from 1.53 for the zero real interest rate series to 0.21 for the large company stock series under the award adjustment policy (Chart 4) and ranges from 1.61 for the zero real interest rate series to 0.22 for the large company stock series under the tax adjustment policy (Chart 5).

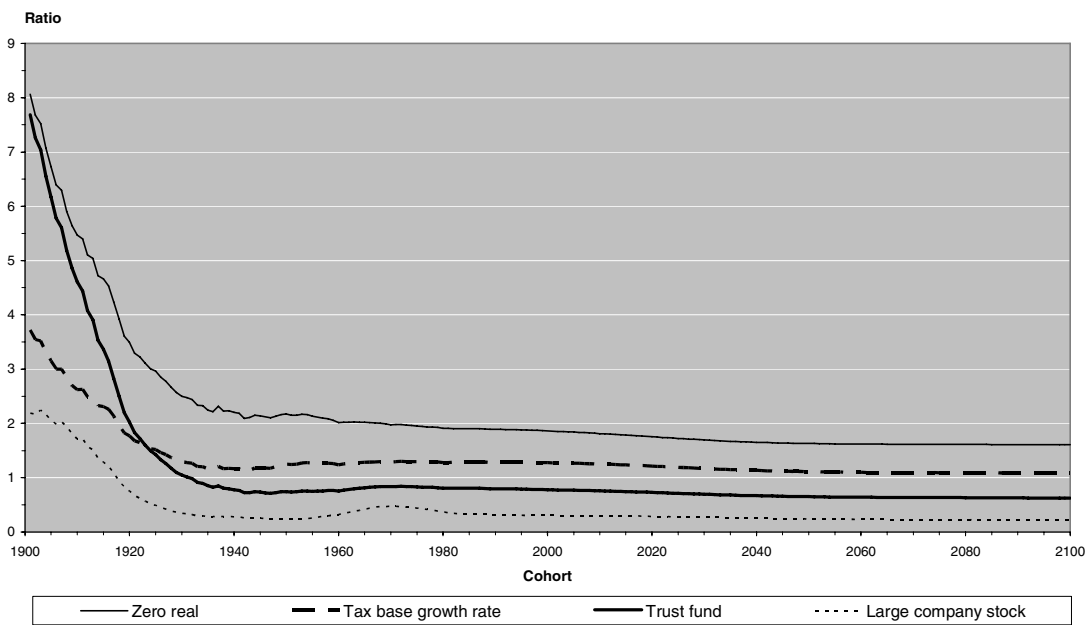
The general levels of and relationships among the lifetime benefit/tax ratio plots for each interest rate series in both Charts 4 and 5 reflect the general levels of and relationships among the interest rate series themselves—generally, the higher the interest rate assumption, the lower the lifetime benefit/tax ratio, given the predominant life cycle pattern of early tax payments and later benefit receipts under the OASI program. Over the

**Chart 4.**  
**OASI lifetime benefit/tax ratio under the award adjustment policy, by interest rate assumption and cohort**



SOURCE: Author's calculations.

**Chart 5.**  
**OASI lifetime benefit/tax ratio under the tax adjustment policy, by interest rate assumption and cohort**



SOURCE: Author's calculations.



entire projection period and much of the historical period, the general order of the interest rate series, from lowest to highest, is the zero real, OASI tax base growth rate, OASI trust fund, and large company stock series. The early-cohort cross-over in the lifetime benefit/tax ratio measures between the tax base growth rate and trust fund interest rate assumptions in both Charts 4 and 5 is linked to a corresponding cross-over in the historical levels of those interest rate series.<sup>57</sup>

A result of special interest in Charts 4 and 5 is the level of the benefit/tax ratios under each policy and interest rate assumption relative to a value of one. Under all of the interest rate assumptions, the benefit/tax ratios for the earliest cohorts exceed one by substantial margins, indicating lifetime benefits well in excess of lifetime taxes. As was evident with the internal rate of return measure, however, the question of whether present and future cohorts will continue to experience lifetime benefits in excess of lifetime taxes depends critically on the risk-adjusted interest rate deemed appropriate for the lifetime benefit/tax ratio calculation.

The lifetime benefit/tax ratios displayed in Charts 4 and 5 exceed one for all past, present, and future birth cohorts for both the zero real and tax base growth rate interest rate assumptions under either balanced budget policy. This result is consistent with the interpretation that factors such as the market-improving and portfolio-enhancing features of the OASI program justify the use of a relatively low interest rate in the lifetime benefit/tax calculation and imply that all cohorts can benefit from the establishment and continuation of such a program.

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<sup>57</sup> The OASI tax base growth rate exceeded the OASI trust fund interest rate in 33 of the 43 years prior to 1981 and had a much higher average real rate (4.76 percent vs. -0.61 percent) and geometric mean real rate (4.51 percent vs. -0.67 percent) during that historical period.

In contrast, the lifetime benefit/tax ratios fall below one for many present and all future birth cohorts for both the trust fund and large company stock interest rate assumptions under either balanced budget policy. This result is consistent with the interpretation that factors such as the market-improving and portfolio-enhancing features of the OASI program are insufficient to justify the use of a relatively low interest rate or are dominated by offsetting program characteristics such as perceived political risk differentials, making a higher interest rate assumption more appropriate.<sup>58</sup> Because a mature public retirement program financed on an essentially pay-as-you-go basis tends to generate a rate of return for program participants largely determined by the growth rate in the program's tax base, lifetime benefit/tax ratios will tend to be greater (less) than one if a risk-adjusted interest rate series generally smaller (larger) than the growth rate in the program tax base is used to calculate lifetime taxes and benefits.

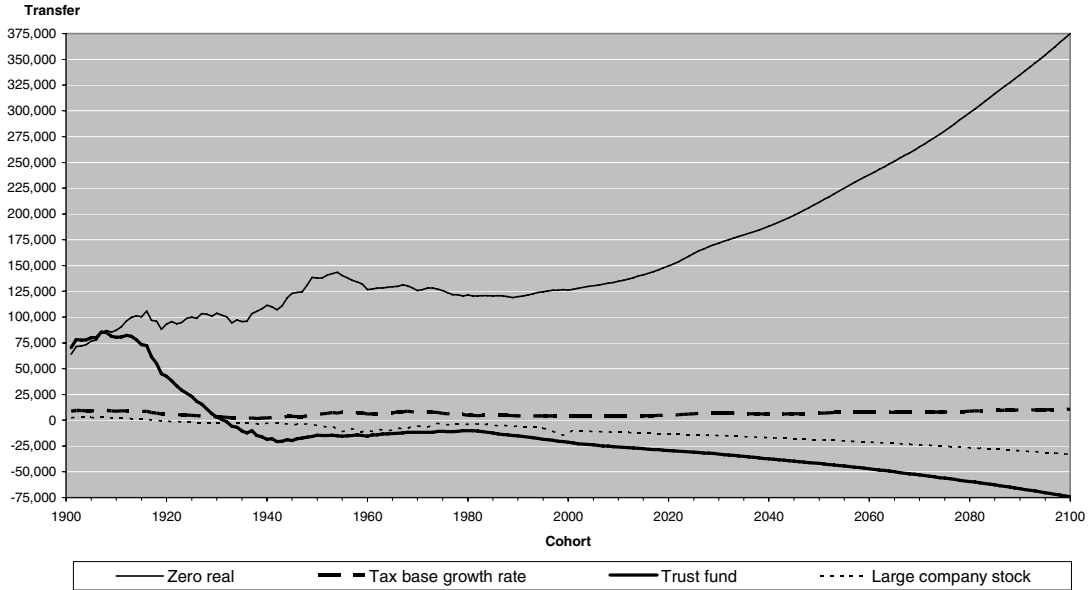
**Lifetime Net Transfer per Initial Cohort Member.** In contrast to the relative measures of lifetime outcomes presented thus far, measures of the absolute difference between lifetime benefits and taxes under the OASI program across birth cohorts are displayed in Charts 6 through 9. These charts again illustrate the dependence of OASI lifetime money's worth and redistributional estimates on the particular interest rate assumption used to evaluate program outcomes but also illustrate that the relationships across the alternative interest rate series can differ between the relative and absolute measures.

The estimates displayed in Charts 6 and 7 can be interpreted as evaluating money's worth outcomes from the perspective of program participants. These charts display the

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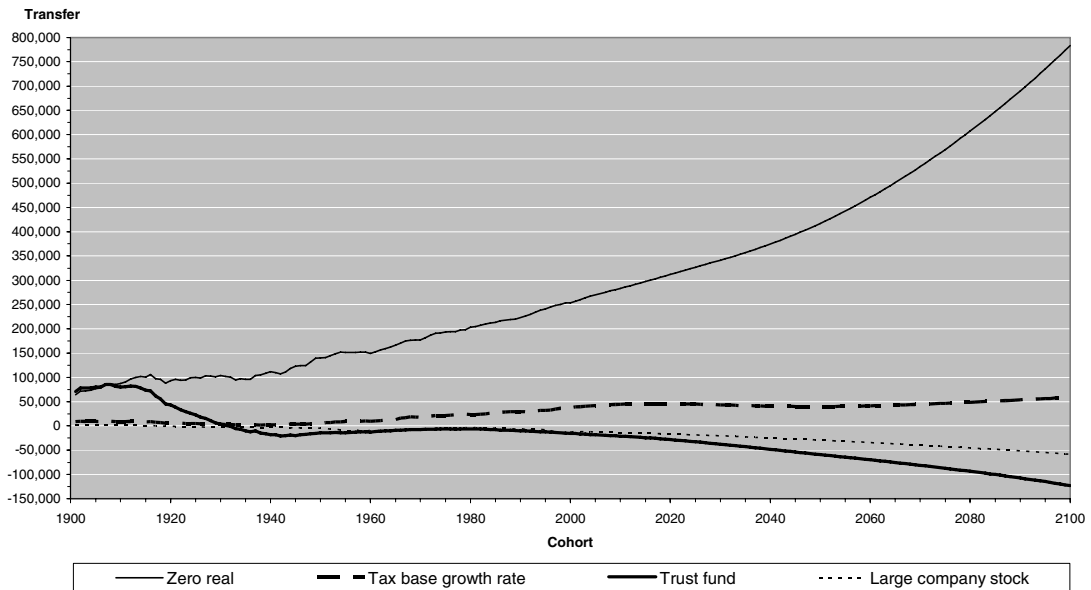
<sup>58</sup> See Leimer (2005b) for a more complete discussion of these issues, including the positive and negative characteristics that can be associated with mandatory pay-as-you-go public retirement programs and how some of the positive characteristics might be captured without incurring the negative characteristics.

**Chart 6.**  
**OASI real lifetime net transfer per initial cohort member under the award adjustment policy**  
**evaluated as of the initial cohort year, by interest rate assumption and cohort (in 2001**  
**dollars)**



SOURCE: Author's calculations.

**Chart 7.**  
**OASI real lifetime net transfer per initial cohort member under the tax adjustment policy**  
**evaluated as of the initial cohort year, by interest rate assumption and cohort (in 2001**  
**dollars)**



SOURCE: Author's calculations.

present value of lifetime net transfers (benefits less taxes) under the program for each birth cohort as a whole divided by the initial population of the cohort. The lifetime net transfer for each cohort is evaluated as of the end of the “initial cohort year,” defined as the birth year of the cohort or as 1937, the first year of OASI benefit and tax payments, for cohorts born prior to 1937.<sup>59</sup> These present values are then converted to constant dollars reflecting the 2001 price level. The aggregate real lifetime net transfer estimated for each cohort as a whole is divided by the number of initial members of that cohort to provide a feel for the level of estimated net lifetime transfers per person in each birth cohort.<sup>60</sup> For cohorts born in 1937 or later, the initial cohort population is defined as the population of the cohort as of the end of their birth year. For cohorts born prior to 1937, the initial cohort population is defined as the population of the cohort at the end of 1937. To summarize, then, the estimates displayed in Charts 6 and 7 represent the real present value of the lifetime net transfer under each interest rate assumption per initial member of each birth cohort as of the year of their birth or, if later, the beginning of the OASI program.

The estimated lifetime net transfer per initial cohort member is displayed in Chart 6 for the balanced budget award policy and in Chart 7 for the balanced budget tax policy.

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<sup>59</sup> Absolute present value measures of lifetime outcomes under the OASI program can be interpreted as “money’s worth” measures when evaluated as of the initial cohort year, since this is a natural evaluation point from a participant cohort’s perspective. Absolute present value measures that are evaluated as of a given point in time across all cohorts can be interpreted as “redistributional” measures, since this is a natural evaluation point from a program perspective. This is not a strong distinction, of course—the purpose of both types of measures is to illuminate the relationship between lifetime benefits and taxes under the program and both types of measures share issues regarding the choice of the appropriate interest rate series. Relative present value measures, such as the lifetime benefit/tax ratio, are independent of the evaluation date since the same evaluation date is used in both the numerator and denominator of the ratio.

<sup>60</sup> These estimates are not equivalent to expected lifetime transfers per initial cohort member because of net immigration over the cohort’s lifetime. The lifetime net transfers reflected in Charts 6 through 9 include benefits and taxes for net immigrants who are not part of the initial cohort population.

Under either policy, the lifetime net transfer per initial cohort member for the collective cohort group born through 1900, evaluated as of 1937, ranges from \$36,760 under the OASI trust fund interest rate assumption to \$2,165 under the large company stock total rate of return series. By the 1945 single-year birth cohort, this differential increases substantially, with a range from about \$123,100 for the zero real interest rate series to about -\$19,800 for the trust fund interest rate series. As with the other measures, the estimated lifetime net transfer per initial cohort member under a given interest rate assumption begins to diverge more noticeably between the two balanced budget policies for cohorts born after about 1950, as projected benefits and taxes begin to play a more important role. For the cohort born in 2100, the most distant cohort simulated in this analysis, the projected lifetime net transfer per initial cohort member, evaluated as of 2100, ranges from about \$375,100 for the zero real interest rate series to about -\$74,300 for the OASI trust fund interest rate series under the award adjustment policy (Chart 6) and ranges from about \$783,500 for the zero real interest rate series to about -\$122,800 for the OASI trust fund interest rate series under the tax adjustment policy (Chart 7).<sup>61</sup>

A key comparison in Charts 6 and 7 is the level of the lifetime net transfer under each policy and interest rate assumption relative to a value of zero. Under both of the balanced

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<sup>61</sup> An interesting feature of Charts 6 through 9, which display absolute measures of lifetime outcomes, is the crossover that occurs between the plots for the OASI trust fund and the large company stock interest rate series over the cohort interval where both plots reflect negative lifetime net transfers. Such crossovers can occur when, for example, net transfer streams characterized by early predominantly negative elements and later predominantly positive elements have negative present values, as in these chart plots. For net transfer streams with uniformly negative early elements followed by uniformly positive elements, the derivative of the present value function with respect to the interest rate is negative so long as the present value itself is positive—increasing the interest rate applied to such a stream always reduces its present value, so crossovers do not occur under those conditions. When these conditions are relaxed, as in the case where the present value itself is negative, the sign of the derivative of the lifetime net transfer present value function with respect to the interest rate becomes analytically indeterminate, creating the potential for crossovers such as those observed in Charts 6 through 9 (and Tables 1 and 2).

budget policies and all of the interest rate assumptions, the lifetime net transfer per initial cohort member for the earliest cohorts is positive, indicating lifetime benefits in excess of lifetime taxes. As with the prior measures considered, however, the question of whether present and future cohorts will continue to experience lifetime benefits in excess of lifetime taxes depends critically on the risk-adjusted interest rate deemed appropriate for the lifetime net transfer calculation.

**Aggregate Lifetime Net Transfers.** As noted above, the accumulated or discounted present value of lifetime benefits less taxes for each birth cohort as a whole, evaluated at a specific point in time using OASI trust fund interest rates, is a measure of the cost of those net transfers to the trust fund as of that evaluation date and can be interpreted as identifying the extent of redistribution across cohorts from the perspective of the program.<sup>62</sup> The interest earned by the OASI trust fund reflects an internal government transaction, however, and can be viewed as a policy or managerial choice open to debate. The rates of return earned by the special Treasury obligations held by the trust fund have historically been based primarily on then current rates for marketable Treasury obligations, a conceptually appropriate basis for such interest payments.<sup>63</sup> These rates are not necessarily appropriate, however, for the evaluation of redistributive outcomes under the program from the perspective of program participants or from the broader

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<sup>62</sup> This description abstracts from a number of complicating factors including the issue of the appropriate interest rate, discussed more fully below, and the treatment of administrative expenses, as discussed above. Although administrative expenses would be significantly higher under some proposed alternative policies, such expenses represent a relatively small and generally declining proportion of total trust fund expenditures for the present OASI program. Table 4.A1 of the 2002 *Annual Statistical Supplement*, for example, indicates that OASI administrative expenses represented 0.52 percent of total trust fund expenditures in 2001. This proportion is projected to fall even further to 0.12 percent by 2080 under the 2002 Trustees Report intermediate projections.

<sup>63</sup> Some may take issue, however, with the specific investment terms of the marketable Treasury obligations that have been used for this purpose.

perspective of society in general. In a pure pay-as-you-go program, of course, there is no trust fund and consequently no trust fund interest rate. The return to contributions under the present program has primarily been generated by the growth in the payroll tax base, with a much smaller proportion of expenditures funded by the return to trust fund assets.

More generally, the issues involved in the choice of an appropriate interest rate to use in developing redistributive estimates as of a particular evaluation date mirror the issues discussed above in conjunction with the money's worth estimates presented in the previous charts. To illustrate the importance of this effect, measures of lifetime redistribution under the OASI program are developed in this analysis using the same alternative interest rate series applied to develop the money's worth estimates presented above.

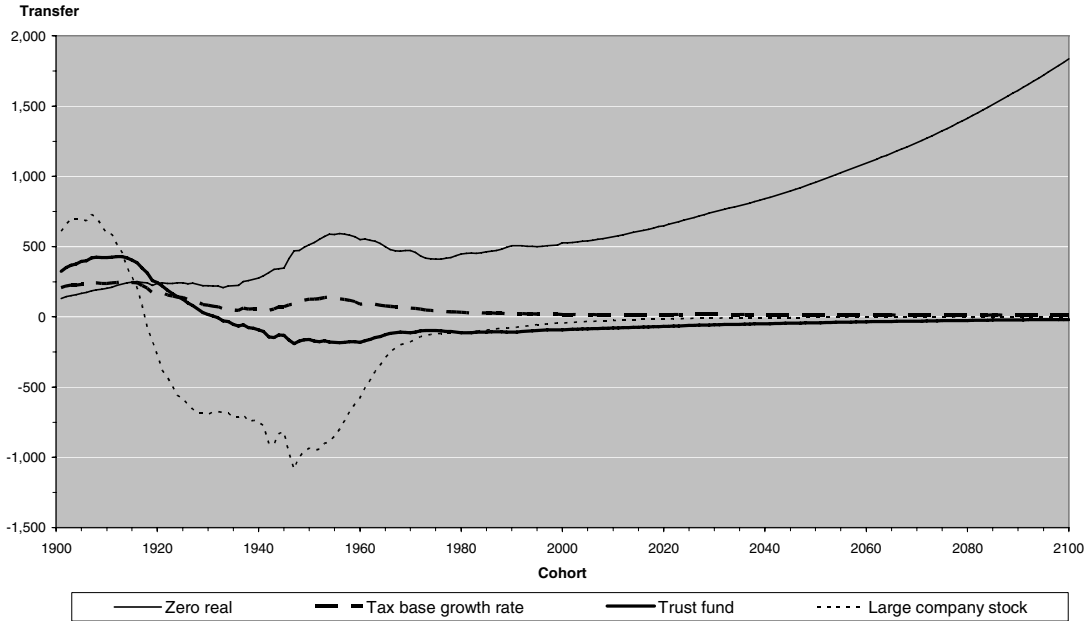
The present values of aggregate lifetime net transfers (benefits less taxes) for each single-year birth cohort, evaluated as of the end of 2001 using each of the four interest rate series, are displayed in Charts 8 and 9 under the two balanced budget policies. Analogous tabular estimates are presented in Tables 1 and 2 for generally 10-year birth cohorts.<sup>64</sup> These aggregate lifetime net transfer estimates reflect the size of each cohort group as well as the average outcome for members of that group.

Under either balanced budget policy, the aggregate lifetime net transfer for the collective cohort group born through 1900, evaluated as of 2001, ranges from \$13,676 billion under the large company stock interest rate assumption to \$1,637 billion under the zero real interest rate assumption. The aggregate lifetime net transfer under either

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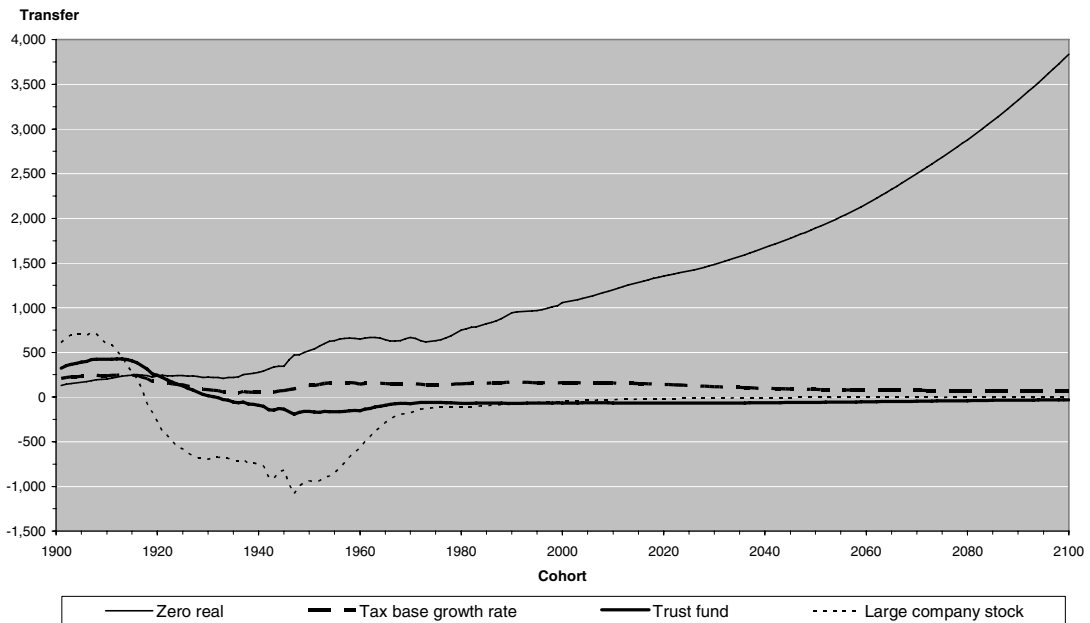
<sup>64</sup> The aggregate lifetime net transfer tables for generally 10-year birth cohorts are included for readers interested in using these estimates for legacy debt calculations, as discussed in a subsequent subsection.

**Chart 8.**  
**Aggregate OASI lifetime net transfers under the award adjustment policy evaluated as of year-end 2001, by interest rate assumption and cohort (in billions of dollars)**



SOURCE: Author's calculations.

**Chart 9.**  
**Aggregate OASI lifetime net transfers under the tax adjustment policy evaluated as of year-end 2001, by interest rate assumption and cohort (in billions of dollars)**



SOURCE: Author's calculations.



**Table 1.****Aggregate OASI lifetime net transfers under the award adjustment policy, evaluated as of year-end 2001 using alternative interest rate assumptions, by 10-year birth cohort (in billions of dollars)**

Birth cohort	Interest rate assumption			
	Zero real	Tax base growth	Trust fund	Large company stock
Pre-1901	1,637.203	3,912.972	4,313.035	13,676.469
1901-1910	1,701.736	2,303.540	3,900.322	6,719.672
1911-1920	2,357.449	2,250.763	3,654.831	1,964.335
1921-1930	2,352.271	1,259.806	1,123.712	-5,787.376
1931-1940	2,364.471	587.418	-493.337	-7,080.525
1941-1950	3,998.263	833.139	-1,504.711	-9,181.005
1951-1960	5,711.384	1,232.563	-1,781.017	-7,942.031
1961-1970	5,018.370	781.136	-1,305.644	-3,020.509
1971-1980	4,265.825	431.199	-1,025.572	-1,251.318
1981-1990	4,698.171	271.206	-1,087.081	-927.633
1991-2000	5,069.634	203.841	-975.594	-562.255
2001-2010	5,460.787	155.808	-847.483	-325.776
2011-2020	6,130.699	145.612	-734.038	-191.678
2021-2030	7,026.295	178.775	-613.178	-111.681
2031-2040	7,972.794	164.718	-526.148	-66.335
2041-2050	9,028.033	143.183	-452.030	-39.434
2051-2060	10,324.157	151.022	-380.821	-23.137
2061-2070	11,725.448	137.560	-325.002	-13.656
2071-2080	13,332.387	130.641	-275.819	-8.016
2081-2090	15,218.277	135.823	-232.287	-4.678
2091-2100	17,326.575	131.947	-196.804	-2.741

SOURCE: Author's calculations.

**Table 2.****Aggregate OASI lifetime net transfers under the tax adjustment policy, evaluated as of year-end 2001 using alternative interest rate assumptions, by 10-year birth cohort (in billions of dollars)**

Birth cohort	Interest rate assumption			
	Zero real	Tax base growth	Trust fund	Large company stock
Pre-1901	1,637.203	3,912.972	4,313.035	13,676.469
1901-1910	1,701.736	2,303.540	3,900.322	6,719.672
1911-1920	2,357.443	2,250.758	3,654.827	1,964.332
1921-1930	2,352.263	1,259.792	1,123.695	-5,787.393
1931-1940	2,364.468	587.339	-493.455	-7,080.644
1941-1950	4,008.346	838.868	-1,501.456	-9,180.301
1951-1960	6,234.408	1,533.047	-1,603.422	-7,889.690
1961-1970	6,499.709	1,519.906	-935.459	-2,951.643
1971-1980	6,622.329	1,424.428	-627.558	-1,221.464
1981-1990	8,380.259	1,576.463	-691.412	-940.021
1991-2000	9,864.792	1,630.610	-667.030	-600.901
2001-2010	11,301.554	1,600.784	-646.621	-370.280
2011-2020	12,894.472	1,502.106	-650.623	-233.583
2021-2030	14,209.973	1,284.397	-650.675	-147.299
2031-2040	15,844.085	1,064.899	-646.060	-94.445
2041-2050	17,898.792	906.113	-612.521	-59.732
2051-2060	20,326.286	809.545	-553.586	-36.729
2061-2070	23,429.706	767.217	-490.938	-22.357
2071-2080	27,052.836	749.290	-428.593	-13.439
2081-2090	31,161.822	736.474	-371.196	-8.018
2091-2100	35,982.899	726.448	-321.944	-4.793

SOURCE: Author's calculations.

balanced budget policy for the 1945 single-year birth cohort, evaluated as of 2001, ranges from about \$346 billion for the zero real interest rate series to about -\$818 billion for the large company stock series. As with the other measures, the estimated aggregate lifetime net transfer begins to diverge more noticeably across policies under a given interest rate assumption for cohorts born after about 1950. The projected aggregate lifetime net transfer for the single-year cohort born in 2100, discounted to 2001, ranges from about \$1,836 billion for the zero real interest rate series to about -\$18 billion for the OASI trust fund interest rate series under the award adjustment policy (Chart 8) and ranges from about \$3,834 billion for the zero real interest rate series to about -\$30 billion for the OASI trust fund interest rate series under the tax adjustment policy (Chart 9).

A key comparison in Charts 8 and 9 and Tables 1 and 2 is the level of the lifetime net transfer under each policy and interest rate assumption relative to zero. Under either of the balanced budget policies, aggregate lifetime net transfers for the earliest cohorts are positive for all of the interest rate assumptions; the question of whether present and future cohorts will continue to experience positive lifetime net transfers again depends critically on the risk-adjusted interest rate used in the calculation.<sup>65</sup>

**Lifetime Net Transfer/Taxable Earnings Rate.** Another money's worth measure of interest is the present value of lifetime net transfers (benefits less taxes) relative to the

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<sup>65</sup> The signs of the corresponding estimates in Charts 6 and 8 and in Charts 7 and 9 will be identical for each single-year birth cohort, because the aggregate lifetime net transfer and the lifetime net transfer per initial cohort member for each single-year cohort under a particular policy and interest rate assumption differ only by a positive multiplicative factor that depends on the initial cohort population and the values of the interest rate index at the alternative evaluation dates. The rank order of the estimates by interest rate assumption for a particular single-year birth cohort can differ between Charts 6 and 8 and between Charts 7 and 9, however, because the relative sizes and even the rank order of the adjustments between the initial cohort evaluation date (used in Charts 6 and 7) and the fixed evaluation date of 2001 (used in Charts 8 and 9) can vary substantially over time.

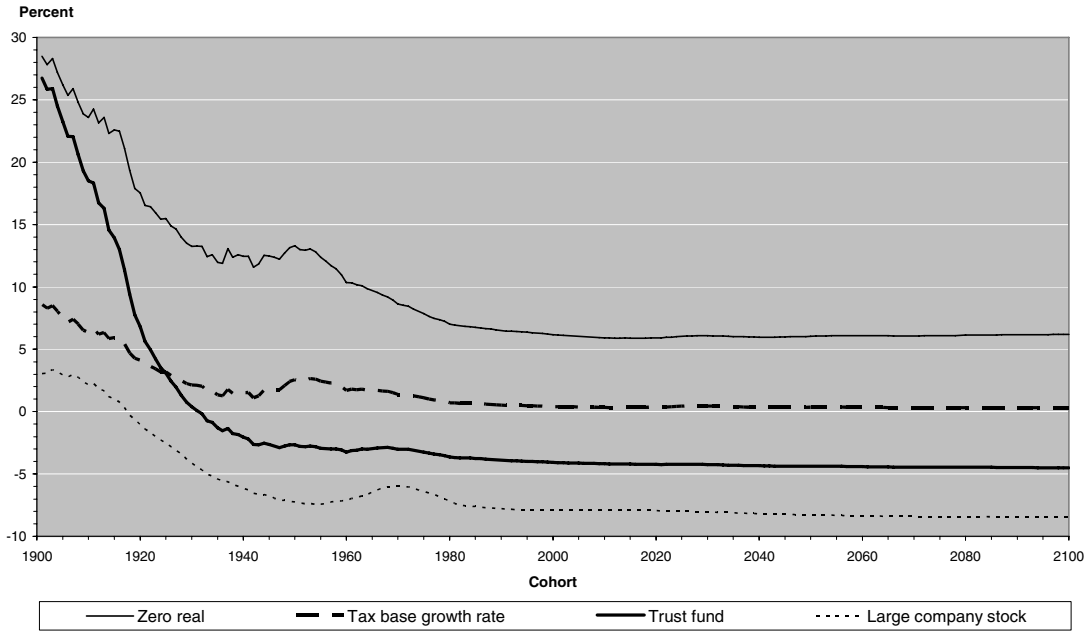
present value of lifetime taxable earnings under the program.<sup>66</sup> If negative (positive) for a particular cohort, this measure can be interpreted as the implicit lifetime tax (subsidy) rate experienced by that cohort under the program.

Estimates for the lifetime net transfer/taxable earnings rate under the two balanced budget policies are displayed in Charts 10 and 11. The general intercohort pattern and implications of this measure are analogous to those for the lifetime benefit/tax ratio, which is also a relative measure. Under either balanced budget policy, the lifetime net transfer/taxable earnings rate for the collective cohort group born through 1900 ranges from 35.3 percent under the OASI trust fund interest rate assumption to 5.1 percent under the large company stock interest rate assumption, a significant subsidy under all of the interest rate assumptions. The net transfer/taxable earnings rate generally declines across subsequent cohorts so that by the 1945 single-year birth cohort the rate ranges from about 12.5 percent for the zero real interest rate series, representing a net subsidy, to about -6.8 percent for the large company stock series, representing a net tax. The net transfer/taxable earnings rate begins to diverge more noticeably across policies for subsequent cohorts under each interest rate assumption. For the most distant projected single-year birth cohort, born in 2100, the projected lifetime net transfer/taxable earnings rate ranges from about 6.2 percent for the zero real interest rate series to about -8.4 percent for the large company stock interest rate series under the award adjustment policy (Chart 10) and ranges from about 12.9 percent for the zero real interest rate series to about -14.9 percent for the large company stock series under the tax adjustment policy (Chart 11).

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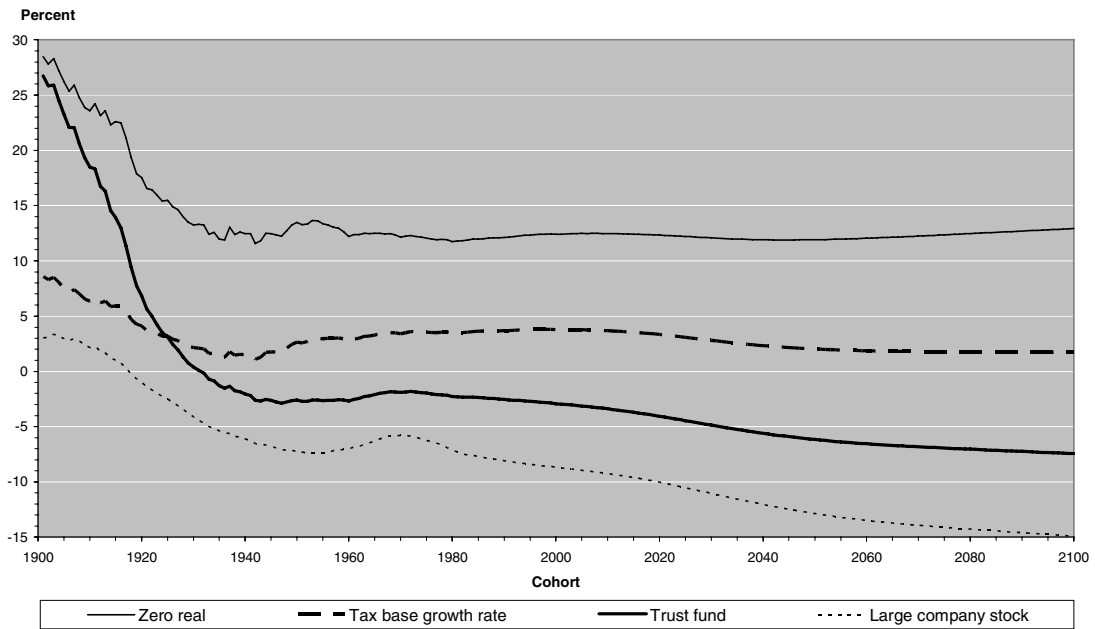
<sup>66</sup> As implemented in this analysis, the net transfers represented in the numerator and the taxable earnings in the denominator occur over only the last portions of the lifetimes of cohorts born prior to the inception of OASI taxes and benefits in 1937. For cohorts born during or after 1937, the lifetime net transfer/taxable earnings rate represents a full lifetime measure.

**Chart 10.**  
**Aggregate OASI lifetime net transfers as a percent of aggregate OASI lifetime taxable earnings under the award adjustment policy, by interest rate assumption and cohort**



SOURCE: Author's calculations.

**Chart 11.**  
**Aggregate OASI lifetime net transfers as a percent of aggregate OASI lifetime taxable earnings under the tax adjustment policy, by interest rate assumption and cohort**



SOURCE: Author's calculations.

As in Charts 6 through 9, a key comparison in Charts 10 and 11 is the level of the lifetime net transfer/taxable earnings rate relative to zero. Again, the lifetime net transfer/taxable earnings rate is positive for the earliest cohorts under either of the balanced budget policies for all of the interest rate assumptions, but the question of whether present and future cohorts will continue to experience positive lifetime subsidies depends critically on the risk-adjusted interest rate used in the calculation.

**Legacy Debt Calculations.** Some studies have used estimates of aggregate net transfers by cohort based on the OASI trust fund interest rate, analogous to the estimates presented in the third data column of Tables 1 and 2, to identify the accumulated sum of aggregate net transfers under the program to past and present cohorts.<sup>67</sup> This accumulated sum has been referred to as the “legacy debt” associated with the OASI program, with the implication that lifetime net transfers for future cohorts under the program must necessarily be negative because of the positive net transfers experienced by past and present cohorts. Some analysts have suggested that a portion of this legacy debt be repaid as part of OASI reform.

The relevance of such legacy debt measures would be clear in an abstract world where interest rates and economic growth rates were known with certainty. Under these abstract conditions, the present value of aggregate net transfers across all past, present, and future cohorts in a pure pay-as-you-go program with a constant tax rate approaches zero if the market interest rate generally exceeds the growth rate in the tax base of the

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<sup>67</sup> For example, see Geanakoplos, Mitchell, and Zeldes (1999) and Diamond and Orszag (2004).

pay-as-you-go retirement program.<sup>68</sup> Under such abstract conditions, then, the positive net transfers received by early cohorts under a pay-as-you-go program are offset by negative net transfers from later cohorts, and the accumulation of net transfers across early cohorts under the program can be interpreted as a “legacy debt” that is borne by later cohorts.

Under real world conditions, however, such legacy debt measures may lose quantitative and even qualitative relevance, reflecting the much more complex relationships among uncertain, stochastic market interest rates and the growth rates in economic aggregates.<sup>69</sup> As discussed above, the risk-adjusted interest rate appropriate to the evaluation of program outcomes from the perspective of program participants or society in general may be lower than the trust fund or other market interest rate or even the growth rate in the program’s tax base as a result of the program’s potential market-improving and portfolio-enhancing characteristics. Legacy debt calculations based on inappropriate risk-adjusted interest rates will misstate the burden, if any, imposed by the

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<sup>68</sup> See Geanakoplos, Mitchell, and Zeldes (1999) for one demonstration of this result. Under these abstract conditions, this is analogous to the requirement that the market interest rate exceed the economic growth rate for an economy to be “dynamically efficient.” If instead the growth rate in the economy exceeds the market interest rate under these conditions, the economy can be characterized as “dynamically inefficient” with too much output allocated to capital formation and not enough to consumption. The concept of dynamic efficiency has been addressed in numerous economic growth articles; see Diamond (1965) for an early contribution to this literature.

<sup>69</sup> In a stochastic environment, the conditions for dynamic efficiency also become much more complex. In particular, the relationships between market interest rates and the growth rates in economic aggregates cease to be reliable indicators of dynamic efficiency. See Abel, Mankiw, Summers, and Zeckhauser (1989) for further detail.

program on present and future cohorts.<sup>70</sup> In short, the legacy debt concept and measure are critically sensitive to the choice of the interest rate series deemed appropriate for the evaluation of program outcomes, just as in the case of the money's worth and lifetime redistributive measures presented in this analysis.

## **Comparison with Previous Research**

This section provides a brief general literature context for the present analysis but focuses on a review and comparison of results with the most similar previous analyses. Special attention is paid to the differences in method and results between the present analysis and Leimer (1994), which this analysis updates.

A number of studies have included intercohort analyses based on longitudinal data for individual sample cases drawn from Social Security Administration files; these studies include Frieden, Leimer, and Hoffman (1976), Burkhauser and Warlick (1981), Meyer and Wolff (1987), and Duggan, Gillingham, and Greenlees (1993). Social Security administrative data files with samples drawn from individual records contain taxes, benefits, or both over only partial lifetimes for most cohorts, however, limiting the range of cohorts that can be analyzed or necessitating the simulation of missing tax or benefit

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<sup>70</sup> The legacy debt measure may also be a misleading indicator of the burden of an existing pay-as-you-go program on present and future cohorts for other reasons, such as the fiscal policy effects of the program. The Social Security program, for example, was established during a low point of the business cycle with an aged population in special need of financial assistance. Under such conditions, the establishment of a pay-as-you-go program can potentially address intergenerational equity concerns as well as lead to increased economic activity, resulting in more income and capital in subsequent periods. Such improvements in intergenerational equity and increases in private and total societal wealth would not be captured by the legacy debt accounting measure.



data, even for historical periods.<sup>71</sup> Other studies have focused on results for cohorts as a whole. Leimer and Petri (1981) used a long-run general equilibrium model that included a detailed OASI sector to project future taxes and benefits by cohort but employed a less accurate accounting of historical taxes and benefits by cohort than the present study. Moffitt (1984) used historical administrative data on benefits by cohort, but estimated the historical taxes of each included cohort using median earnings by age and gender; the Moffitt analysis was also limited to a relatively narrow range of cohorts born between 1875 and 1910.

More recently, as part of the current policy debate related to restoring solvency to the OASI program, there have been numerous studies projecting various types of outcomes for varying sets of cohorts under alternative program provisions.<sup>72</sup> The most comparable of these more recent analyses include Leimer (1994), Anderson, Yamagata, and Tuljapurkar (2001), and Goss (2001), the latter being a comment on the Anderson, Yamagata, and Tuljapurkar analysis. These analyses are sufficiently similar to the present analysis to merit an examination of differences in results.

These prior studies use less accurate or less recent estimates of the historical taxes and benefits experienced by each birth cohort, employ prospective simulation methods

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<sup>71</sup> Longitudinal benefit data in files derived from administrative record samples cover only about one-half of the Social Security program's historical period. Although more historical years are available for the earnings records of sample individuals, administrative files with current earnings data only contain taxable earnings on an annual basis back to 1951. Because the life cycles of only the oldest cohorts have been completed, prospective tax and benefit streams must also be projected for most cohorts.

<sup>72</sup> For example, Congressional Budget Office (2006) includes estimates at selected percentiles of the lifetime benefit/tax ratio for a subset of members of 10-year birth cohorts from 1940 to 2000 based on either scheduled or payable benefits under present law using a 3 percent real interest rate to discount lifetime tax and benefit flows. These estimates are not directly comparable to those presented in the present analysis for a number of reasons, including a different program and participant focus and important differences in assumptions and methods.

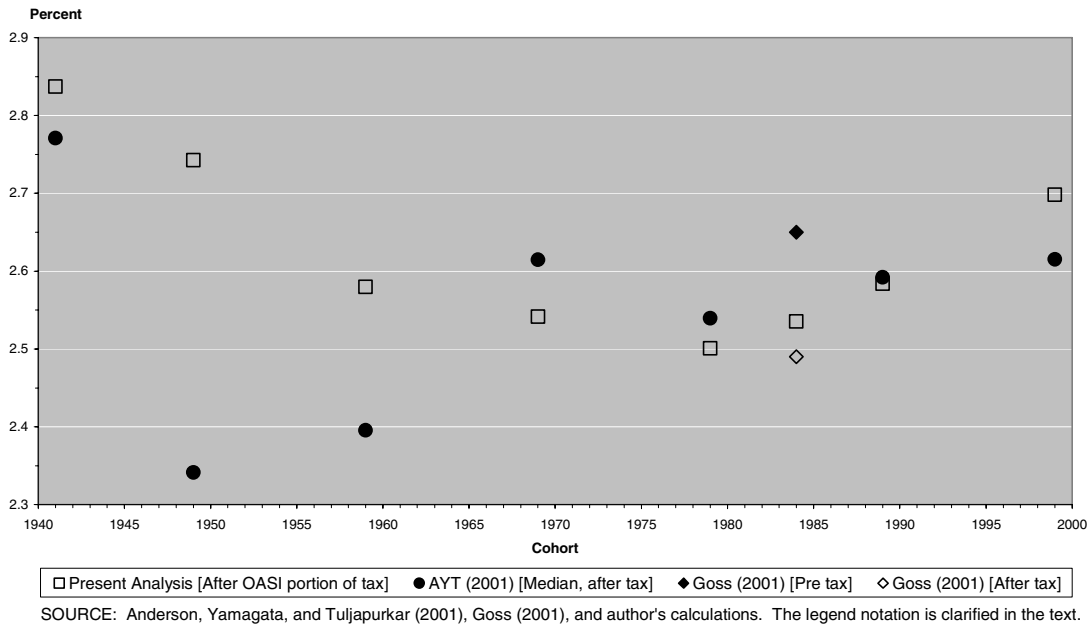
that differ in a number of important respects from those in the present analysis, and are limited to a narrower range of cohorts. Leimer (1994), for example, had access to 13 fewer years of historical administrative data on OASI taxes and benefits by age and year than the present analysis, projects results for cohorts born through 2050 compared to 2100 in the present analysis, is based on projections from a much earlier (1991) Trustees Report, and, as discussed more fully below, uses projection methods that do not conform as closely to the Trustees Report projections. The stochastic simulations in Anderson, Yamagata, and Tuljapurkar (2001) use historical estimates patterned on those in Leimer (1994) but use projections that differ in important respects from the Trustees Report projections;<sup>73</sup> results are limited to selected cohorts born between 1941 and 1999. While fully consistent with the 2001 Trustees Report projections, the Goss (2001) comment only presents results for the combined 1982-1986 birth cohort.

Some results from the Anderson, Yamagata, and Tuljapurkar (2001) and the Goss (2001) analyses are contrasted with those from the present analysis in Chart 12. This chart shows projected real internal rates of return under present law for the birth cohorts that are included in the Anderson, Yamagata, and Tuljapurkar and in the Goss analyses. The legend in Chart 12 reflects some aspects of the different measures and treatment of benefit income taxation used in the analyses. As indicated above, the present analysis projects internal rates of return for each birth cohort as a whole net of the portion of OASI benefit income taxation returned to the OASI trust fund. The Chart 12 legend reflects this OASI benefit income tax treatment as “After OASI portion of tax.” The

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<sup>73</sup> Anderson, Yamagata, and Tuljapurkar characterize these simulations as projecting results after year-end 1999 using an “autoregressive model of productivity growth, combined with stylized demographic forecasts.”

**Chart 12.**  
**OASI real internal rates of return projected under present law as estimated in the present analysis; Anderson, Yamagata, and Tuljapurkar [AYT] (2001); and Goss (2001), expressed as percents, by birth cohort**



Anderson, Yamagata, and Tuljapurkar (AYT) estimates in Chart 12 represent the median rate of return from the distribution of rates of return generated for the cohort as a whole from their set of stochastic simulations. Although not characterized in detail in their paper, their estimates appear to be net of all OASI benefit income taxes, including the benefit income tax revenues returned to the HI trust fund. The Chart 12 legend reflects this measure and OASI benefit income tax treatment as “Median, after tax.” The Goss comment presents both “pre tax” and “after tax” estimates of the real internal rate of return for the combined 1982-86 birth cohort as a whole based on the 2001 Trustees Report assumptions. Again, while not characterized in detail in the comment, these estimates appear to be gross and net, respectively, of all OASI benefit income taxes,

including those returned to the HI trust fund. The Chart 12 legend reflects this OASI benefit income tax treatment for the two estimates as “Pre tax” and “After tax.”

The two Goss estimates are displayed in Chart 12 as single data points located at the middle (1984) birth cohort in the 1982-86 cohort group. Not surprisingly, given the similarity of method and assumptions, the estimate for the 1984 birth cohort in the present analysis lies between the “pre tax” and “after tax” estimates for the 1982-1986 birth cohort group from the Goss (2001) comment. The differences between the median estimates from the Anderson, Yamagata, and Tuljapurkar (2001) analysis and the cohort estimates from the present analysis are not surprising given the differences in measure, method, and assumptions, although it is not clear why their median estimates for the 1949 and 1959 birth cohorts dip so far below those for the surrounding cohorts.

One of the primary purposes of the present analysis is to update the Leimer (1994) estimates. Despite many similarities, the projection method used in Leimer (1994) differs substantially from the method used in the present analysis. A major difference is that the present analysis enforces exact consistency with the detailed economic and demographic assumptions underlying the Trustees Report. The economic and demographic projections in Leimer (1994) were simulated using a long-run general equilibrium model of the U.S. economy and its interrelationships with the OASI program, with various parameters of the model calibrated to achieve as high a degree of correspondence as possible between the simulated geometric mean growth rates of key economic, demographic, and program variables and the corresponding geometric mean growth rates of those variables as

projected by the 1991 Trustees Report.<sup>74</sup> Despite a close correspondence in the cumulative growth in these variables over the full Trustees Report projection period, the annual time paths of some of the economic variables nevertheless differed in important ways between the two projection methods within and beyond that projection period. These differences had associated significant effects on estimated outcomes across birth cohorts.

The simulated time path of real wage growth under the two projection methods is an important example. In contrast to the exogenous and generally flat real wage growth rate assumptions in the Trustees Report, annual real wages in the Leimer (1994) general equilibrium model responded endogenously to simulated changes in labor productivity arising from such factors as the assumed rate and nature of technological progress, the changing demographic structure of the work force, and the ratio of capital to effective (productivity-weighted) labor. The effects of the demographic structure and capital/labor ratio factors varied significantly over the Trustees Report projection period as, for example, the baby-boom cohorts moved through various life cycle stages characterized by different productivity, labor supply, and saving behavior. As a consequence, the simulated real wage growth rate in the Leimer (1994) projections was significantly above the Trustees Report real wage growth rate assumptions during the first part of the projection period but significantly below the Trustees Report assumptions during the last

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<sup>74</sup> The economic, demographic, and program variables that were constrained to the extent possible in Leimer (1994) included population, employment, beneficiary aggregates, beneficiary age distributions, inflation rates, average covered earnings, OASI taxable payroll, gross domestic output, OASI expenditures, OASI trust fund interest rates, and year-end OASI trust fund balances.

part of the projection period.<sup>75</sup> This different time path in simulated real wage growth in turn affected the simulated pattern of lifetime outcomes under the program across affected birth cohorts. In particular, since real wage growth under these constraints was lower during the last part of the projection period in the Leimer (1994) projections than in the Trustees Report, relative lifetime outcomes under the program for the most distant birth cohorts were also projected to be less favorable than if higher real wage growth had been projected over that period.

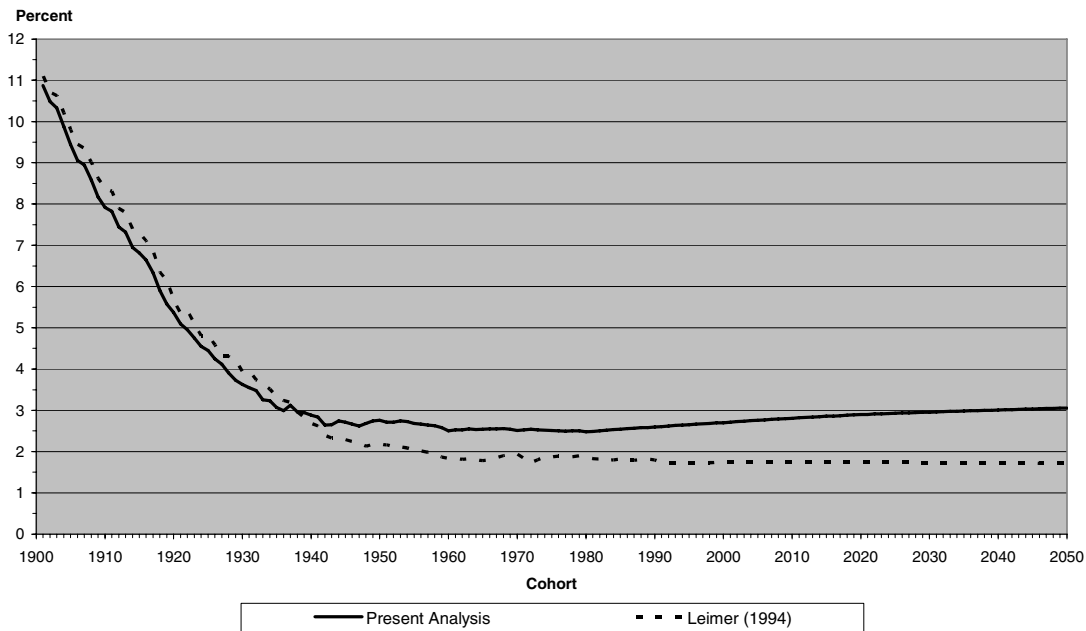
Whether the constrained general equilibrium approach adopted in Leimer (1994) or the approach of exact adherence to the Trustees Report assumptions adopted in the present analysis is preferable depends on the interpretation and use of the analysis results. The approach in the present analysis has the advantage of precise and continuous consistency with the economic and demographic assumptions underlying the Trustees Report, which represents the official projection of the financial status of the program. In contrast, the simulation approach in Leimer (1994) has the advantage of generating projections that are internally consistent across all of the economic and demographic variables within the context of a general equilibrium model of the U.S. economy and its interrelations with the OASI program.<sup>76</sup>

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<sup>75</sup> Figure 3 in Leimer (1992), based on an earlier but similar version of the Leimer (1994) model, illustrates the different time paths of real wage growth between the exogenous Trustees Report assumptions and the constrained general equilibrium model used in Leimer (1994).

<sup>76</sup> More generally, if not constrained to the Trustees Report assumption set, the general equilibrium model in Leimer (1994) permitted evaluations of the broader economic effects of alternative OASI program and fiscal policies characterized by different unfunded liabilities and total government indebtedness; these evaluations included the effects on private consumption and saving, wages, prices, interest rates, and the total lifetime incomes of successive cohorts.

**Chart 13.**  
**OASI real internal rates of return projected under present law in the present analysis and Leimer (1994), expressed as percents, by birth cohort**



SOURCE: Leimer (1994) and author's calculations.

Some of the effects of the alternative simulation methods are reflected in Chart 13, which contrasts projections of OASI real internal rates of return for single-year birth cohorts under present law in the Leimer (1994) analysis and the present analysis. The different projected time path of real wage growth accounts for much of the difference between the two sets of results. Another contributing factor is the somewhat lower labor force growth projected towards the end of the projection period in the 1991 Trustees Report underlying the Leimer (1994) estimates than in the 2002 Trustees Report underlying the present analysis.<sup>77</sup> Another important difference in the internal rate of return estimates under present law assumptions arises from differences in the mortality

<sup>77</sup> The 1991 Trustees Report projected the annual growth rate in the labor force to fall from 0.5 percent in 2010 to 0.1 percent in 2065 under the intermediate assumption set. The 2002 Trustees Report projected that rate to fall from 0.7 percent in 2010 to 0.2 percent in 2065 and remain at that level through 2080.

rate projections underlying the two analyses;<sup>78</sup> mortality rates were projected to be generally higher and life expectancies corresponding lower for distant cohorts in the 1991 Trustees Report than in the 2002 Trustees Report.<sup>79</sup> For a number of reasons, then, the real internal rates of return projected under present law for the most distant cohorts differ substantially between the two analyses. For example, the real internal rate projected for the 2050 cohort under the present law policy was 1.71 percent in the Leimer (1994) analysis in contrast to 3.06 percent in the present analysis.

Analogous comparisons between the simulations of balanced budget award and balanced budget tax policies in the Leimer (1994) and present analyses are presented in Charts 14 and 15. In addition to the differences discussed above in the economic and demographic assumptions and simulation approaches underlying the two analyses, details of the balanced budget award and balanced budget tax policies differ between the two analyses. Nevertheless, the balanced budget award and balanced budget tax policies in both analyses are designed to bring the OASI program into financial balance over a simulation period extending far beyond the respective Trustees Report projection

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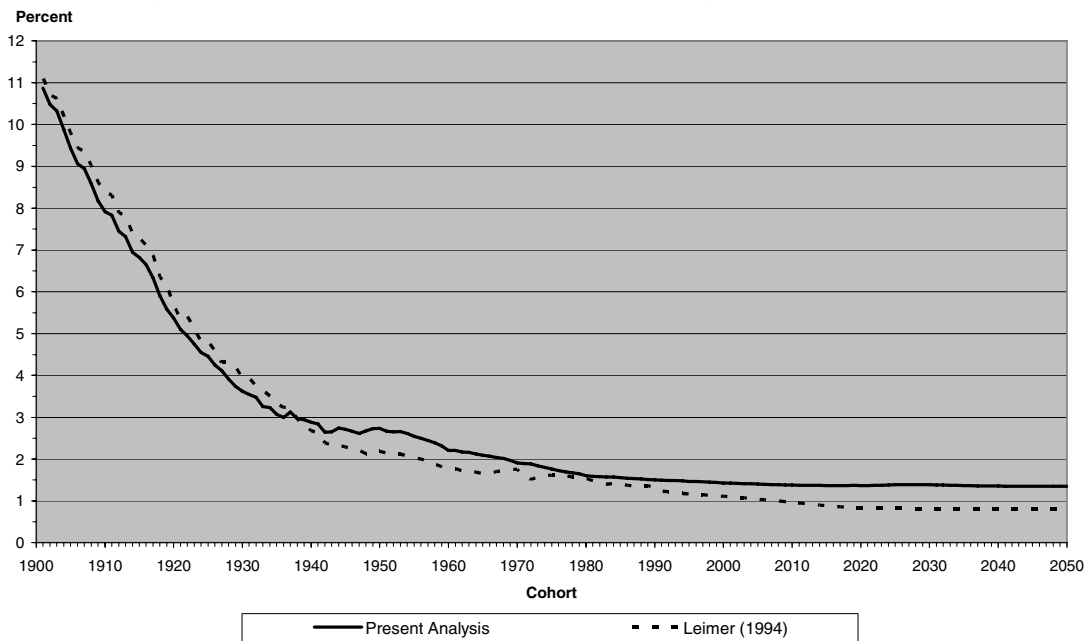
<sup>78</sup> Differences in mortality rate projections are an important factor in the internal rate of return differences under the present law assumptions but not under the balanced budget policies discussed below. Under the balanced budget policies, increases in benefit costs resulting from improving survival rates are offset by either tax rate increases or benefit award decreases. Under the present law assumptions, however, the increased benefit costs resulting from improving survival rates are not offset in the simulations, resulting in higher internal rates of return for the later cohorts experiencing increased longevity. As indicated in a preceding endnote, the primary factor driving the growing divergence over time between projected expenditures and non-interest revenues under present law is the continuing declines in mortality rates underlying the Trustees Report and extended projections.

<sup>79</sup> For example, the life expectancy for males at age 65 in 2065 under the intermediate assumption set was projected to be 18.5 years in the 1991 Trustees Report and 19.7 years in the 2002 Trustees Report. The corresponding projections for females were 22.4 and 22.6, respectively. By 2080, life expectancy at age 65 was projected to improve further under the 2002 Trustees Report intermediate assumptions to 20.4 years for males and 23.4 years for females.



**Chart 14.**

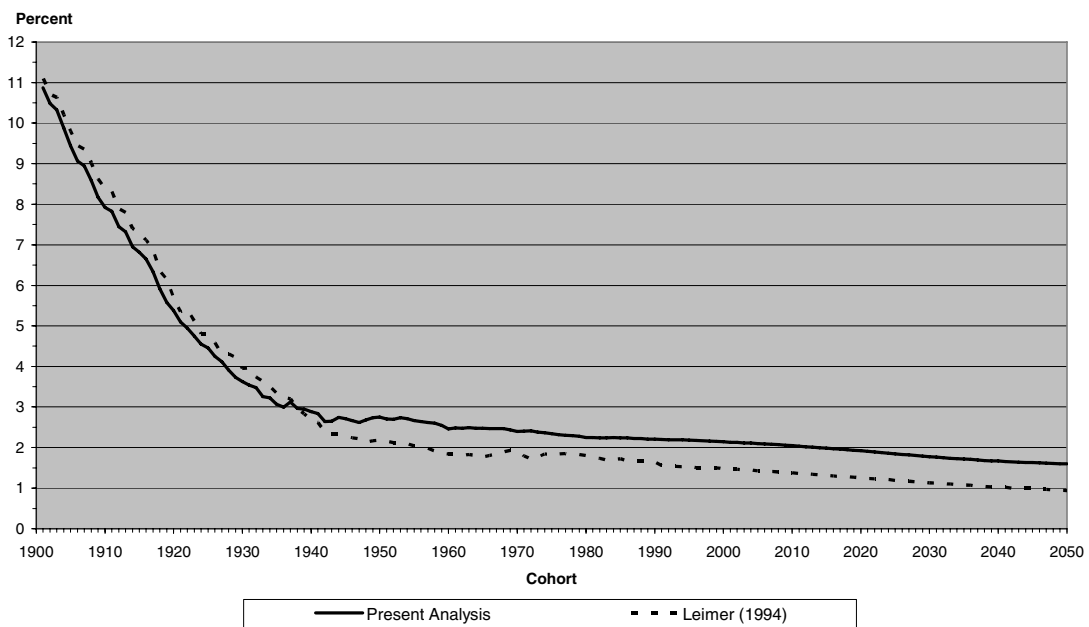
**OASI real internal rates of return projected under the balanced budget award policy in the present analysis and Leimer (1994), expressed as percents, by birth cohort**



SOURCE: Leimer (1994) and author's calculations.

**Chart 15.**

**OASI real internal rates of return projected under the balanced budget tax policy in the present analysis and Leimer (1994), expressed as percents, by birth cohort**



SOURCE: Leimer (1994) and author's calculations.

periods.<sup>80</sup> The higher internal rates of return that are projected for the most distant cohorts under each balanced budget policy in the present analysis compared to the Leimer (1994) analysis are illustrated in Charts 14 and 15. The real internal rate of return for the 2050 cohort, for example, is projected as 0.80 percent under the Leimer (1994) balanced budget award policy and as 1.35 percent for the balanced budget award policy in the present analysis. The real internal rate of return for the 2050 cohort is projected as 0.94 percent under the Leimer (1994) balanced budget tax policy compared to 1.60 percent under the balanced budget tax policy in the present analysis. Again, much of the difference in the internal rates of return projected for the most distant cohorts in the present analysis compared to those projected in the Leimer (1994) analysis can be attributed to differences between the projected time paths of real wage growth and the labor force in the two analyses.

## **Concluding Comments**

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This study presents various measures of the balance between lifetime taxes and benefits for past, present, and future birth cohorts under OASI present law and under stylized solvent tax rate and benefit award adjustment policies conditional on the intermediate assumptions in the 2002 Trustees Report. These estimates update corresponding estimates presented in Leimer (1994) and reflect an accounting of OASI taxes and benefits that is more comprehensive, more accurate historically and extensive prospectively, and/or conforms more closely to the official Trustees Report projections than analogous estimates in previous analyses. The various interest rate series and redistributional and money's worth measures included in this analysis are intended to

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<sup>80</sup> The simulation period extends through 2150 in Leimer (1994) and through 2220 in the present analysis.

facilitate comparison with previous analyses and to increase the range of questions to which the results can be applied.

While lifetime benefits exceed lifetime taxes for early cohorts under all of the interest rate assumptions, net program outcomes for many present and future cohorts depend critically on the interest rates used to calculate the various measures. In a stochastic world where retirement saving alternatives have different risk and return characteristics, the choice of an appropriate risk-adjusted interest rate to evaluate program outcomes is difficult and controversial.

Based on the internal rate of return estimates in this analysis, even the most distant birth cohorts will receive their money's worth from the OASI program under any of the policies considered if a risk-adjusted real interest rate below 1.35 percent is deemed appropriate for evaluating program outcomes. If instead, a risk-adjusted real interest rate of 2 percent or above is deemed appropriate, then no cohort born after about 2015 is projected to receive its money's worth by this measure under either of the balanced budget policies considered.

Based on the other money's worth and lifetime redistributive measures in this analysis, estimated lifetime benefits exceed lifetime taxes for all past, present, and future birth cohorts for both the zero real and tax base growth rate interest rate assumptions under either balanced budget policy. This result is consistent with the interpretation that the market-improving and portfolio-enhancing features of the OASI program justify the use of a relatively low interest rate in the calculation of the money's worth and lifetime redistributive measures. In contrast, estimated lifetime taxes exceed lifetime benefits

for many present and all future birth cohorts for both the trust fund and large company stock interest rate assumptions under either balanced budget policy. This result is consistent with the interpretation that the market-improving and portfolio-enhancing features of the OASI program are insufficient to justify the use of a relatively low interest rate or are dominated by offsetting characteristics of the program, such as perceived political risk differentials. Because a mature public retirement program financed on an essentially pay-as-you-go basis tends to generate a rate of return for program participants roughly equal to the growth rate in the program's tax base, lifetime benefits will tend to be greater (less) than lifetime taxes if the risk-adjusted interest rate series used in the calculations is generally less (greater) than the growth rate in the program tax base.

Under certain assumptions, the aggregate lifetime net transfer estimates developed in this analysis can be used to calculate the legacy debt associated with net transfers to early cohorts under the OASI program. The legacy debt concept and measure are critically sensitive to the choice of the interest rate series deemed appropriate for the evaluation of program outcomes, however, just as for the money's worth and lifetime redistributive measures. As such, the typical practice of using the trust fund or other market interest rate unadjusted for risk in the legacy debt calculation may produce a quantitatively misleading or even qualitatively invalid indication of any "debt" or "burden" imposed by the program on present and future cohorts.

## **Appendix A.**

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This appendix presents OASI money's worth and redistributive measures of lifetime outcomes by birth cohort as simulated under the present law policy consistent with the underlying Trustees Report projections. Because the program is projected to be out of long-run financial balance under present law provisions, these present law outcomes include unfunded benefits.

**Table A-1**  
**OASI money's worth and redistributive measures (including unfunded benefits) under present law, by birth cohort**

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption					
		Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock			
Pre-1901	18.367	12.037	6.093	12.037	3.207	3.207	31,365	36,760	2,165	1,637,203	3,912,972	4,313,035	13,676,469	34.97	13.39	35.27	5.12								
1901	10.868	8.065	3.718	7.688	2.186	2.186	63,959	8,809	70,672	130,104	207,357	323,140	608,789	28.47	8.57	26.75	3.05								
1902	10.481	7.683	3.546	7.262	2.168	2.168	71,461	9,477	78,181	143,414	220,098	352,677	658,360	27.81	8.28	25.84	3.07								
1903	10.329	7.518	3.517	7.037	2.244	2.244	71,974	9,286	77,732	150,715	225,014	365,871	698,657	28.30	8.50	25.91	3.36								
1904	9.881	7.074	3.323	6.552	2.163	2.163	73,349	9,106	78,018	157,567	226,369	376,721	699,208	27.19	8.04	24.52	3.19								
1905	9.444	6.733	3.150	6.170	2.064	2.064	76,601	9,167	80,121	167,332	231,728	393,407	698,935	26.21	7.54	23.26	2.94								
1906	9.061	6.392	3.001	5.784	1.985	1.985	77,991	9,989	79,971	173,566	231,504	400,043	683,963	25.36	7.15	22.08	2.76								
1907	8.950	6.296	2.997	5.610	2.030	2.030	84,950	9,594	85,292	185,763	242,778	419,234	727,784	25.90	7.41	22.05	2.97								
1908	8.583	5.906	2.840	5.185	1.935	1.935	86,906	9,461	85,196	193,056	243,223	425,403	706,590	24.78	7.01	20.62	2.75								
1909	8.170	5.641	2.695	4.857	1.807	1.807	85,464	8,919	81,453	196,610	237,439	421,196	643,861	23.86	6.52	19.31	2.40								
1910	7.918	5.471	2.622	4.612	1.714	1.714	87,207	8,810	80,531	201,609	238,030	422,630	593,524	23.58	6.35	18.50	2.15								
1911	7.827	5.396	2.626	4.436	1.718	1.718	90,647	8,974	80,737	203,908	242,761	424,247	587,565	24.23	6.65	18.31	2.25								
1912	7.447	5.102	2.485	4.077	1.574	1.574	96,353	9,113	82,184	1,835	223,759	244,892	428,995	515,688	23.14	6.19	16.74	1.83							
1913	7.319	5.039	2.474	3.906	1.508	1.508	99,764	9,222	81,382	1,630	233,270	249,526	427,725	23.57	6.34	16.30	1.67								
1914	6.948	4.718	2.326	3.531	1.357	1.357	101,417	8,908	78,101	1,213	242,292	246,283	419,411	22.30	5.86	14.55	1.20								
1915	6.820	4.660	2.309	3.365	1.288	1.288	100,249	8,595	73,098	945	246,675	244,736	404,299	281,400	22.58	5.93	13.94	1.00							
1916	6.650	4.535	2.263	3.147	1.210	1.210	105,892	8,797	72,334	716	252,141	242,387	387,148	226,400	22.48	5.92	12.99	0.75							
1917	6.333	4.237	2.127	2.831	1.082	1.082	96,989	7,647	61,573	267	243,594	222,256	347,606	21.10	5.43	11.34	0.30								
1918	5.912	3.919	1.958	2.497	0.927	0.927	96,059	7,010	55,225	-256	242,391	204,685	313,232	19.35	4.70	9.41	-0.27								
1919	5.578	3.608	1.827	2.196	0.835	0.835	88,188	5,988	45,165	-554	223,952	175,974	257,809	17.88	4.27	7.75	-0.66								
1920	5.378	3.492	1.771	2.027	0.754	0.754	93,299	6,018	42,712	-881	237,471	177,265	244,361	17.52	4.11	6.80	-1.02								
1921	5.098	3.295	1.677	1.834	0.673	0.673	95,665	5,730	38,368	-1,245	243,133	168,538	219,185	16.53	3.73	5.64	-1.40								
1922	4.949	3.225	1.643	1.722	0.619	0.619	93,622	5,350	33,189	-1,404	237,395	156,975	189,167	16.43	3.64	4.97	-1.68								
1923	4.748	3.114	1.589	1.602	0.565	0.565	94,704	5,094	29,216	-1,626	236,927	147,486	164,291	15.94	3.44	4.22	-2.00								
1924	4.554	3.004	1.534	1.494	0.519	0.519	98,910	4,976	26,144	-1,899	241,876	140,816	143,705	15.43	3.20	3.52	-2.28								
1925	4.453	2.964	1.517	1.427	0.490	0.490	99,944	4,850	23,018	-1,982	241,940	135,861	125,249	15.47	3.18	3.10	-2.51								
1926	4.249	2.853	1.460	1.331	0.447	0.447	98,621	4,411	18,445	-2,153	235,838	122,065	99,144	14.89	2.90	2.44	-2.82								
1927	4.114	2.776	1.426	1.259	0.419	0.419	103,283	4,348	15,545	-2,342	239,855	116,858	81,143	14.63	2.78	1.95	-3.11								
1928	3.910	2.664	1.368	1.173	0.387	0.387	102,655	3,894	10,862	-2,499	231,153	101,469	54,976	13.99	2.48	1.33	-3.42								
1929	3.735	2.566	1.321	1.097	0.360	0.360	100,946	3,454	6,267	-2,570	221,021	87,513	30,841	13.51	2.25	0.76	-3.80								
1930	3.627	2.501	1.294	1.049	0.344	0.344	103,705	3,304	3,321	-2,670	223,263	82,312	16,072	13.25	2.14	0.39	-4.12								
1931	3.546	2.474	1.279	1.012	0.330	0.330	101,916	3,064	772	-2,593	219,617	76,413	3,742	13.29	2.10	0.09	-4.43								
1932	3.476	2.442	1.264	0.980	0.318	0.318	100,466	2,856	-1,310	-2,537	220,560	72,564	-6,462	13.24	2.04	-0.16	-4.68								
1933	3.259	2.332	1.205	0.914	0.296	0.296	94,529	2,201	-5,715	-2,553	208,711	56,248	-28,365	12.42	1.62	-0.72	-5.02								
1934	3.228	2.329	1.203	0.898	0.295	0.295	97,235	2,211	-6,856	-2,527	217,958	57,341	-34,544	12.59	1.65	-0.87	-5.16								
1935	3.068	2.246	1.162	0.851	0.285	0.285	95,654	1,806	-10,317	-2,568	220,733	48,238	-53,512	11.98	1.34	-1.29	-5.40								

SOURCE: Author's calculations.

**Table A-1—Continued**  
**OASI money's worth and redistributive measures (including unfunded benefits) under present law, by birth cohort**

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption					
		Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock			
1936	2.995	2.218	1.150	0.826	0.284	96,211	1,682	-12,201	-2,533	224,664	45,446	-64,041	-715,951	11.88	1.27	-1.52	-5.57								
1937	3.127	2.314	1.205	0.850	0.295	103,510	2,242	-10,262	-2,373	251,299	62,990	-56,000	-697,310	13.07	1.78	-1.33	-5.62								
1938	2.966	2.229	1.165	0.806	0.284	105,471	1,774	-14,962	-3,395	258,062	54,569	-78,136	-745,349	12.38	1.46	-1.75	-5.85								
1939	2.946	2.233	1.172	0.797	0.283	108,138	2,082	-16,035	-3,323	266,743	57,262	-82,060	-735,035	12.60	1.55	-1.85	-5.97								
1940	2.882	2.204	1.165	0.778	0.279	111,409	2,255	-18,384	-3,012	277,107	58,972	-93,547	-751,622	12.47	1.52	-2.05	-6.13								
1941	2.837	2.190	1.163	0.765	0.274	110,124	2,535	-17,739	-2,343	291,573	58,910	-102,993	-772,605	12.46	1.53	-2.19	-6.28								
1942	2.645	2.098	1.115	0.721	0.255	107,346	2,154	-20,575	-2,711	315,264	47,969	-141,609	-900,313	11.58	1.10	-2.64	-6.53								
1943	2.653	2.110	1.132	0.720	0.254	111,133	2,803	-20,363	-3,240	337,248	56,436	-146,335	-911,186	11.84	1.27	-2.67	-6.62								
1944	2.745	2.158	1.174	0.739	0.260	118,614	3,737	-18,808	-3,641	343,021	70,932	-128,963	-832,063	12.53	1.71	-2.52	-6.65								
1945	2.717	2.144	1.178	0.732	0.256	123,276	3,745	-19,767	-4,912	346,853	72,388	-132,121	-818,324	12.49	1.78	-2.61	-6.76								
1946	2.668	2.125	1.175	0.720	0.243	124,077	3,418	-17,811	-3,810	416,281	84,820	-164,438	-972,930	12.39	1.77	-2.75	-6.94								
1947	2.621	2.105	1.172	0.710	0.235	124,877	3,506	-17,216	-3,657	470,790	93,940	-191,099	-1,082,200	12.26	1.76	-2.87	-7.08								
1948	2.681	2.139	1.204	0.724	0.236	131,898	4,329	-16,264	-3,626	474,929	106,022	-172,228	-997,688	12.76	2.11	-2.76	-7.12								
1949	2.743	2.173	1.235	0.739	0.239	139,635	4,960	-15,738	-4,232	499,661	121,892	-160,550	-956,532	13.28	2.46	-2.63	-7.16								
1950	2.759	2.185	1.252	0.745	0.238	140,088	5,202	-14,257	-4,951	521,045	131,430	-156,765	-934,246	13.51	2.66	-2.59	-7.22								
1951	2.711	2.163	1.245	0.737	0.235	141,470	6,659	-14,371	-5,711	541,900	132,889	-167,058	-947,420	13.32	2.61	-2.70	-7.31								
1952	2.709	2.163	1.254	0.740	0.237	145,600	7,338	-14,300	-6,476	571,007	142,010	-168,329	-937,441	13.41	2.73	-2.68	-7.35								
1953	2.745	2.193	1.277	0.753	0.245	149,506	8,274	-13,439	-5,947	600,837	156,315	-159,425	-896,490	13.72	3.00	-2.57	-7.34								
1954	2.727	2.176	1.280	0.754	0.248	153,273	8,363	-13,738	-8,797	629,674	163,515	-162,041	-883,842	13.70	3.06	-2.57	-7.36								
1955	2.686	2.151	1.275	0.752	0.254	152,518	9,588	-13,836	-10,825	636,546	162,019	-162,835	-842,972	13.45	3.02	-2.61	-7.36								
1956	2.666	2.138	1.277	0.756	0.267	152,684	10,065	-13,226	-10,302	653,526	165,564	-160,348	-794,148	13.34	3.06	-2.59	-7.30								
1957	2.643	2.120	1.277	0.761	0.286	152,467	10,297	-12,561	-8,084	663,144	166,888	-155,544	-731,175	13.17	3.08	-2.55	-7.17								
1958	2.627	2.111	1.281	0.767	0.299	153,648	10,138	-11,986	-10,367	667,117	167,523	-147,070	-664,453	13.11	3.13	-2.50	-7.10								
1959	2.580	2.086	1.273	0.768	0.312	154,490	10,953	-11,954	-10,570	667,137	163,217	-144,339	-610,827	12.83	3.06	-2.51	-7.03								
1960	2.499	2.048	1.253	0.760	0.323	151,590	10,235	-12,252	-9,628	659,903	152,490	-147,509	-566,522	12.38	2.85	-2.61	-7.00								
1961	2.528	2.062	1.272	0.779	0.347	155,207	10,913	-11,096	-10,636	673,974	161,220	-130,576	-495,272	12.59	3.07	-2.41	-6.82								
1962	2.525	2.063	1.279	0.789	0.362	159,313	11,615	-10,553	-8,895	678,355	162,986	-119,882	-440,298	12.63	3.16	-2.31	-6.73								
1963	2.549	2.074	1.296	0.808	0.383	162,508	12,305	-9,179	-9,174	680,694	167,682	-103,699	-378,297	12.79	3.37	-2.12	-6.56								
1964	2.594	2.071	1.299	0.814	0.399	166,497	12,978	-9,119	-9,614	676,319	165,594	-95,829	-333,969	12.77	3.41	-2.05	-6.43								
1965	2.541	2.074	1.310	0.827	0.422	170,944	13,997	-8,409	-9,424	657,964	162,619	-82,714	-281,168	12.82	3.53	-1.91	-6.22								
1966	2.547	2.078	1.319	0.839	0.443	174,956	17,398	-7,689	-7,308	645,481	160,635	-72,423	-240,139	12.87	3.65	-1.79	-6.01								
1967	2.550	2.075	1.327	0.849	0.461	180,569	18,461	-7,186	-7,920	647,141	161,603	-65,320	-210,127	12.84	3.73	-1.68	-5.83								
1968	2.559	2.079	1.337	0.859	0.473	182,780	20,444	-6,461	-7,501	655,557	164,653	-59,228	-187,793	12.89	3.85	-1.57	-5.70								
1969	2.541	2.074	1.337	0.859	0.476	184,081	20,532	-6,189	-5,989	676,797	167,933	-59,137	-178,229	12.82	3.85	-1.57	-5.68								
1970	2.514	2.062	1.333	0.857	0.480	184,851	19,833	-6,109	-5,443	694,725	169,434	-59,974	-167,941	12.67	3.81	-1.59	-5.63								

SOURCE: Author's calculations.

**Table A-1—Continued**  
**OASI money's worth and redistributive measures (including unfunded benefits) under present law, by birth cohort**

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption					
		Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock			
1971	2.527	2.071	1.345	0.864	0.481	189,533	20,328	-5,788	687,464	168,625	-53,910	-150,141	12.78	3.94	-1.51	-5.62									
1972	2.545	2.080	1.358	0.872	0.480	196,059	23,241	-5,461	661,889	163,651	-46,492	-130,516	12.90	4.09	-1.42	-5.62									
1973	2.529	2.075	1.359	0.870	0.470	200,555	25,083	-5,341	650,829	159,162	-45,008	-121,088	12.83	4.10	-1.44	-5.72									
1974	2.521	2.074	1.362	0.870	0.461	202,700	25,418	-4,962	660,016	160,212	-44,345	-115,863	12.83	4.14	-1.44	-5.82									
1975	2.513	2.072	1.365	0.869	0.451	205,094	24,891	-4,866	669,830	161,331	-43,800	-111,012	12.80	4.17	-1.45	-5.92									
1976	2.502	2.069	1.366	0.867	0.440	206,315	26,245	-4,921	685,851	163,501	-44,277	-108,234	12.76	4.19	-1.48	-6.04									
1977	2.495	2.068	1.368	0.866	0.431	207,855	27,168	-4,866	711,182	168,038	-44,992	-106,440	12.75	4.22	-1.49	-6.13									
1978	2.501	2.073	1.376	0.868	0.417	211,718	28,392	-4,623	735,687	173,411	-44,164	-104,230	12.82	4.30	-1.47	-6.28									
1979	2.501	2.075	1.380	0.867	0.401	213,732	29,267	-4,294	772,232	180,727	-44,990	-104,732	12.85	4.35	-1.48	-6.46									
1980	2.480	2.066	1.376	0.862	0.385	220,333	29,180	-4,342	812,891	186,890	-48,113	-106,766	12.73	4.31	-1.54	-6.63									
1981	2.491	2.073	1.383	0.864	0.372	222,695	29,584	-4,180	833,015	190,946	-46,538	-103,656	12.83	4.40	-1.51	-6.77									
1982	2.501	2.080	1.390	0.867	0.361	226,192	30,397	-4,284	853,854	194,931	-45,103	-100,351	12.92	4.48	-1.48	-6.89									
1983	2.519	2.090	1.400	0.871	0.357	230,199	31,703	-4,311	882,212	196,603	-42,172	-94,148	13.05	4.59	-1.43	-6.94									
1984	2.536	2.099	1.408	0.876	0.357	233,664	34,184	-4,360	919,691	200,800	-39,984	-89,089	13.17	4.69	-1.38	-6.94									
1985	2.546	2.105	1.415	0.879	0.356	236,196	35,466	-4,460	949,691	205,925	-38,878	-85,293	13.24	4.77	-1.35	-6.95									
1986	2.557	2.113	1.422	0.881	0.352	240,188	37,976	-4,712	929,692	209,309	-37,493	-81,219	13.35	4.85	-1.33	-6.99									
1987	2.567	2.120	1.428	0.883	0.350	243,040	38,869	-4,761	953,317	213,298	-36,400	-77,632	13.45	4.93	-1.30	-7.02									
1988	2.578	2.128	1.435	0.886	0.349	245,655	39,857	-4,764	985,860	219,302	-35,440	-74,576	13.54	5.01	-1.27	-7.03									
1989	2.584	2.133	1.439	0.887	0.347	247,283	40,769	-4,810	1,028,081	226,788	-35,404	-72,691	13.61	5.06	-1.26	-7.05									
1990	2.593	2.140	1.445	0.889	0.346	252,579	41,032	-4,791	1,065,362	233,370	-34,729	-70,069	13.70	5.13	-1.24	-7.06									
1991	2.602	2.147	1.451	0.891	0.344	257,024	41,326	-4,887	1,083,693	235,694	-33,453	-66,404	13.80	5.20	-1.22	-7.09									
1992	2.617	2.157	1.460	0.895	0.345	262,509	42,682	-4,893	1,093,268	236,636	-31,312	-61,974	13.93	5.30	-1.18	-7.08									
1993	2.632	2.167	1.468	0.898	0.345	268,413	43,975	-4,898	1,100,319	236,925	-29,266	-57,799	14.06	5.40	-1.14	-7.08									
1994	2.645	2.176	1.475	0.901	0.344	274,113	45,932	-4,912	1,110,573	237,665	-27,568	-54,100	14.18	5.49	-1.10	-7.08									
1995	2.652	2.182	1.481	0.903	0.345	279,197	47,429	-4,989	1,119,283	237,583	-26,331	-50,695	14.25	5.55	-1.08	-7.08									
1996	2.666	2.192	1.489	0.907	0.346	284,863	49,023	-4,920	1,137,774	240,083	-24,826	-47,698	14.38	5.65	-1.04	-7.07									
1997	2.677	2.199	1.495	0.909	0.347	289,710	52,046	-4,940	1,160,961	243,312	-23,644	-45,115	14.48	5.73	-1.01	-7.06									
1998	2.686	2.205	1.501	0.912	0.348	293,872	55,253	-4,963	1,183,926	246,162	-22,712	-42,721	14.56	5.79	-0.99	-7.05									
1999	2.698	2.213	1.508	0.915	0.349	298,644	57,756	-4,903	1,204,470	248,743	-21,470	-40,270	14.66	5.88	-0.95	-7.04									
2000	2.701	2.216	1.511	0.916	0.350	301,163	59,460	-4,990	1,255,330	256,734	-21,446	-39,129	14.70	5.92	-0.94	-7.03									
2001	2.713	2.224	1.518	0.919	0.351	306,570	62,249	-4,968	1,274,224	258,732	-20,234	-36,818	14.80	6.00	-0.91	-7.02									
2002	2.726	2.232	1.525	0.922	0.353	312,258	63,480	-4,799	1,316,223	263,581	-18,930	-34,653	14.91	6.09	-0.87	-7.00									
2003	2.738	2.240	1.532	0.925	0.354	317,768	66,170	-4,692	1,339,611	266,352	-17,795	-32,647	15.01	6.17	-0.83	-6.99									
2004	2.750	2.248	1.539	0.929	0.356	323,380	68,448	-4,557	1,364,303	269,156	-16,668	-30,790	15.11	6.25	-0.80	-6.97									
2005	2.761	2.255	1.546	0.932	0.357	328,861	70,670	-4,431	1,397,597	272,000	-15,582	-29,070	15.21	6.33	-0.76	-6.96									

SOURCE: Author's calculations.



**Table A-1—Continued**  
**OASI money's worth and redistributive measures (including unfunded benefits) under present law, by birth cohort**

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption					
		Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock			
2006	2.769	2.261	1.551	0.934	0.359	333,867	72,676	-4,346	-9,729	1,388,975	271,633	-14,916	-27,490	15.28	6.39	-0.74	-6.94								
2007	2.781	2.269	1.558	0.938	0.360	339,617	74,890	-4,173	-9,855	1,418,446	275,335	-13,907	-26,007	15.39	6.48	-0.70	-6.93								
2008	2.792	2.276	1.564	0.940	0.362	345,077	77,000	-4,036	-9,981	1,448,234	278,793	-13,073	-24,633	15.48	6.55	-0.67	-6.91								
2009	2.800	2.281	1.569	0.943	0.363	350,238	78,857	-3,934	-10,103	1,477,762	281,897	-12,400	-23,348	15.56	6.61	-0.64	-6.90								
2010	2.810	2.288	1.575	0.945	0.365	355,752	80,797	-3,794	-10,217	1,508,907	285,343	-11,642	-22,126	15.64	6.68	-0.61	-6.88								
2011	2.818	2.294	1.580	0.948	0.366	361,277	82,677	-3,670	-10,332	1,539,684	288,515	-10,959	-20,968	15.72	6.74	-0.58	-6.87								
2012	2.828	2.301	1.586	0.951	0.367	367,076	84,637	-3,519	-10,444	1,570,982	291,769	-10,226	-19,863	15.81	6.81	-0.55	-6.86								
2013	2.837	2.307	1.591	0.953	0.368	372,922	86,540	-3,384	-10,555	1,601,612	294,687	-9,565	-18,809	15.90	6.88	-0.53	-6.85								
2014	2.846	2.314	1.596	0.956	0.369	378,969	88,478	-3,233	-10,664	1,632,292	297,555	-8,888	-17,806	15.99	6.94	-0.50	-6.84								
2015	2.855	2.320	1.601	0.958	0.370	385,052	90,364	-3,089	-10,769	1,662,351	300,149	-8,257	-16,850	16.07	7.00	-0.47	-6.83								
2016	2.864	2.327	1.607	0.961	0.371	391,363	92,289	-2,927	-10,869	1,692,787	302,743	-7,609	-15,937	16.16	7.07	-0.44	-6.82								
2017	2.872	2.333	1.612	0.963	0.372	397,598	94,172	-2,786	-10,970	1,722,270	304,973	-7,038	-15,073	16.24	7.13	-0.41	-6.81								
2018	2.881	2.340	1.617	0.966	0.373	404,166	96,148	-2,624	-11,074	1,752,665	307,327	-6,443	-14,256	16.33	7.19	-0.39	-6.80								
2019	2.889	2.346	1.622	0.968	0.373	410,709	98,111	-2,471	-11,182	1,782,360	309,382	-5,914	-13,484	16.42	7.25	-0.36	-6.79								
2020	2.896	2.352	1.626	0.970	0.373	417,259	100,030	-2,352	-11,299	1,811,317	311,143	-5,450	-12,757	16.49	7.30	-0.34	-6.79								
2021	2.903	2.358	1.630	0.972	0.373	423,893	101,959	-2,227	-11,418	1,839,705	312,698	-5,009	-12,065	16.57	7.35	-0.32	-6.79								
2022	2.910	2.364	1.634	0.974	0.373	430,657	103,891	-2,101	-11,541	1,867,678	314,091	-4,584	-11,406	16.65	7.40	-0.30	-6.79								
2023	2.916	2.370	1.638	0.975	0.373	437,524	105,848	-1,976	-11,668	1,895,138	315,301	-4,181	-10,781	16.72	7.45	-0.28	-6.79								
2024	2.922	2.375	1.642	0.977	0.373	444,498	107,842	-1,849	-11,796	1,922,293	316,379	-3,792	-10,186	16.80	7.50	-0.25	-6.79								
2025	2.929	2.381	1.646	0.979	0.373	451,559	109,850	-1,727	-11,930	1,949,568	317,374	-3,433	-9,627	16.87	7.55	-0.24	-6.80								
2026	2.935	2.386	1.650	0.981	0.373	458,708	111,898	-1,598	-12,063	1,976,966	318,329	-3,079	-9,095	16.94	7.59	-0.22	-6.80								
2027	2.941	2.391	1.654	0.983	0.373	465,597	113,886	-1,473	-12,189	2,010,823	320,213	-2,761	-8,620	17.01	7.64	-0.20	-6.79								
2028	2.946	2.396	1.657	0.984	0.373	472,548	115,912	-1,344	-12,314	2,045,293	322,101	-2,451	-8,170	17.08	7.68	-0.18	-6.79								
2029	2.952	2.402	1.661	0.986	0.373	479,561	117,979	-1,222	-12,445	2,080,459	323,981	-2,169	-7,746	17.15	7.72	-0.16	-6.79								
2030	2.957	2.406	1.664	0.987	0.373	486,612	120,066	-1,106	-12,580	2,116,261	325,844	-1,910	-7,348	17.21	7.76	-0.14	-6.80								
2031	2.962	2.411	1.667	0.989	0.373	493,738	122,192	-986	-12,715	2,152,850	327,734	-1,658	-6,970	17.28	7.80	-0.13	-6.80								
2032	2.967	2.416	1.670	0.990	0.373	500,953	124,363	-860	-12,850	2,190,229	329,660	-1,408	-6,611	17.34	7.84	-0.11	-6.80								
2033	2.973	2.421	1.674	0.992	0.373	508,276	126,582	-726	-12,982	2,228,389	331,623	-1,156	-6,269	17.41	7.88	-0.09	-6.80								
2034	2.978	2.426	1.677	0.993	0.373	515,668	128,845	-597	-13,121	2,267,128	333,554	-927	-5,947	17.48	7.92	-0.07	-6.80								
2035	2.983	2.431	1.680	0.995	0.373	523,150	131,133	-471	-13,263	2,306,496	335,472	-711	-5,643	17.54	7.96	-0.06	-6.80								
2036	2.988	2.436	1.683	0.996	0.373	530,743	133,459	-338	-13,405	2,346,484	337,394	-497	-5,353	17.61	8.00	-0.04	-6.80								
2037	2.993	2.441	1.686	0.998	0.373	538,448	135,822	-199	-13,548	2,387,019	339,305	-286	-5,078	17.67	8.04	-0.02	-6.80								
2038	2.998	2.446	1.690	0.999	0.373	546,283	138,228	-55	-13,691	2,428,094	341,205	-077	-4,816	17.74	8.07	-0.01	-6.80								
2039	3.003	2.451	1.693	1.001	0.373	554,241	140,673	94	-13,835	2,469,572	343,072	0128	-4,567	17.80	8.11	0.01	-6.80								
2040	3.009	2.456	1.696	1.003	0.373	562,332	143,146	247	-13,981	2,511,411	344,896	0326	-4,330	17.87	8.15	0.03	-6.80								

SOURCE: Author's calculations.

**Table A-1—Continued**  
**OASI money's worth and redistributive measures (including unfunded benefits) under present law, by birth cohort**

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption					
		Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock
2041	3.013	2.461	1.699	1.004	0.373	570,521	145,624	397	-14,132	2,553,381	346,631	0.509	-4.105	17.94	8.19	0.05	-6.80								
2042	3.019	2.466	1.702	1.006	0.373	578,826	148,126	554	-14,283	2,595,504	348,307	0.692	-3.891	18.00	8.23	0.06	-6.80								
2043	3.024	2.470	1.706	1.007	0.373	587,231	150,642	720	-14,431	2,637,666	349,909	0.875	-3.686	18.07	8.27	0.08	-6.80								
2044	3.029	2.475	1.709	1.009	0.373	595,734	153,175	885	-14,583	2,679,894	351,423	1.045	-3.492	18.14	8.31	0.10	-6.80								
2045	3.034	2.480	1.712	1.010	0.373	604,364	155,728	1,061	-14,733	2,722,380	352,900	1.218	-3.307	18.20	8.35	0.12	-6.80								
2046	3.039	2.485	1.715	1.012	0.373	613,110	158,294	1,233	-14,888	2,765,168	354,317	1.376	-3.132	18.27	8.38	0.13	-6.80								
2047	3.045	2.490	1.718	1.013	0.373	621,980	160,884	1,408	-15,046	2,808,362	355,700	1.527	-2.966	18.33	8.42	0.15	-6.80								
2048	3.049	2.495	1.721	1.015	0.373	630,961	163,494	1,581	-15,207	2,851,984	357,045	1.668	-2.809	18.40	8.46	0.17	-6.80								
2049	3.054	2.500	1.724	1.017	0.373	640,082	166,143	1,765	-15,366	2,896,226	358,396	1.808	-2.659	18.46	8.50	0.19	-6.80								
2050	3.059	2.505	1.727	1.018	0.373	649,214	168,781	1,944	-15,529	2,940,571	359,662	1.936	-2.518	18.53	8.53	0.20	-6.80								
2051	3.064	2.509	1.730	1.020	0.373	658,526	171,459	2,131	-15,692	2,985,843	360,970	2.063	-2.384	18.59	8.57	0.22	-6.80								
2052	3.069	2.514	1.733	1.021	0.374	667,985	174,180	2,326	-15,855	3,031,981	362,307	2.188	-2.258	18.66	8.61	0.24	-6.79								
2053	3.074	2.519	1.736	1.023	0.374	677,566	176,928	2,515	-16,025	3,078,930	363,639	2.300	-2.138	18.72	8.65	0.25	-6.79								
2054	3.079	2.524	1.739	1.024	0.374	687,304	179,725	2,718	-16,192	3,126,923	365,029	2.415	-2.025	18.79	8.68	0.27	-6.79								
2055	3.084	2.528	1.742	1.026	0.374	697,174	182,562	2,926	-16,360	3,175,919	366,454	2.528	-1.917	18.85	8.72	0.29	-6.79								
2056	3.089	2.533	1.746	1.027	0.374	707,183	185,432	3,138	-16,530	3,225,994	367,917	2.636	-1.816	18.92	8.76	0.31	-6.79								
2057	3.094	2.538	1.749	1.029	0.374	717,340	188,341	3,351	-16,703	3,277,229	369,417	2.737	-1.720	18.98	8.80	0.32	-6.79								
2058	3.099	2.543	1.752	1.030	0.374	727,684	191,301	3,563	-16,881	3,329,836	370,975	2.830	-1.630	19.04	8.83	0.34	-6.79								
2059	3.103	2.547	1.754	1.032	0.374	738,191	194,299	3,770	-17,067	3,383,696	372,563	2.912	-1.545	19.11	8.87	0.36	-6.79								
2060	3.107	2.552	1.757	1.033	0.374	748,834	197,329	3,977	-17,256	3,438,653	374,174	2.988	-1.465	19.17	8.90	0.37	-6.79								
2061	3.112	2.556	1.760	1.034	0.374	759,611	200,390	4,185	-17,449	3,494,659	375,800	3.058	-1.389	19.23	8.94	0.39	-6.79								
2062	3.116	2.561	1.763	1.036	0.374	770,557	203,507	4,406	-17,639	3,551,822	377,474	3.132	-1.317	19.29	8.97	0.40	-6.79								
2063	3.121	2.565	1.766	1.037	0.374	781,664	206,661	4,633	-17,831	3,610,035	379,167	3.204	-1.249	19.35	9.01	0.42	-6.79								
2064	3.125	2.570	1.769	1.039	0.374	792,931	209,859	4,869	-18,022	3,669,240	380,874	3.275	-1.183	19.41	9.04	0.44	-6.78								
2065	3.130	2.574	1.772	1.040	0.375	804,384	213,100	5,109	-18,215	3,729,481	382,594	3.343	-1.122	19.47	9.08	0.45	-6.78								
2066	3.134	2.579	1.774	1.042	0.375	815,965	216,373	5,361	-18,406	3,790,431	384,302	3.413	-1.063	19.53	9.11	0.47	-6.78								
2067	3.139	2.583	1.777	1.043	0.375	827,650	219,677	5,620	-18,596	3,851,917	386,075	3.480	-1.007	19.60	9.15	0.49	-6.77								
2068	3.144	2.588	1.780	1.045	0.376	839,410	223,001	5,887	-18,785	3,913,757	387,893	3.545	-0.954	19.66	9.19	0.51	-6.77								
2069	3.149	2.592	1.783	1.046	0.376	851,274	226,341	6,161	-18,972	3,976,051	389,766	3.609	-0.904	19.72	9.22	0.52	-6.76								
2070	3.154	2.597	1.786	1.048	0.377	863,307	229,735	6,442	-19,161	4,039,068	390,720	3.669	-0.856	19.78	9.26	0.54	-6.76								
2071	3.159	2.601	1.789	1.050	0.377	875,520	233,170	6,729	-19,351	4,102,869	392,258	3.727	-0.810	19.84	9.30	0.56	-6.75								
2072	3.164	2.606	1.792	1.051	0.378	887,898	236,643	7,021	-19,542	4,167,363	393,768	3.782	-0.767	19.91	9.33	0.58	-6.75								
2073	3.169	2.610	1.795	1.053	0.379	900,454	240,160	7,317	-19,736	4,232,628	395,257	3.832	-0.726	19.97	9.37	0.59	-6.74								
2074	3.174	2.615	1.798	1.054	0.379	913,196	243,721	7,618	-19,933	4,298,741	396,730	3.879	-0.688	20.03	9.40	0.61	-6.73								
2075	3.179	2.619	1.801	1.056	0.380	926,074	247,313	7,923	-20,130	4,365,490	398,169	3.923	-0.651	20.09	9.44	0.63	-6.73								

SOURCE: Author's calculations.

**Table A-1—Continued**  
**OASI money's worth and redistributive measures (including unfunded benefits) under present law, by birth cohort**

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption					
		Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock			
2076	3.183	2.624	1.804	1.057	0.380	939,141	250,953	8,234	-20,330	4,433.153	399,599	3,963	-0.616	20.15	9.47	0.65	-6.72								
2077	3.188	2.628	1.807	1.059	0.381	952,533	254,680	8,552	-20,534	4,502.439	401,083	4,002	-0.583	20.21	9.51	0.67	-6.72								
2078	3.193	2.633	1.809	1.061	0.382	966,284	258,530	8,877	-20,745	4,573.561	402,635	4,038	-0.552	20.27	9.55	0.68	-6.71								
2079	3.198	2.637	1.812	1.062	0.382	979,333	262,203	9,207	-20,937	4,641.529	403,830	4,072	-0.522	20.33	9.58	0.70	-6.70								
2080	3.203	2.642	1.815	1.064	0.383	993,320	266,129	9,548	-21,147	4,708.479	404,850	4,100	-0.494	20.40	9.62	0.72	-6.70								
2081	3.207	2.646	1.818	1.065	0.383	1,007,255	270,035	9,885	-21,358	4,781.038	406,250	4,127	-0.468	20.46	9.65	0.74	-6.69								
2082	3.212	2.650	1.821	1.067	0.384	1,021,363	273,990	10,226	-21,571	4,854.861	407,663	4,150	-0.443	20.52	9.69	0.75	-6.68								
2083	3.217	2.655	1.824	1.068	0.385	1,035,642	277,993	10,572	-21,786	4,929.965	409,089	4,172	-0.419	20.58	9.72	0.77	-6.68								
2084	3.221	2.659	1.827	1.070	0.385	1,050,094	282,044	10,922	-22,004	5,006.378	410,527	4,191	-0.397	20.64	9.76	0.79	-6.67								
2085	3.226	2.663	1.829	1.071	0.386	1,064,720	286,144	11,277	-22,224	5,084.097	411,976	4,208	-0.376	20.70	9.79	0.80	-6.67								
2086	3.230	2.668	1.832	1.073	0.386	1,079,521	290,292	11,636	-22,447	5,163.118	413,433	4,222	-0.356	20.75	9.83	0.82	-6.66								
2087	3.235	2.672	1.835	1.074	0.387	1,094,511	294,494	12,001	-22,671	5,243.488	414,902	4,235	-0.337	20.81	9.86	0.84	-6.66								
2088	3.239	2.676	1.838	1.076	0.387	1,109,694	298,750	12,372	-22,899	5,325.193	416,379	4,246	-0.319	20.87	9.89	0.85	-6.65								
2089	3.243	2.680	1.840	1.077	0.388	1,125,070	303,061	12,748	-23,129	5,408.208	417,861	4,255	-0.302	20.93	9.93	0.87	-6.65								
2090	3.248	2.685	1.843	1.079	0.388	1,140,645	307,429	13,131	-23,361	5,492.515	419,346	4,262	-0.286	20.99	9.96	0.89	-6.64								
2091	3.252	2.689	1.846	1.080	0.389	1,156,431	311,856	13,519	-23,596	5,578.144	420,834	4,268	-0.271	21.05	10.00	0.90	-6.63								
2092	3.256	2.693	1.848	1.081	0.389	1,172,412	316,338	13,913	-23,834	5,664.974	422,313	4,271	-0.257	21.11	10.03	0.92	-6.63								
2093	3.261	2.697	1.851	1.083	0.390	1,188,620	320,884	14,314	-24,074	5,753.116	423,793	4,274	-0.243	21.16	10.06	0.94	-6.62								
2094	3.265	2.702	1.854	1.084	0.390	1,205,040	325,491	14,721	-24,318	5,842.459	425,262	4,275	-0.230	21.22	10.10	0.95	-6.62								
2095	3.269	2.706	1.856	1.086	0.391	1,221,681	330,160	15,134	-24,564	5,933.002	426,721	4,274	-0.218	21.28	10.13	0.97	-6.61								
2096	3.273	2.710	1.859	1.087	0.391	1,238,546	334,891	15,554	-24,813	6,024.704	428,163	4,271	-0.207	21.34	10.16	0.98	-6.61								
2097	3.278	2.714	1.862	1.089	0.392	1,255,639	339,687	15,980	-25,065	6,117.546	429,589	4,267	-0.196	21.39	10.20	1.00	-6.60								
2098	3.282	2.718	1.864	1.090	0.392	1,272,964	344,549	16,414	-25,319	6,211.512	430,996	4,262	-0.185	21.45	10.23	1.02	-6.60								
2099	3.286	2.722	1.867	1.091	0.393	1,290,522	349,477	16,854	-25,577	6,306.629	432,384	4,255	-0.175	21.51	10.26	1.03	-6.59								
2100	3.290	2.727	1.870	1.093	0.393	1,308,324	354,473	17,301	-25,838	6,402.966	433,758	4,247	-0.166	21.57	10.30	1.05	-6.59								

SOURCE: Author's calculations.

## **Appendix B.**

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This appendix presents OASI money's worth and redistributive measures of lifetime outcomes by birth cohort as simulated under the balanced budget award adjustment policy. As discussed in the text, this stylized policy brings the program into long-run financial balance consistent with the underlying Trustees Report projections.

**Table B-1**  
**OASI money's worth and redistributive measures under the award adjustment policy, by birth cohort**

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption					
		Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock
Pre-1901	18.367	12.037	6.093	12.037	3.207	31,365	6,478	36,760	2,165	1,637,203	3,912,972	4,313,035	13,676,469	34.97	13.39	35.27	5.12								
1901	10.868	8.065	3.718	7.688	2.186	63,959	8,809	70,672	2,473	130,104	207,357	323,140	608,789	28.47	8.57	26.75	3.05								
1902	10.481	7.683	3.546	7.262	2.168	71,461	9,477	78,181	2,711	143,414	220,098	352,677	658,360	27.81	8.28	25.84	3.07								
1903	10.329	7.518	3.517	7.037	2.244	71,974	9,286	77,732	2,757	150,715	225,014	365,871	698,657	28.30	8.50	25.91	3.36								
1904	9.881	7.074	3.323	6.552	2.163	73,349	9,106	78,018	2,690	157,567	226,369	376,721	699,208	27.19	8.04	24.52	3.19								
1905	9.444	6.733	3.150	6.170	2.064	76,601	9,167	80,121	2,644	167,332	231,728	393,407	698,935	26.21	7.54	23.26	2.94								
1906	9.061	6.392	3.001	5.784	1.985	77,991	8,989	79,971	2,540	173,566	231,504	400,043	683,963	25.36	7.15	22.08	2.76								
1907	8.950	6.296	2.997	5.610	2.030	84,950	9,594	85,292	2,750	185,763	242,778	419,234	727,784	25.90	7.41	22.05	2.97								
1908	8.583	5.906	2.840	5.185	1.935	86,906	9,461	85,196	2,628	193,056	243,223	425,403	706,590	24.78	7.01	20.62	2.75								
1909	8.170	5.641	2.695	4.857	1.807	85,464	8,919	81,453	2,313	196,610	237,439	421,196	643,861	23.86	6.52	19.31	2.40								
1910	7.918	5.471	2.622	4.612	1.714	87,207	8,810	80,531	2,101	203,609	238,030	422,630	593,524	23.58	6.35	18.50	2.15								
1911	7.827	5.396	2.626	4.436	1.718	90,647	8,974	80,737	2,077	211,908	242,761	424,247	587,565	24.23	6.65	18.31	2.25								
1912	7.447	5.102	2.485	4.077	1.574	96,353	9,113	82,184	1,835	223,759	244,892	428,995	515,688	23.14	6.19	16.74	1.83								
1913	7.319	5.039	2.474	3.906	1.508	99,764	9,222	81,382	1,630	233,270	249,526	427,725	461,109	23.57	6.34	16.30	1.67								
1914	6.948	4.718	2.326	3.531	1.357	101,416	8,908	78,101	1,213	242,291	246,283	419,411	350,614	22.30	5.86	14.55	1.20								
1915	6.820	4.660	2.309	3.365	1.288	100,249	8,595	73,098	945	246,675	244,736	404,298	281,400	22.58	5.93	13.94	1.00								
1916	6.650	4.535	2.263	3.147	1.210	105,892	8,797	72,334	716	252,141	242,387	387,148	206,414	22.48	5.92	12.99	0.75								
1917	6.333	4.237	2.127	2.831	1.082	96,988	7,647	61,573	267	243,594	222,256	347,606	81,261	21.10	5.43	11.34	0.30								
1918	5.912	3.919	1.958	2.497	0.927	96,058	7,009	55,225	-256	242,391	204,684	313,232	-78,107	19.35	4.70	9.41	-0.27								
1919	5.578	3.608	1.827	2.196	0.835	88,188	5,988	45,165	-554	223,951	175,974	257,809	-170,316	17.88	4.27	7.75	-0.66								
1920	5.378	3.492	1.771	2.027	0.754	93,299	6,018	42,712	-881	237,470	177,264	244,360	-271,293	17.52	4.11	6.80	-1.02								
1921	5.098	3.295	1.677	1.834	0.673	95,664	5,730	38,368	-1,245	243,131	168,536	219,184	-382,817	16.53	3.73	5.64	-1.40								
1922	4.949	3.225	1.643	1.722	0.619	93,620	5,349	33,189	-1,404	237,391	156,973	189,166	-430,817	16.43	3.64	4.97	-1.68								
1923	4.748	3.114	1.589	1.602	0.565	94,702	5,094	29,215	-1,626	236,922	147,483	164,289	-492,441	15.94	3.44	4.22	-2.00								
1924	4.554	3.004	1.534	1.494	0.519	98,907	4,976	26,143	-1,899	241,870	140,812	143,702	-562,014	15.43	3.20	3.52	-2.28								
1925	4.453	2.964	1.517	1.427	0.490	99,941	4,850	23,018	-1,982	241,931	135,855	125,245	-580,545	15.47	3.18	3.10	-2.51								
1926	4.249	2.853	1.460	1.331	0.447	98,616	4,411	18,444	-2,153	235,826	122,057	99,138	-622,992	14.89	2.90	2.44	-2.82								
1927	4.114	2.776	1.426	1.259	0.419	103,276	4,348	15,343	-2,342	239,840	116,848	81,136	-658,250	14.63	2.78	1.95	-3.11								
1928	3.910	2.664	1.368	1.173	0.387	102,646	3,893	10,360	-2,494	231,132	101,455	54,966	-680,974	13.99	2.47	1.33	-3.42								
1929	3.734	2.565	1.321	1.097	0.360	100,935	3,453	6,264	-2,570	220,996	87,496	30,829	-680,948	13.51	2.25	0.76	-3.80								
1930	3.627	2.501	1.294	1.049	0.344	103,691	3,303	3,318	-2,670	223,231	82,290	16,057	-695,577	13.25	2.14	0.39	-4.12								
1931	3.546	2.474	1.279	1.011	0.330	101,898	3,063	769	-2,593	219,578	76,388	3,724	-676,328	13.29	2.10	0.09	-4.43								
1932	3.476	2.442	1.264	0.980	0.318	100,445	2,855	-1,314	-2,537	220,513	72,533	-6,483	-673,996	13.24	2.04	-0.16	-4.68								
1933	3.259	2.332	1.204	0.914	0.296	94,504	2,200	-5,720	-2,553	208,656	56,212	-28,389	-682,238	12.42	1.62	-0.72	-5.02								
1934	3.228	2.329	1.203	0.898	0.295	97,205	2,209	-6,862	-2,527	217,890	57,297	-34,574	-685,436	12.59	1.64	-0.87	-5.16								
1935	3.068	2.246	1.162	0.851	0.285	95,619	1,804	-10,323	-2,568	220,653	48,187	-53,546	-717,157	11.97	1.34	-1.29	-5.40								

SOURCE: Author's calculations.

Table B-1—Continued

OASI money's worth and redistributive measures under the award adjustment policy, by birth cohort

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption					
		Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock
1936	2.995	2.217	1.149	0.826	0.284	0.284	1.149	0.826	0.284	0.284	1.680	-12,209	-2,534	224,569	45,385	-64,081	-715,966	11.87	1.27	-1.53	-5.57				
1937	3.127	2.313	1.204	0.850	0.295	103,462	2,239	-10,271	-2,373	251,183	62,916	-56,049	-697,328	13.06	1.77	-1.34	-5.62								
1938	2.966	2.228	1.165	0.805	0.284	105,414	1,771	-14,973	-3,395	257,923	54,481	-78,193	-745,370	12.38	1.46	-1.75	-5.85								
1939	2.946	2.292	1.172	0.797	0.283	108,072	2,079	-16,048	-3,323	266,580	57,161	-82,126	-735,059	12.59	1.55	-1.85	-5.97								
1940	2.881	2.203	1.164	0.778	0.278	111,336	2,251	-18,399	-3,012	276,925	56,859	-93,620	-751,647	12.46	1.51	-2.05	-6.13								
1941	2.836	2.189	1.163	0.765	0.273	110,043	2,529	-17,754	-2,343	291,359	58,778	-103,076	-772,634	12.46	1.53	-2.20	-6.28								
1942	2.644	2.097	1.115	0.720	0.255	107,256	2,146	-20,590	-2,711	314,998	47,807	-141,712	-900,348	11.57	1.09	-2.64	-6.54								
1943	2.652	2.109	1.131	0.720	0.254	111,030	2,793	-20,379	-3,240	336,935	56,246	-146,454	-911,225	11.83	1.27	-2.67	-6.62								
1944	2.744	2.157	1.174	0.739	0.260	118,496	3,726	-18,826	-3,641	342,681	70,727	-129,090	-832,105	12.52	1.71	-2.52	-6.65								
1945	2.715	2.142	1.177	0.732	0.256	123,101	3,729	-19,796	-4,912	346,362	72,085	-132,314	-818,393	12.48	1.77	-2.62	-6.77								
1946	2.665	2.123	1.174	0.719	0.243	123,820	3,397	-17,848	-3,811	415,419	84,284	-164,785	-973,058	12.36	1.75	-2.76	-6.95								
1947	2.617	2.102	1.171	0.709	0.235	124,513	3,474	-17,266	-3,658	469,417	93,084	-191,653	-1,082,406	12.22	1.74	-2.88	-7.08								
1948	2.675	2.135	1.202	0.723	0.236	131,382	4,282	-16,335	-3,627	473,073	104,869	-172,972	-997,963	12.71	2.08	-2.77	-7.13								
1949	2.728	2.164	1.230	0.736	0.239	138,416	4,848	-15,918	-4,235	495,299	119,120	-162,385	-957,252	13.16	2.41	-2.66	-7.16								
1950	2.731	2.167	1.242	0.739	0.237	137,850	4,993	-14,576	-4,958	512,720	126,138	-160,271	-935,621	13.29	2.55	-2.65	-7.23								
1951	2.668	2.136	1.230	0.728	0.233	138,025	6,242	-14,805	-5,723	528,705	124,572	-172,515	-949,513	13.00	2.44	-2.78	-7.33								
1952	2.649	2.126	1.233	0.728	0.234	140,634	6,710	-14,970	-6,496	551,532	129,858	-176,215	-940,389	12.95	2.49	-2.81	-7.38								
1953	2.657	2.128	1.245	0.735	0.241	142,209	7,314	-14,423	-5,975	571,512	138,171	-171,097	-900,774	13.05	2.65	-2.76	-7.37								
1954	2.612	2.105	1.239	0.730	0.244	143,490	7,105	-15,062	-8,853	589,483	138,927	-177,668	-889,422	12.82	2.60	-2.82	-7.41								
1955	2.542	2.065	1.224	0.723	0.248	140,383	7,778	-15,464	-10,910	585,898	131,435	-181,998	-849,594	12.38	2.45	-2.92	-7.42								
1956	2.494	2.035	1.216	0.721	0.260	138,157	7,813	-15,112	-10,401	591,348	128,525	-183,213	-801,780	12.07	2.37	-2.96	-7.37								
1957	2.441	2.002	1.206	0.720	0.277	135,530	7,627	-14,686	-8,177	589,478	123,612	-181,855	-739,648	11.71	2.28	-2.99	-7.26								
1958	2.396	1.978	1.199	0.720	0.290	134,146	7,170	-14,379	-10,509	582,440	118,479	-176,425	-673,568	11.44	2.21	-3.00	-7.20								
1959	2.317	1.936	1.181	0.715	0.301	132,034	7,238	-14,655	-10,739	570,165	107,858	-176,953	-620,582	10.96	2.02	-3.07	-7.14								
1960	2.205	1.883	1.152	0.701	0.310	126,532	6,116	-15,206	-9,802	550,821	91,126	-183,079	-576,762	10.34	1.70	-3.23	-7.12								
1961	2.204	1.880	1.159	0.713	0.332	127,277	6,359	-14,359	-10,865	552,694	93,948	-168,974	-505,934	10.32	1.79	-3.12	-6.96								
1962	2.170	1.865	1.156	0.717	0.345	128,133	6,440	-14,146	-8,911	545,592	90,374	-160,692	-451,227	10.16	1.75	-3.10	-6.89								
1963	2.162	1.858	1.161	0.727	0.364	128,235	6,623	-13,277	-9,443	537,134	90,259	-146,546	-389,367	10.09	1.81	-3.00	-6.75								
1964	2.117	1.839	1.153	0.727	0.379	128,671	6,575	-13,356	-9,933	522,670	83,892	-140,345	-345,060	9.87	1.73	-3.01	-6.64								
1965	2.092	1.826	1.152	0.732	0.399	129,487	6,798	-12,969	-9,785	498,396	78,974	-127,570	-291,937	9.71	1.72	-2.95	-6.46								
1966	2.067	1.813	1.150	0.737	0.418	129,904	8,093	-12,505	-7,627	479,268	74,723	-117,779	-250,640	9.56	1.70	-2.91	-6.28								
1967	2.037	1.795	1.146	0.739	0.434	131,264	8,172	-12,337	-8,314	470,438	71,535	-112,131	-220,580	9.33	1.65	-2.88	-6.12								
1968	2.015	1.783	1.145	0.741	0.443	130,249	8,685	-11,746	-7,918	467,151	69,950	-107,679	-198,227	9.19	1.63	-2.86	-6.02								
1969	1.968	1.763	1.135	0.735	0.443	128,355	8,114	-11,541	-6,346	471,911	66,367	-110,283	-188,852	8.94	1.52	-2.92	-6.02								
1970	1.912	1.737	1.122	0.728	0.446	125,885	7,154	-11,575	-5,791	473,115	61,114	-113,645	-178,683	8.63	1.37	-3.00	-5.99								

SOURCE: Author's calculations.

Table B-1—Continued

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio									Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars									Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars									Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings								
		Interest rate assumption			Trust fund			Company stock			Interest rate assumption			Trust fund			Company stock			Interest rate assumption			Trust fund			Company stock											
		Zero real	Tax base growth	Large company stock	Zero real	Tax base growth	Large company stock	Zero real	Tax base growth	Large company stock	Zero real	Tax base growth	Large company stock	Zero real	Tax base growth	Large company stock	Zero real	Tax base growth	Large company stock	Zero real	Tax base growth	Large company stock	Zero real	Tax base growth	Large company stock												
1971	1.894	1.729	1.121	0.727	0.444	126,518	7,047	-11,555	-5,961	458,898	58,459	-107,615	-160,498	8.53	1.37	-3.01	-6.01																				
1972	1.880	1.722	1.122	0.727	0.440	128,323	7,805	-11,583	-6,437	433,215	54,957	-98,620	-140,203	8.44	1.37	-3.01	-6.04																				
1973	1.837	1.703	1.113	0.719	0.428	128,366	7,774	-11,491	-4,884	416,566	49,330	-96,833	-130,372	8.21	1.27	-3.10	-6.16																				
1974	1.802	1.689	1.106	0.712	0.417	127,004	7,331	-10,885	-3,059	413,541	46,209	-97,276	-125,008	8.04	1.19	-3.17	-6.28																				
1975	1.766	1.673	1.099	0.705	0.405	125,695	6,637	-10,869	-3,754	410,515	43,016	-97,836	-120,011	7.84	1.11	-3.24	-6.40																				
1976	1.728	1.656	1.090	0.697	0.392	123,605	6,378	-11,101	-4,254	410,897	39,734	-99,881	-117,161	7.64	1.02	-3.33	-6.54																				
1977	1.694	1.642	1.083	0.690	0.382	121,805	6,026	-11,115	-3,538	416,759	37,274	-102,778	-115,385	7.47	0.94	-3.41	-6.65																				
1978	1.674	1.633	1.080	0.686	0.366	121,709	5,951	-10,858	-3,338	422,920	36,345	-103,741	-113,121	7.37	0.90	-3.46	-6.82																				
1979	1.649	1.623	1.075	0.679	0.348	120,458	5,665	-10,242	-3,373	435,224	34,983	-107,300	-113,699	7.24	0.84	-3.53	-7.01																				
1980	1.603	1.603	1.063	0.670	0.331	121,237	4,823	-10,260	-3,966	447,289	30,891	-113,691	-115,861	7.01	0.71	-3.63	-7.20																				
1981	1.590	1.597	1.061	0.666	0.316	120,420	4,627	-10,160	-3,317	450,445	29,864	-113,124	-112,558	6.94	0.69	-3.67	-7.35																				
1982	1.576	1.591	1.059	0.663	0.304	120,276	4,491	-10,697	-3,722	454,029	28,798	-112,631	-109,055	6.87	0.66	-3.71	-7.49																				
1983	1.571	1.589	1.059	0.662	0.298	120,731	4,595	-11,179	-4,161	452,199	28,447	-109,350	-102,492	6.84	0.67	-3.72	-7.55																				
1984	1.566	1.586	1.059	0.662	0.296	120,892	4,850	-11,743	-4,001	456,509	28,493	-107,683	-97,195	6.81	0.67	-3.72	-7.57																				
1985	1.555	1.581	1.057	0.659	0.294	120,390	4,791	-12,353	-4,793	463,672	27,816	-107,674	-93,234	6.75	0.64	-3.75	-7.60																				
1986	1.546	1.578	1.056	0.657	0.288	120,690	4,905	-13,410	-5,328	467,153	27,034	-106,701	-88,916	6.71	0.63	-3.78	-7.65																				
1987	1.535	1.574	1.054	0.654	0.284	120,372	4,768	-13,897	-5,073	472,156	26,165	-106,246	-85,121	6.66	0.60	-3.81	-7.70																				
1988	1.526	1.570	1.052	0.652	0.283	120,000	4,676	-14,311	-5,338	481,580	25,729	-106,466	-81,917	6.62	0.59	-3.83	-7.72																				
1989	1.513	1.564	1.049	0.649	0.279	119,015	4,449	-14,709	-6,319	494,807	24,749	-108,277	-79,952	6.55	0.55	-3.86	-7.76																				
1990	1.502	1.560	1.047	0.646	0.277	119,874	4,232	-15,027	-5,487	505,621	24,070	-108,929	-77,194	6.50	0.53	-3.89	-7.78																				
1991	1.493	1.557	1.045	0.644	0.273	120,325	4,033	-15,712	-6,599	507,327	22,999	-107,559	-73,261	6.46	0.51	-3.92	-7.82																				
1992	1.488	1.555	1.045	0.643	0.273	121,401	4,073	-16,348	-6,538	505,596	22,583	-104,612	-68,511	6.44	0.51	-3.93	-7.82																				
1993	1.485	1.554	1.045	0.641	0.271	122,712	4,119	-16,993	-6,643	503,040	22,194	-101,537	-64,011	6.43	0.51	-3.94	-7.84																				
1994	1.479	1.552	1.044	0.640	0.270	123,832	4,178	-17,646	-6,219	501,707	21,617	-99,027	-60,020	6.40	0.50	-3.96	-7.86																				
1995	1.469	1.548	1.042	0.638	0.269	124,459	4,060	-18,366	-7,906	498,948	20,338	-96,938	-56,331	6.35	0.48	-3.99	-7.87																				
1996	1.464	1.546	1.042	0.636	0.268	125,514	4,099	-18,848	-8,910	501,319	20,076	-95,097	-53,105	6.33	0.47	-4.00	-7.87																				
1997	1.457	1.543	1.041	0.635	0.268	126,086	4,187	-19,613	-11,036	505,269	19,575	-93,876	-50,324	6.30	0.46	-4.02	-7.88																				
1998	1.448	1.540	1.039	0.633	0.268	126,300	4,214	-20,373	-13,176	508,826	18,775	-92,854	-47,735	6.26	0.44	-4.04	-7.88																				
1999	1.442	1.537	1.039	0.632	0.268	126,866	4,268	-20,851	-14,654	511,665	18,381	-91,307	-45,084	6.23	0.43	-4.05	-7.88																				
2000	1.428	1.531	1.035	0.629	0.268	126,176	4,007	-21,194	-12,130	525,937	17,303	-92,787	-43,873	6.16	0.40	-4.08	-7.88																				
2001	1.422	1.529	1.035	0.628	0.268	126,966	4,047	-21,911	-9,951	527,721	16,822	-91,069	-41,361	6.13	0.39	-4.09	-7.88																				
2002	1.418	1.527	1.034	0.627	0.268	127,940	4,047	-22,643	-10,285	530,599	16,655	-89,322	-39,010	6.11	0.39	-4.10	-7.88																				
2003	1.414	1.525	1.034	0.626	0.268	128,842	4,114	-23,130	-10,497	533,676	16,387	-87,720	-36,825	6.09	0.38	-4.11	-7.88																				
2004	1.409	1.523	1.034	0.626	0.268	129,769	4,164	-23,573	-10,693	537,573	16,203	-86,223	-34,803	6.07	0.38	-4.12	-7.88																				
2005	1.404	1.521	1.033	0.625	0.268	130,587	4,168	-23,988	-10,870	541,750	15,874	-84,898	-32,927	6.04	0.37	-4.13	-7.88																				

SOURCE: Author's calculations.

Table B-1—Continued

OASI money's worth and redistributive measures under the award adjustment policy, by birth cohort

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption					
		Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock
2006	1.396	1.518	1.032	0.623	0.268	131,072	4,052	-24,418	-11,041	545,294	15,144	-83,808	-31,199	6.00	0.36	-4.14	-7.88								
2007	1.392	1.516	1.031	0.622	0.269	132,008	4,092	-24,798	-11,210	551,344	15,043	-82,634	-29,583	5.98	0.35	-4.15	-7.88								
2008	1.388	1.515	1.031	0.622	0.269	132,934	4,115	-25,181	-11,377	557,903	14,899	-81,566	-28,079	5.96	0.35	-4.16	-7.88								
2009	1.382	1.512	1.030	0.620	0.269	133,651	4,045	-25,580	-11,539	563,914	14,460	-80,629	-26,666	5.94	0.34	-4.17	-7.88								
2010	1.378	1.511	1.030	0.620	0.269	134,626	4,055	-25,948	-11,694	571,012	14,322	-79,614	-25,324	5.92	0.34	-4.18	-7.88								
2011	1.374	1.510	1.029	0.619	0.269	135,618	4,046	-26,324	-11,850	577,975	14,118	-78,610	-24,048	5.90	0.33	-4.19	-7.88								
2012	1.372	1.509	1.029	0.618	0.268	136,784	4,087	-26,681	-12,003	585,398	14,089	-77,531	-22,828	5.89	0.33	-4.20	-7.88								
2013	1.371	1.509	1.030	0.618	0.268	138,180	4,181	-27,022	-12,153	593,450	14,236	-76,387	-21,658	5.89	0.33	-4.20	-7.88								
2014	1.371	1.509	1.030	0.618	0.268	139,853	4,357	-27,937	-12,301	602,374	14,652	-75,158	-20,541	5.90	0.34	-4.20	-7.89								
2015	1.367	1.508	1.030	0.617	0.268	140,925	4,304	-27,713	-12,450	608,404	14,295	-74,084	-19,479	5.88	0.33	-4.21	-7.89								
2016	1.366	1.508	1.030	0.617	0.267	142,480	4,404	-28,039	-12,590	616,279	14,446	-72,878	-18,461	5.88	0.34	-4.22	-7.90								
2017	1.365	1.508	1.030	0.616	0.267	143,986	4,468	-28,378	-12,733	623,702	14,469	-71,698	-17,495	5.88	0.34	-4.22	-7.90								
2018	1.366	1.509	1.031	0.616	0.266	145,858	4,641	-28,691	-12,877	632,512	14,836	-70,449	-16,577	5.89	0.35	-4.22	-7.91								
2019	1.368	1.510	1.032	0.616	0.266	147,916	4,863	-28,997	-13,024	641,915	15,336	-69,177	-15,705	5.91	0.36	-4.22	-7.91								
2020	1.368	1.510	1.032	0.615	0.264	149,434	4,866	-29,377	-13,184	648,690	15,137	-68,064	-14,886	5.91	0.36	-4.23	-7.93								
2021	1.368	1.511	1.032	0.615	0.263	151,533	5,063	-29,709	-13,344	657,656	15,527	-66,812	-14,099	5.92	0.36	-4.23	-7.94								
2022	1.371	1.514	1.034	0.615	0.262	153,891	5,335	-30,024	-13,506	667,394	16,131	-65,507	-13,348	5.95	0.38	-4.23	-7.95								
2023	1.375	1.516	1.035	0.616	0.261	156,414	5,653	-30,335	-13,672	677,509	16,839	-64,178	-12,632	5.98	0.40	-4.23	-7.96								
2024	1.380	1.518	1.037	0.616	0.260	158,994	5,980	-30,647	-13,840	687,590	17,542	-62,851	-11,951	6.01	0.42	-4.22	-7.97								
2025	1.383	1.521	1.038	0.616	0.259	161,553	6,284	-30,975	-14,015	697,489	18,155	-61,569	-11,309	6.04	0.43	-4.22	-7.98								
2026	1.387	1.523	1.040	0.616	0.258	164,093	6,577	-31,307	-14,189	707,219	18,709	-60,310	-10,698	6.06	0.45	-4.22	-7.99								
2027	1.388	1.524	1.040	0.616	0.257	166,206	6,738	-31,659	-14,359	717,812	18,946	-59,336	-10,155	6.07	0.45	-4.22	-8.00								
2028	1.388	1.525	1.040	0.616	0.256	168,221	6,860	-32,025	-14,529	728,097	19,064	-58,401	-9,639	6.08	0.45	-4.22	-8.01								
2029	1.387	1.525	1.040	0.615	0.255	170,120	6,930	-32,414	-14,706	738,024	19,029	-57,521	-9,154	6.08	0.45	-4.23	-8.03								
2030	1.385	1.525	1.040	0.614	0.253	171,881	6,939	-32,825	-14,888	747,505	18,832	-56,694	-8,696	6.08	0.45	-4.24	-8.04								
2031	1.383	1.524	1.039	0.614	0.252	173,567	6,915	-33,249	-15,072	756,805	18,548	-55,899	-8,262	6.07	0.44	-4.25	-8.06								
2032	1.379	1.523	1.038	0.613	0.251	175,080	6,824	-33,693	-15,258	765,470	18,088	-55,144	-7,849	6.06	0.43	-4.26	-8.07								
2033	1.376	1.522	1.037	0.612	0.249	176,594	6,727	-34,140	-15,443	774,226	17,622	-54,398	-7,457	6.05	0.42	-4.27	-8.08								
2034	1.372	1.521	1.036	0.610	0.248	178,099	6,614	-34,599	-15,633	783,012	17,122	-53,674	-7,086	6.04	0.41	-4.28	-8.10								
2035	1.368	1.520	1.035	0.609	0.246	179,614	6,493	-35,067	-15,828	791,892	16,610	-52,964	-6,734	6.02	0.39	-4.29	-8.11								
2036	1.365	1.519	1.034	0.608	0.245	181,176	6,381	-35,535	-16,023	801,005	16,131	-52,252	-6,399	6.01	0.38	-4.31	-8.13								
2037	1.362	1.518	1.033	0.607	0.244	182,792	6,279	-36,003	-16,220	810,343	15,686	-51,539	-6,080	6.00	0.37	-4.32	-8.14								
2038	1.359	1.517	1.032	0.606	0.242	184,481	6,194	-36,471	-16,417	819,973	15,290	-50,820	-5,775	5.99	0.36	-4.33	-8.16								
2039	1.356	1.516	1.031	0.605	0.241	186,254	6,130	-36,937	-16,616	829,905	14,950	-50,094	-5,485	5.98	0.35	-4.34	-8.17								
2040	1.354	1.516	1.031	0.605	0.240	188,121	6,088	-37,402	-16,817	840,162	14,669	-49,362	-5,208	5.98	0.35	-4.34	-8.18								

SOURCE: Author's calculations.



**Table B-1—Continued**  
**OASI money's worth and redistributive measures under the award adjustment policy, by birth cohort**

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio				Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars				Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars				Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings			
		Interest rate assumption				Interest rate assumption				Interest rate assumption				Interest rate assumption			
		Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock
2041	1.352	1.516	1.030	0.604	0.239	190,071	6,062	-37,871	-17,022	850,669	14,430	-48,628	-4,945	5.98	0.34	-4.35	-8.19
2042	1.351	1.516	1.030	0.603	0.238	192,121	6,066	-38,333	-17,227	861,484	14,263	-47,879	-4,693	5.98	0.34	-4.36	-8.20
2043	1.350	1.516	1.030	0.603	0.237	194,264	6,098	-38,789	-17,431	872,578	14,165	-47,117	-4,453	5.98	0.33	-4.36	-8.21
2044	1.350	1.516	1.030	0.602	0.236	196,497	6,152	-39,244	-17,638	883,938	14,115	-46,352	-4,224	5.98	0.33	-4.37	-8.22
2045	1.350	1.517	1.030	0.602	0.235	198,841	6,241	-39,692	-17,844	895,684	14,143	-45,576	-4,005	5.99	0.33	-4.37	-8.23
2046	1.351	1.518	1.030	0.602	0.234	201,260	6,344	-40,143	-18,053	907,696	14,199	-44,807	-3,797	6.00	0.34	-4.37	-8.24
2047	1.351	1.518	1.030	0.602	0.233	203,752	6,462	-40,597	-18,265	919,982	14,287	-44,043	-3,600	6.01	0.34	-4.38	-8.25
2048	1.352	1.519	1.030	0.601	0.232	206,303	6,590	-41,054	-18,481	932,503	14,391	-43,289	-3,414	6.02	0.34	-4.38	-8.26
2049	1.353	1.520	1.031	0.601	0.231	208,917	6,733	-41,511	-18,696	945,300	14,525	-42,540	-3,236	6.03	0.34	-4.38	-8.27
2050	1.354	1.521	1.031	0.601	0.231	211,549	6,882	-41,968	-18,913	958,198	14,664	-41,799	-3,067	6.04	0.35	-4.38	-8.28
2051	1.355	1.522	1.031	0.601	0.230	214,226	7,033	-42,431	-19,132	971,327	14,806	-41,072	-2,907	6.05	0.35	-4.38	-8.28
2052	1.356	1.523	1.032	0.601	0.229	216,932	7,187	-42,897	-19,351	984,654	14,949	-40,357	-2,755	6.06	0.36	-4.38	-8.29
2053	1.356	1.524	1.032	0.601	0.228	219,642	7,327	-43,378	-19,577	998,077	15,059	-39,665	-2,612	6.07	0.36	-4.39	-8.30
2054	1.357	1.524	1.032	0.601	0.228	222,366	7,467	-43,860	-19,802	1,011,664	15,165	-38,984	-2,476	6.08	0.36	-4.39	-8.31
2055	1.358	1.525	1.032	0.600	0.227	225,090	7,598	-44,349	-20,029	1,025,378	15,252	-38,320	-2,347	6.09	0.36	-4.39	-8.31
2056	1.358	1.526	1.032	0.600	0.226	227,787	7,709	-44,850	-20,258	1,039,106	15,299	-37,676	-2,225	6.09	0.36	-4.39	-8.32
2057	1.358	1.526	1.032	0.600	0.226	230,451	7,792	-45,367	-20,492	1,052,838	15,283	-37,056	-2,110	6.10	0.36	-4.39	-8.33
2058	1.357	1.526	1.032	0.600	0.225	233,090	7,846	-45,904	-20,732	1,066,605	15,215	-36,461	-2,002	6.10	0.36	-4.40	-8.33
2059	1.356	1.526	1.032	0.599	0.224	235,697	7,868	-46,462	-20,979	1,080,379	15,087	-35,891	-1,899	6.10	0.36	-4.40	-8.34
2060	1.355	1.526	1.032	0.599	0.224	238,268	7,864	-47,036	-21,230	1,094,129	14,911	-35,340	-1,802	6.10	0.35	-4.41	-8.35
2061	1.354	1.526	1.031	0.598	0.223	240,821	7,840	-47,623	-21,485	1,107,918	14,702	-34,803	-1,710	6.10	0.35	-4.42	-8.36
2062	1.352	1.526	1.031	0.597	0.222	243,372	7,807	-48,214	-21,741	1,121,805	14,481	-34,275	-1,623	6.09	0.34	-4.42	-8.37
2063	1.350	1.525	1.030	0.597	0.221	245,921	7,764	-48,815	-21,998	1,135,799	14,245	-33,757	-1,540	6.09	0.34	-4.43	-8.37
2064	1.349	1.525	1.029	0.596	0.221	248,511	7,719	-49,422	-22,257	1,149,970	14,010	-33,244	-1,462	6.08	0.33	-4.43	-8.38
2065	1.347	1.524	1.029	0.596	0.220	251,125	7,670	-50,038	-22,520	1,164,326	13,771	-32,744	-1,387	6.08	0.33	-4.44	-8.38
2066	1.346	1.524	1.029	0.595	0.220	253,796	7,639	-50,651	-22,782	1,178,966	13,567	-32,241	-1,316	6.08	0.32	-4.44	-8.39
2067	1.345	1.524	1.028	0.595	0.219	256,508	7,619	-51,262	-23,043	1,193,800	13,386	-31,739	-1,248	6.07	0.32	-4.45	-8.39
2068	1.344	1.524	1.028	0.595	0.219	259,274	7,617	-51,867	-23,303	1,208,866	13,239	-31,235	-1,184	6.07	0.31	-4.45	-8.40
2069	1.343	1.524	1.028	0.594	0.219	262,098	7,633	-52,474	-23,563	1,224,182	13,123	-30,732	-1,122	6.07	0.31	-4.46	-8.40
2070	1.342	1.524	1.027	0.594	0.218	264,997	7,664	-53,074	-23,825	1,239,816	13,035	-30,231	-1,064	6.07	0.31	-4.46	-8.40
2071	1.342	1.524	1.027	0.594	0.218	267,981	7,714	-53,681	-24,089	1,255,816	12,978	-29,734	-1,009	6.07	0.31	-4.46	-8.41
2072	1.341	1.524	1.027	0.594	0.218	271,032	7,775	-54,292	-24,356	1,272,094	12,938	-29,243	-956	6.08	0.31	-4.46	-8.41
2073	1.341	1.524	1.027	0.593	0.218	274,148	7,846	-54,909	-24,626	1,288,647	12,913	-28,756	-906	6.08	0.31	-4.46	-8.41
2074	1.341	1.525	1.027	0.593	0.217	277,380	7,943	-55,527	-24,899	1,305,724	12,929	-28,274	-859	6.08	0.31	-4.47	-8.41
2075	1.342	1.525	1.027	0.593	0.217	280,697	8,061	-56,145	-25,173	1,323,197	12,979	-27,795	-814	6.09	0.31	-4.47	-8.41

SOURCE: Author's calculations.

**Table B-1—Continued**  
**OASI money's worth and redistributive measures under the award adjustment policy, by birth cohort**

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio				Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars				Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars				Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings			
		Interest rate assumption				Interest rate assumption				Interest rate assumption				Interest rate assumption			
		Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock
2076	1.342	1.526	1.027	0.593	0.217	284,045	8,177	-56,773	-25,450	1,340,816	13,020	-27,325	-0.771	6.09	0.31	-4.47	-8.42
2077	1.342	1.526	1.028	0.593	0.217	287,500	8,303	-57,413	-25,734	1,358,958	13,076	-26,864	-0.731	6.10	0.31	-4.47	-8.42
2078	1.343	1.527	1.028	0.593	0.217	291,043	8,431	-58,073	-26,026	1,377,546	13,130	-26,417	-0.693	6.11	0.31	-4.47	-8.42
2079	1.343	1.527	1.028	0.593	0.217	294,495	8,611	-58,665	-26,294	1,395,753	13,263	-25,944	-0.656	6.11	0.31	-4.47	-8.42
2080	1.344	1.528	1.028	0.593	0.217	298,269	8,819	-59,306	-26,585	1,413,836	13,415	-25,467	-0.621	6.12	0.32	-4.47	-8.42
2081	1.345	1.529	1.028	0.593	0.217	301,867	8,962	-59,963	-26,877	1,432,843	13,483	-25,033	-0.589	6.13	0.32	-4.47	-8.42
2082	1.345	1.529	1.029	0.593	0.217	305,498	9,104	-60,627	-27,172	1,452,130	13,546	-24,608	-0.558	6.14	0.32	-4.47	-8.42
2083	1.346	1.530	1.029	0.593	0.217	309,127	9,232	-61,303	-27,471	1,471,536	13,586	-24,193	-0.529	6.14	0.32	-4.47	-8.42
2084	1.346	1.530	1.029	0.593	0.217	312,820	9,371	-61,984	-27,773	1,491,383	13,639	-23,785	-0.501	6.15	0.32	-4.47	-8.42
2085	1.346	1.531	1.029	0.593	0.216	316,533	9,503	-62,674	-28,078	1,511,464	13,682	-23,386	-0.475	6.15	0.33	-4.47	-8.42
2086	1.346	1.531	1.029	0.592	0.216	320,166	9,592	-63,384	-28,387	1,531,287	13,660	-23,000	-0.450	6.16	0.32	-4.47	-8.42
2087	1.346	1.531	1.029	0.592	0.216	323,824	9,675	-64,103	-28,699	1,551,346	13,631	-22,620	-0.427	6.16	0.32	-4.48	-8.43
2088	1.345	1.531	1.029	0.592	0.216	327,494	9,748	-64,833	-29,015	1,571,575	13,586	-22,249	-0.404	6.16	0.32	-4.48	-8.43
2089	1.345	1.531	1.029	0.592	0.216	331,186	9,815	-65,574	-29,335	1,592,011	13,533	-21,885	-0.383	6.16	0.32	-4.48	-8.43
2090	1.345	1.531	1.028	0.592	0.216	334,914	9,880	-66,323	-29,659	1,612,701	13,476	-21,528	-0.363	6.16	0.32	-4.48	-8.43
2091	1.344	1.531	1.028	0.592	0.216	338,675	9,940	-67,083	-29,986	1,633,625	13,414	-21,176	-0.345	6.16	0.32	-4.48	-8.43
2092	1.344	1.532	1.028	0.591	0.216	342,475	10,001	-67,851	-30,317	1,654,805	13,351	-20,831	-0.327	6.17	0.32	-4.49	-8.43
2093	1.343	1.532	1.028	0.591	0.215	346,330	10,064	-68,628	-30,652	1,676,294	13,292	-20,491	-0.310	6.17	0.32	-4.49	-8.43
2094	1.343	1.532	1.028	0.591	0.215	350,238	10,131	-69,414	-30,991	1,698,078	13,236	-20,156	-0.294	6.17	0.31	-4.49	-8.44
2095	1.343	1.532	1.028	0.591	0.215	354,205	10,203	-70,208	-31,333	1,720,170	13,187	-19,826	-0.278	6.17	0.31	-4.49	-8.44
2096	1.342	1.532	1.028	0.590	0.215	358,236	10,281	-71,010	-31,680	1,742,582	13,144	-19,500	-0.264	6.17	0.31	-4.50	-8.44
2097	1.342	1.532	1.028	0.590	0.215	362,329	10,364	-71,820	-32,031	1,765,290	13,107	-19,178	-0.250	6.17	0.31	-4.50	-8.44
2098	1.342	1.533	1.028	0.590	0.215	366,505	10,461	-72,637	-32,386	1,788,384	13,085	-18,861	-0.237	6.18	0.31	-4.50	-8.44
2099	1.342	1.533	1.028	0.590	0.215	370,747	10,563	-73,463	-32,745	1,811,795	13,069	-18,547	-0.225	6.18	0.31	-4.50	-8.44
2100	1.342	1.533	1.028	0.590	0.214	375,060	10,674	-74,297	-33,108	1,835,552	13,062	-18,238	-0.213	6.18	0.31	-4.50	-8.44

SOURCE: Author's calculations.

## **Appendix C.**

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This appendix presents OASI money's worth and redistributive measures of lifetime outcomes by birth cohort as simulated under the balanced budget tax rate adjustment policy. As discussed in the text, this stylized policy brings the program into long-run financial balance consistent with the underlying Trustees Report projections.

**Table C-1**  
**OASI money's worth and redistributive measures under the tax adjustment policy, by birth cohort**

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption					
		Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock			
Pre-1901	18.367	12.037	6.093	3.207	31,365	36,760	2,165	1,637.203	3,912.972	4,313.035	13,676.469	34.97	13.39	35.27	5.12										
1901	10.868	8.065	3.718	7.688	63,959	8,809	70,672	130.104	207.357	323.140	608.789	28.47	8.57	26.75	3.05										
1902	10.481	7.683	3.546	7.262	71,461	9,477	78,181	143.414	220.098	352.677	658.360	27.81	8.28	25.84	3.07										
1903	10.329	7.518	3.517	7.037	71,974	9,286	77,732	150.715	225.014	365.871	698.657	28.30	8.50	25.91	3.36										
1904	9.881	7.074	3.323	6.552	73,349	9,106	78,018	157.567	226.369	376.721	699.208	27.19	8.04	24.52	3.19										
1905	9.444	6.733	3.150	6.170	76,601	9,167	80,121	167.332	231.728	393.407	698.935	26.21	7.54	23.26	2.94										
1906	9.061	6.392	3.001	5.784	77,991	9,889	79,971	173.566	231.504	400.043	683.963	25.36	7.15	22.08	2.76										
1907	8.950	6.296	2.997	5.610	84,950	9,594	85,292	185.763	242.778	419.234	727.784	25.90	7.41	22.05	2.97										
1908	8.583	5.906	2.840	5.185	86,906	9,461	85,196	193.056	243.223	425.403	706.590	24.78	7.01	20.62	2.75										
1909	8.170	5.641	2.695	4.857	85,464	8,919	81,453	196.610	237.439	421.196	643.861	23.86	6.52	19.31	2.40										
1910	7.918	5.471	2.622	4.612	87,207	8,810	80,531	203.609	238.030	422.630	593.524	23.58	6.35	18.50	2.15										
1911	7.827	5.396	2.626	4.436	90,647	8,974	80,737	211.908	242.247	424.247	587.565	24.23	6.65	18.31	2.25										
1912	7.447	5.102	2.485	4.077	96,353	9,113	82,184	223.758	244.892	428.995	515.688	23.14	6.19	16.74	1.83										
1913	7.319	5.039	2.474	3.906	99,764	9,222	81,382	233.270	249.526	427.725	461.109	23.57	6.34	16.30	1.67										
1914	6.948	4.718	2.326	3.531	101,416	8,908	78,101	242.291	246.283	419.411	350.614	22.30	5.86	14.55	1.20										
1915	6.820	4.660	2.309	3.365	100,249	8,595	73,098	246.675	244.736	404.298	281.400	22.58	5.93	13.94	1.00										
1916	6.650	4.535	2.263	3.147	105,891	8,797	72,334	252.140	242.386	387.148	206.414	22.48	5.92	12.99	0.75										
1917	6.333	4.237	2.127	2.831	108,297	7,647	61,573	243.593	222.255	347.605	81.261	21.10	5.43	11.34	0.30										
1918	5.912	3.919	1.958	2.497	96,058	7,009	55,225	242.390	204.683	313.231	-78.108	19.35	4.70	9.41	-0.27										
1919	5.578	3.608	1.827	2.196	88,187	5,988	45,165	223.950	175.973	257.808	-170.316	17.88	4.27	7.75	-0.66										
1920	5.378	3.492	1.771	2.027	93,298	6,018	42,712	237.468	177.263	244.359	-271.294	17.52	4.11	6.80	-1.02										
1921	5.098	3.295	1.677	1.834	95,663	5,730	38,367	243.129	168.535	219.183	-382.818	16.53	3.73	5.64	-1.40										
1922	4.949	3.225	1.643	1.722	93,619	5,349	33,189	237.389	156.971	189.164	-430.819	16.43	3.64	4.97	-1.68										
1923	4.748	3.114	1.589	1.602	94,701	5,094	29,215	236.920	147.481	164.287	-492.442	15.94	3.44	4.22	-2.00										
1924	4.554	3.004	1.534	1.494	98,906	4,976	26,143	241.867	140.810	143.700	-562.016	15.43	3.20	3.52	-2.28										
1925	4.453	2.964	1.517	1.427	99,940	4,850	23,017	241.929	135.853	125.243	-580.546	15.47	3.18	3.10	-2.51										
1926	4.249	2.853	1.460	1.331	98,616	4,411	18,443	235.825	122.056	99.136	-622.994	14.89	2.90	2.44	-2.82										
1927	4.114	2.775	1.426	1.259	103,276	4,348	15,543	239.839	116.846	81.134	-658.252	14.63	2.78	1.95	-3.11										
1928	3.910	2.664	1.368	1.173	102,646	3,893	10,360	231.133	101.454	54.964	-680.976	13.99	2.47	1.33	-3.42										
1929	3.734	2.565	1.321	1.097	100,935	3,453	6,264	220.997	87.299	30.828	-680.950	13.51	2.25	0.76	-3.80										
1930	3.627	2.501	1.294	1.049	103,692	3,303	3,318	223.233	82.490	16.055	-695.580	13.25	2.14	0.39	-4.12										
1931	3.546	2.474	1.279	1.011	101,899	3,063	769	219.582	76.388	3.722	-676.331	13.29	2.10	0.09	-4.43										
1932	3.476	2.441	1.264	0.980	100,447	2,855	-1,314	220.518	72.534	-6.485	-673.999	13.24	2.04	-0.16	-4.68										
1933	3.259	2.332	1.204	0.914	94,506	2,200	-5,721	208.662	56.213	-28.392	-682.243	12.42	1.62	-0.72	-5.02										
1934	3.228	2.329	1.203	0.898	97,208	2,209	-6,863	217.896	57.297	-34.578	-685.442	12.59	1.64	-0.87	-5.16										
1935	3.088	2.245	1.162	0.851	95,621	1,804	-10,324	220.657	48.184	-53.553	-717.165	11.97	1.34	-1.29	-5.40										

SOURCE: Author's calculations.

Table C-1—Continued

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption								
		Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock						
1936	2.994	2.217	1.149	0.826	0.284	96,172	1,679	-12,210	-2,534	224,573	45,381	-64,090	-715,976	11.87	1.27	-1.53	-5.57								
1937	3.127	2.313	1.204	0.850	0.295	103,463	2,239	-10,273	-2,373	251,186	62,909	-56,061	-697,341	13.06	1.77	-1.34	-5.62								
1938	2.965	2.227	1.165	0.805	0.284	105,414	1,770	-14,976	-3,395	257,922	54,469	-78,210	-745,387	12.38	1.46	-1.75	-5.85								
1939	2.945	2.231	1.171	0.797	0.283	108,069	2,078	-16,053	-3,323	266,573	57,141	-82,150	-735,081	12.59	1.55	-1.85	-5.97								
1940	2.881	2.202	1.164	0.778	0.279	111,325	2,250	-18,406	-3,012	276,898	56,823	-93,658	-751,679	12.46	1.51	-2.06	-6.13								
1941	2.835	2.188	1.163	0.765	0.273	110,026	2,527	-17,763	-2,343	291,312	58,725	-103,131	-772,675	12.45	1.53	-2.20	-6.28								
1942	2.643	2.095	1.115	0.720	0.255	107,231	2,143	-20,601	-2,711	314,923	47,728	-141,789	-900,405	11.56	1.09	-2.64	-6.54								
1943	2.651	2.107	1.131	0.720	0.254	110,995	2,788	-20,394	-3,241	336,829	56,140	-146,556	-911,298	11.83	1.26	-2.67	-6.62								
1944	2.743	2.154	1.173	0.738	0.260	118,447	3,719	-18,845	-3,642	342,539	70,591	-129,215	-832,191	12.51	1.71	-2.52	-6.65								
1945	2.714	2.140	1.177	0.731	0.256	123,076	3,725	-19,811	-4,912	346,290	71,991	-132,414	-818,471	12.47	1.77	-2.62	-6.77								
1946	2.665	2.120	1.174	0.720	0.243	123,844	3,396	-17,855	-3,811	415,501	84,271	-164,844	-973,135	12.36	1.75	-2.76	-6.95								
1947	2.617	2.100	1.170	0.709	0.235	124,602	3,478	-17,265	-3,658	469,750	93,207	-191,642	-1,082,475	12.23	1.74	-2.88	-7.08								
1948	2.676	2.133	1.202	0.723	0.236	131,563	4,295	-16,324	-3,627	473,723	103,172	-172,858	-998,009	12.73	2.09	-2.77	-7.13								
1949	2.737	2.166	1.233	0.738	0.239	139,227	4,918	-15,813	-4,234	498,200	120,861	-161,316	-956,923	13.24	2.44	-2.65	-7.16								
1950	2.752	2.176	1.249	0.744	0.238	139,613	5,153	-14,341	-4,953	519,277	130,183	-157,691	-934,719	13.46	2.63	-2.61	-7.23								
1951	2.702	2.153	1.241	0.736	0.235	140,904	6,582	-14,435	-5,714	539,734	131,359	-168,194	-948,002	13.27	2.58	-2.71	-7.32								
1952	2.699	2.152	1.250	0.738	0.237	144,920	7,241	-14,419	-6,481	568,341	140,127	-169,729	-938,157	13.34	2.69	-2.71	-7.36								
1953	2.733	2.169	1.272	0.751	0.245	148,698	8,153	-13,582	-5,952	597,590	154,023	-161,128	-897,361	13.64	2.96	-2.60	-7.35								
1954	2.712	2.160	1.274	0.752	0.248	152,313	8,220	-13,912	-8,808	625,728	160,733	-164,105	-884,893	13.61	3.01	-2.61	-7.37								
1955	2.668	2.133	1.268	0.749	0.254	151,386	9,391	-14,045	-10,841	631,822	158,696	-165,294	-844,219	13.35	2.96	-2.65	-7.37								
1956	2.645	2.117	1.268	0.753	0.266	151,360	9,823	-13,468	-10,321	647,859	161,588	-163,282	-795,625	13.23	2.98	-2.64	-7.32								
1957	2.618	2.096	1.267	0.757	0.285	150,919	10,006	-12,841	-8,103	656,410	162,178	-159,009	-732,904	13.04	2.99	-2.61	-7.19								
1958	2.598	2.084	1.269	0.763	0.299	151,852	9,809	-12,311	-10,398	659,318	162,088	-151,052	-666,422	12.95	3.03	-2.57	-7.12								
1959	2.546	2.056	1.260	0.762	0.312	152,397	10,532	-12,333	-10,609	658,099	156,945	-148,912	-613,065	12.65	2.94	-2.59	-7.06								
1960	2.460	2.014	1.239	0.754	0.322	149,202	9,753	-12,684	-9,671	649,508	145,311	-152,717	-569,042	12.19	2.71	-2.70	-7.03								
1961	2.485	2.024	1.255	0.772	0.346	152,494	10,365	-11,593	-10,696	662,196	153,128	-136,415	-498,062	12.37	2.92	-2.52	-6.85								
1962	2.476	2.021	1.260	0.781	0.360	156,212	10,972	-11,123	-8,755	665,151	153,964	-126,353	-443,349	12.38	2.99	-2.44	-6.77								
1963	2.493	2.027	1.274	0.797	0.381	159,014	11,575	-10,037	-9,254	666,056	157,738	-110,787	-381,593	12.51	3.17	-2.27	-6.61								
1964	2.472	2.020	1.274	0.802	0.397	162,548	12,129	-9,849	-9,715	660,279	154,765	-103,496	-337,484	12.47	3.19	-2.22	-6.50								
1965	2.471	2.018	1.282	0.814	0.419	166,481	13,006	-9,232	-9,547	640,784	151,096	-90,816	-284,826	12.49	3.28	-2.10	-6.30								
1966	2.470	2.016	1.288	0.823	0.439	169,967	16,070	-8,598	-7,423	627,075	148,374	-80,981	-243,943	12.51	3.37	-2.00	-6.11								
1967	2.463	2.008	1.291	0.831	0.457	174,896	16,924	-8,212	-8,074	626,810	148,152	-74,640	-214,205	12.44	3.42	-1.92	-5.94								
1968	2.463	2.005	1.298	0.838	0.468	176,535	18,617	-7,564	-7,675	633,160	149,943	-69,342	-192,146	12.45	3.50	-1.84	-5.84								
1969	2.437	1.995	1.294	0.837	0.469	177,245	18,528	-7,358	-6,148	651,662	151,548	-70,314	-182,959	12.35	3.47	-1.86	-5.83								
1970	2.400	1.977	1.287	0.833	0.473	177,350	17,698	-7,366	-5,609	666,536	151,198	-72,315	-173,077	12.15	3.40	-1.91	-5.80								

SOURCE: Author's calculations.

**Table C-1—Continued**  
**OASI money's worth and redistributive measures under the tax adjustment policy, by birth cohort**

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio				Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars				Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars				Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings			
		Interest rate assumption				Interest rate assumption				Interest rate assumption				Interest rate assumption			
		Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock
1971	2.403	1.979	1.294	0.837	0.472	18,016	-7,170	-5,772	657,580	149,446	-66,782	-155,405	12.22	3.49	-1.87	-5.82	
1972	2.409	1.980	1.302	0.842	0.470	186,936	-6,993	-6,233	631,091	144,047	-59,537	-135,756	12.30	3.60	-1.82	-5.85	
1973	2.383	1.969	1.298	0.838	0.459	190,494	-6,955	-4,737	618,179	138,551	-58,607	-126,452	12.19	3.57	-1.88	-5.98	
1974	2.364	1.961	1.297	0.835	0.449	191,827	-6,583	-2,972	624,611	138,053	-58,836	-121,476	12.14	3.57	-1.92	-6.10	
1975	2.344	1.952	1.295	0.831	0.438	193,317	-6,584	-3,656	631,366	137,467	-59,268	-116,892	12.06	3.56	-1.96	-6.23	
1976	2.321	1.941	1.291	0.826	0.426	193,659	-6,768	-4,155	643,778	137,629	-60,893	-114,432	11.98	3.53	-2.03	-6.39	
1977	2.302	1.933	1.289	0.822	0.417	194,313	-6,809	-3,466	664,848	139,803	-62,959	-113,016	11.92	3.51	-2.09	-6.51	
1978	2.295	1.930	1.290	0.820	0.402	197,134	-6,842	-3,280	685,012	142,813	-63,454	-111,156	11.93	3.54	-2.12	-6.70	
1979	2.282	1.925	1.289	0.816	0.385	198,186	-6,297	-3,326	716,062	147,125	-65,974	-112,122	11.92	3.54	-2.17	-6.91	
1980	2.247	1.908	1.280	0.808	0.368	203,233	-6,430	-3,298	749,803	149,494	-71,248	-114,757	11.74	3.45	-2.28	-7.13	
1981	2.244	1.907	1.281	0.807	0.354	204,589	-6,367	-3,298	765,285	151,183	-70,898	-111,903	11.79	3.48	-2.30	-7.31	
1982	2.240	1.905	1.282	0.806	0.343	206,951	-6,716	-3,715	781,221	152,704	-70,715	-108,848	11.82	3.51	-2.33	-7.47	
1983	2.241	1.905	1.285	0.806	0.337	209,774	-7,014	-4,171	785,712	152,569	-68,609	-102,738	11.89	3.56	-2.33	-7.57	
1984	2.243	1.905	1.287	0.807	0.336	212,074	-7,370	-4,029	800,829	154,343	-67,587	-97,870	11.95	3.61	-2.34	-7.62	
1985	2.237	1.902	1.287	0.805	0.333	213,435	-7,795	-4,850	822,026	156,481	-67,945	-94,343	11.97	3.62	-2.36	-7.69	
1986	2.233	1.901	1.287	0.804	0.328	216,140	-8,509	-5,418	836,610	157,359	-67,701	-90,414	12.01	3.65	-2.40	-7.78	
1987	2.227	1.899	1.287	0.802	0.324	217,771	-8,877	-5,184	854,200	158,569	-67,865	-86,991	12.05	3.66	-2.43	-7.87	
1988	2.222	1.897	1.287	0.801	0.322	219,163	-9,200	-5,484	879,541	161,235	-68,442	-84,158	12.08	3.68	-2.46	-7.93	
1989	2.212	1.893	1.285	0.798	0.319	219,599	-9,553	-6,526	912,984	164,618	-70,320	-82,581	12.09	3.67	-2.51	-8.01	
1990	2.205	1.890	1.284	0.795	0.316	223,297	-9,840	-6,899	941,851	167,403	-71,330	-80,174	12.11	3.68	-2.55	-8.08	
1991	2.198	1.888	1.283	0.793	0.313	226,211	-10,376	-7,015	953,776	167,102	-71,034	-76,506	12.14	3.69	-2.59	-8.16	
1992	2.196	1.887	1.284	0.793	0.312	230,057	-10,853	-7,015	958,118	166,116	-69,450	-71,945	12.21	3.72	-2.61	-8.22	
1993	2.194	1.887	1.285	0.792	0.310	234,223	-11,352	-7,015	960,164	164,665	-67,828	-67,593	12.27	3.75	-2.63	-8.28	
1994	2.190	1.885	1.285	0.791	0.308	238,127	-11,878	-6,604	964,774	163,402	-66,661	-63,738	12.31	3.77	-2.67	-8.34	
1995	2.180	1.881	1.283	0.788	0.307	241,340	-12,498	-6,445	967,517	161,225	-65,968	-60,173	12.32	3.77	-2.71	-8.41	
1996	2.176	1.879	1.283	0.787	0.306	245,116	-12,922	-6,573	979,021	161,194	-65,199	-57,054	12.37	3.79	-2.74	-8.46	
1997	2.170	1.876	1.282	0.785	0.306	248,079	-13,568	-6,865	994,132	161,440	-64,944	-54,385	12.40	3.80	-2.78	-8.51	
1998	2.160	1.871	1.280	0.783	0.305	250,339	-14,253	-7,015	1,008,545	161,167	-64,963	-51,902	12.40	3.79	-2.82	-8.57	
1999	2.154	1.868	1.279	0.781	0.305	253,136	-14,727	-6,865	1,020,928	160,908	-64,491	-49,315	12.43	3.80	-2.86	-8.62	
2000	2.139	1.856	1.274	0.778	0.304	253,778	-15,188	-6,865	1,057,816	163,391	-66,491	-48,291	12.39	3.77	-2.92	-8.68	
2001	2.131	1.856	1.273	0.776	0.303	256,991	-15,866	-6,865	1,068,153	162,571	-65,945	-45,806	12.41	3.77	-2.96	-8.73	
2002	2.125	1.853	1.272	0.775	0.303	260,414	-16,557	-6,865	1,146,079,998	162,158	-65,313	-43,467	12.44	3.78	-3.00	-8.78	
2003	2.117	1.849	1.270	0.773	0.302	263,591	-17,105	-6,865	1,177,019,816	161,479	-64,871	-41,290	12.45	3.78	-3.04	-8.84	
2004	2.110	1.845	1.269	0.771	0.302	266,803	-17,627	-6,865	1,105,241	161,055	-64,477	-39,270	12.47	3.78	-3.08	-8.89	
2005	2.101	1.840	1.267	0.769	0.302	269,818	-18,158	-6,865	1,119,361	160,487	-64,265	-37,392	12.48	3.77	-3.12	-8.95	

SOURCE: Author's calculations.

Table C-1—Continued

OASI money's worth and redistributive measures under the tax adjustment policy, by birth cohort

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption					
		Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock
2006	2.089	1.834	1.263	0.767	0.301	272,291	42,648	-18,741	-12,621	1,132,803	159,400	-64,321	-35,663	12.46	3.75	-3.18	-9.01								
2007	2.081	1.830	1.261	0.765	0.301	275,443	43,347	-19,257	-12,897	1,150,416	159,368	-64,169	-34,035	12.48	3.75	-3.22	-9.06								
2008	2.071	1.825	1.259	0.763	0.300	278,237	43,894	-19,827	-13,178	1,167,717	158,925	-64,223	-32,522	12.48	3.73	-3.28	-9.12								
2009	2.058	1.818	1.255	0.760	0.300	280,661	44,198	-20,448	-13,456	1,184,192	157,998	-64,452	-31,099	12.46	3.70	-3.33	-9.19								
2010	2.047	1.813	1.252	0.757	0.299	283,359	44,553	-21,050	-13,732	1,201,856	157,343	-64,584	-29,737	12.46	3.68	-3.39	-9.25								
2011	2.034	1.807	1.248	0.755	0.298	285,988	44,814	-21,687	-14,012	1,218,816	156,386	-64,763	-28,437	12.45	3.66	-3.45	-9.32								
2012	2.023	1.801	1.245	0.752	0.298	288,805	45,109	-22,318	-14,294	1,236,003	155,503	-64,854	-27,184	12.44	3.63	-3.51	-9.39								
2013	2.010	1.795	1.241	0.749	0.297	291,582	45,311	-22,965	-14,579	1,252,273	154,295	-64,974	-25,980	12.43	3.60	-3.57	-9.46								
2014	1.998	1.790	1.238	0.747	0.296	294,471	45,509	-23,656	-14,866	1,268,342	153,047	-65,037	-24,823	12.42	3.57	-3.64	-9.53								
2015	1.986	1.784	1.234	0.744	0.294	297,308	45,623	-24,354	-15,154	1,283,544	151,540	-65,105	-23,711	12.41	3.54	-3.70	-9.61								
2016	1.973	1.778	1.230	0.741	0.293	300,288	45,738	-25,054	-15,440	1,298,855	150,037	-65,120	-22,641	12.40	3.50	-3.77	-9.68								
2017	1.960	1.772	1.226	0.738	0.292	303,103	45,756	-25,796	-15,735	1,312,949	148,178	-65,175	-21,619	12.38	3.46	-3.84	-9.76								
2018	1.947	1.766	1.222	0.735	0.291	306,170	45,819	-26,541	-16,036	1,327,705	146,455	-65,169	-20,644	12.37	3.43	-3.91	-9.85								
2019	1.934	1.760	1.218	0.732	0.289	309,129	45,810	-27,326	-16,348	1,341,533	144,457	-65,191	-19,714	12.36	3.38	-3.98	-9.93								
2020	1.919	1.754	1.214	0.728	0.288	312,014	45,719	-28,156	-16,676	1,354,540	142,208	-65,234	-18,829	12.33	3.34	-4.05	-10.03								
2021	1.905	1.748	1.209	0.725	0.286	314,900	45,588	-29,014	-17,014	1,366,671	139,813	-65,250	-17,978	12.31	3.29	-4.13	-10.12								
2022	1.890	1.742	1.204	0.722	0.284	317,834	45,424	-29,898	-17,363	1,378,385	137,329	-65,230	-17,160	12.29	3.24	-4.21	-10.22								
2023	1.876	1.735	1.200	0.718	0.282	320,797	45,235	-30,808	-17,723	1,389,537	134,748	-65,179	-16,376	12.26	3.18	-4.29	-10.32								
2024	1.862	1.729	1.195	0.715	0.280	323,800	45,032	-31,740	-18,092	1,400,316	132,113	-65,091	-15,623	12.24	3.13	-4.37	-10.42								
2025	1.847	1.723	1.191	0.712	0.278	326,827	44,802	-32,700	-18,474	1,411,041	129,441	-64,999	-14,907	12.21	3.08	-4.46	-10.52								
2026	1.833	1.718	1.186	0.708	0.276	329,888	44,566	-33,674	-18,860	1,421,771	126,783	-64,870	-14,221	12.18	3.02	-4.54	-10.62								
2027	1.819	1.712	1.182	0.705	0.274	332,717	44,268	-34,651	-19,243	1,436,940	124,469	-64,944	-13,609	12.16	2.97	-4.62	-10.73								
2028	1.805	1.706	1.177	0.702	0.272	335,573	43,968	-35,641	-19,630	1,452,433	122,179	-64,994	-13,023	12.13	2.91	-4.70	-10.83								
2029	1.791	1.700	1.173	0.698	0.270	338,460	43,662	-36,651	-20,028	1,468,326	119,900	-65,040	-12,466	12.10	2.86	-4.78	-10.93								
2030	1.777	1.695	1.168	0.695	0.268	341,358	43,341	-37,679	-20,435	1,484,554	117,623	-65,078	-11,935	12.08	2.80	-4.86	-11.04								
2031	1.764	1.690	1.164	0.692	0.266	344,306	43,026	-38,716	-20,846	1,501,281	115,401	-65,091	-11,426	12.05	2.75	-4.95	-11.14								
2032	1.751	1.685	1.160	0.689	0.265	347,323	42,724	-39,757	-21,260	1,518,536	113,251	-65,069	-10,937	12.03	2.69	-5.03	-11.25								
2033	1.739	1.680	1.156	0.686	0.263	350,428	42,442	-40,798	-21,676	1,536,350	111,190	-65,007	-10,467	12.00	2.64	-5.10	-11.35								
2034	1.727	1.675	1.152	0.683	0.261	353,585	42,164	-41,854	-22,101	1,554,534	109,155	-64,929	-10,017	11.98	2.59	-5.18	-11.45								
2035	1.716	1.671	1.149	0.680	0.259	356,818	41,892	-42,919	-22,532	1,573,161	107,171	-64,823	-9,587	11.96	2.54	-5.26	-11.55								
2036	1.705	1.667	1.145	0.677	0.258	360,146	41,639	-43,984	-22,966	1,592,255	105,268	-64,677	-9,172	11.95	2.50	-5.33	-11.65								
2037	1.694	1.663	1.142	0.675	0.256	363,570	41,404	-45,052	-23,404	1,611,759	103,433	-64,493	-8,772	11.93	2.45	-5.40	-11.75								
2038	1.684	1.659	1.138	0.672	0.254	367,105	41,191	-46,121	-23,844	1,631,692	101,676	-64,268	-8,388	11.92	2.41	-5.47	-11.85								
2039	1.675	1.656	1.135	0.670	0.253	370,746	40,999	-47,192	-24,289	1,651,961	99,987	-64,003	-8,017	11.91	2.36	-5.54	-11.94								
2040	1.666	1.652	1.133	0.668	0.251	374,503	40,826	-48,266	-24,738	1,672,556	98,366	-63,699	-7,661	11.90	2.33	-5.61	-12.03								

SOURCE: Author's calculations.

Table C-1—Continued

Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio						Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars						Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars						Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings					
		Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption			Interest rate assumption								
		Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock	Zero real	Trust fund	Large company stock						
2041	1.657	1.649	1.130	0.666	0.250	378,340	40,655	-49,349	1,693,273	96,772	-63,366	-7,319	11.90	2.29	-5.67	-12.13									
2042	1.649	1.646	1.127	0.664	0.249	382,283	40,506	-50,428	1,714,188	95,248	-62,986	-6,988	11.89	2.25	-5.73	-12.22									
2043	1.641	1.644	1.125	0.662	0.247	386,315	40,376	-51,503	1,735,212	93,785	-62,561	-6,669	11.89	2.22	-5.79	-12.30									
2044	1.634	1.641	1.122	0.660	0.246	390,434	40,258	-52,582	1,756,356	92,363	-62,105	-6,363	11.89	2.18	-5.85	-12.39									
2045	1.627	1.639	1.120	0.658	0.245	394,669	40,169	-53,654	1,777,799	91,027	-61,608	-6,067	11.89	2.15	-5.91	-12.47									
2046	1.620	1.636	1.118	0.656	0.244	398,998	40,089	-54,734	1,799,508	89,733	-61,093	-5,785	11.89	2.12	-5.96	-12.56									
2047	1.614	1.634	1.116	0.655	0.243	403,432	40,029	-55,816	1,821,577	88,501	-60,554	-5,514	11.89	2.10	-6.02	-12.64									
2048	1.608	1.632	1.114	0.653	0.241	407,956	39,983	-56,903	1,843,988	87,317	-60,000	-5,254	11.90	2.07	-6.07	-12.72									
2049	1.602	1.631	1.112	0.651	0.240	412,596	39,967	-57,985	1,866,905	86,215	-59,422	-5,006	11.90	2.04	-6.12	-12.79									
2050	1.597	1.629	1.111	0.650	0.239	417,268	39,960	-59,064	1,889,987	85,152	-58,825	-4,768	11.91	2.02	-6.17	-12.87									
2051	1.592	1.627	1.109	0.649	0.238	422,078	39,981	-60,143	1,913,759	84,171	-58,216	-4,540	11.92	2.00	-6.21	-12.94									
2052	1.588	1.626	1.108	0.647	0.237	427,016	40,038	-61,216	1,938,226	83,282	-57,591	-4,323	11.93	1.98	-6.26	-13.01									
2053	1.583	1.625	1.106	0.646	0.236	432,055	40,111	-62,299	1,963,303	82,440	-56,966	-4,115	11.94	1.96	-6.30	-13.08									
2054	1.579	1.624	1.105	0.645	0.236	437,227	40,226	-63,370	1,989,184	81,700	-56,325	-3,917	11.95	1.94	-6.34	-13.14									
2055	1.576	1.623	1.104	0.644	0.235	442,509	40,369	-64,438	2,015,811	81,033	-55,678	-3,728	11.97	1.93	-6.38	-13.20									
2056	1.572	1.621	1.103	0.643	0.234	447,899	40,537	-65,504	2,043,201	80,429	-55,030	-3,548	11.98	1.91	-6.41	-13.26									
2057	1.569	1.621	1.102	0.642	0.233	453,390	40,719	-66,584	2,071,350	79,867	-54,386	-3,376	12.00	1.90	-6.45	-13.32									
2058	1.566	1.620	1.101	0.641	0.233	459,009	40,920	-67,673	2,100,399	79,352	-53,752	-3,213	12.01	1.89	-6.48	-13.38									
2059	1.563	1.619	1.100	0.641	0.232	464,737	41,128	-68,778	2,130,249	78,863	-53,130	-3,058	12.03	1.88	-6.52	-13.43									
2060	1.560	1.618	1.099	0.640	0.231	470,557	41,350	-69,892	2,160,806	78,407	-52,512	-2,911	12.04	1.87	-6.55	-13.49									
2061	1.558	1.618	1.098	0.639	0.231	476,473	41,585	-71,013	2,192,055	77,987	-51,897	-2,771	12.06	1.85	-6.58	-13.54									
2062	1.555	1.617	1.098	0.638	0.230	482,506	41,851	-72,130	2,224,074	77,627	-51,276	-2,637	12.08	1.85	-6.61	-13.59									
2063	1.553	1.617	1.097	0.638	0.229	488,645	42,131	-73,254	2,256,758	77,299	-50,657	-2,509	12.10	1.84	-6.64	-13.64									
2064	1.551	1.616	1.096	0.637	0.229	494,891	42,430	-74,382	2,290,076	77,007	-50,037	-2,387	12.12	1.83	-6.67	-13.68									
2065	1.549	1.616	1.096	0.636	0.228	501,248	42,739	-75,523	2,324,009	76,733	-49,420	-2,271	12.13	1.82	-6.70	-13.73									
2066	1.547	1.615	1.095	0.636	0.228	507,702	43,073	-76,659	2,358,448	76,503	-48,796	-2,160	12.15	1.81	-6.72	-13.77									
2067	1.546	1.615	1.095	0.635	0.228	514,227	43,422	-77,796	2,393,232	76,293	-48,168	-2,053	12.18	1.81	-6.75	-13.81									
2068	1.544	1.615	1.094	0.635	0.227	520,802	43,783	-78,931	2,428,243	76,098	-47,533	-1,952	12.20	1.80	-6.77	-13.85									
2069	1.543	1.614	1.094	0.634	0.227	527,445	44,156	-80,067	2,463,539	75,918	-46,895	-1,855	12.22	1.80	-6.80	-13.89									
2070	1.541	1.614	1.093	0.634	0.227	534,192	44,541	-81,212	2,499,271	75,752	-46,259	-1,763	12.24	1.80	-6.82	-13.93									
2071	1.540	1.614	1.093	0.633	0.227	541,049	44,938	-82,370	2,535,467	75,598	-45,625	-1,675	12.26	1.79	-6.84	-13.96									
2072	1.539	1.614	1.093	0.633	0.227	547,997	45,339	-83,541	2,572,033	75,443	-44,997	-1,592	12.29	1.79	-6.87	-14.00									
2073	1.537	1.614	1.092	0.633	0.226	555,046	45,746	-84,728	2,609,019	75,289	-44,373	-1,512	12.31	1.78	-6.89	-14.03									
2074	1.536	1.613	1.092	0.632	0.226	562,197	46,157	-85,932	2,646,463	75,134	-43,756	-1,436	12.33	1.78	-6.91	-14.07									
2075	1.535	1.613	1.091	0.632	0.226	569,422	46,571	-87,147	2,684,242	74,978	-43,143	-1,364	12.35	1.78	-6.93	-14.10									

SOURCE: Author's calculations.



Birth cohort	Real internal rate of return (percent)	Lifetime benefit/tax ratio										Lifetime net transfer per initial cohort member evaluated as of the initial cohort year in constant (2001) dollars										Aggregate lifetime net transfer evaluated as of year-end 2001 in billions of dollars										Aggregate lifetime net transfer as a percent of aggregate lifetime taxable earnings									
		Interest rate assumption					Interest rate assumption					Interest rate assumption					Interest rate assumption					Interest rate assumption					Interest rate assumption														
		Zero real	Tax base growth	Trust fund	Large company stock	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock	Large company stock	Zero real	Tax base growth	Trust fund	Large company stock											
2076	1.534	1.613	1.091	0.632	0.226	576,756	46,992	-88,378	-42,760	2,722,539	74,827	-42,536	-1,296	-1,296	12.38	1.77	-6.96	-14.14																							
2077	1.533	1.613	1.091	0.631	0.226	584,283	47,430	-89,636	-43,336	2,761,795	74,695	-41,942	-1,231	-1,231	12.40	1.77	-6.98	-14.17																							
2078	1.531	1.613	1.090	0.631	0.226	592,024	47,889	-90,926	-43,927	2,802,133	74,583	-41,361	-1,169	-1,169	12.42	1.77	-7.00	-14.21																							
2079	1.531	1.613	1.090	0.631	0.226	599,360	48,341	-92,130	-44,479	2,840,656	74,453	-40,743	-1,110	-1,110	12.45	1.77	-7.02	-14.24																							
2080	1.530	1.613	1.090	0.630	0.225	607,258	48,835	-93,422	-45,073	2,878,489	74,290	-40,116	-1,053	-1,053	12.47	1.77	-7.04	-14.27																							
2081	1.529	1.613	1.089	0.630	0.225	615,081	49,296	-94,724	-45,669	2,919,546	74,163	-39,545	-1,000	-1,000	12.49	1.76	-7.06	-14.31																							
2082	1.528	1.612	1.089	0.630	0.225	622,998	49,762	-96,043	-46,272	2,961,308	74,040	-38,983	-950	-950	12.51	1.76	-7.08	-14.34																							
2083	1.527	1.612	1.089	0.629	0.225	631,009	50,233	-97,377	-46,881	3,003,794	73,922	-38,429	-902	-902	12.54	1.76	-7.10	-14.37																							
2084	1.526	1.612	1.089	0.629	0.225	639,113	50,707	-98,728	-47,498	3,047,001	73,806	-37,885	-857	-857	12.56	1.75	-7.12	-14.40																							
2085	1.524	1.612	1.088	0.628	0.225	647,307	51,183	-100,096	-48,122	3,090,928	73,691	-37,350	-814	-814	12.58	1.75	-7.14	-14.44																							
2086	1.523	1.612	1.088	0.628	0.225	655,595	51,663	-101,481	-48,753	3,135,571	73,578	-36,823	-773	-773	12.60	1.75	-7.16	-14.47																							
2087	1.522	1.612	1.088	0.628	0.224	663,988	52,150	-102,881	-49,392	3,180,976	73,471	-36,304	-734	-734	12.63	1.75	-7.18	-14.50																							
2088	1.521	1.612	1.087	0.628	0.224	672,485	52,641	-104,300	-50,038	3,227,119	73,367	-35,793	-697	-697	12.65	1.74	-7.20	-14.53																							
2089	1.520	1.612	1.087	0.627	0.224	681,089	53,138	-105,736	-50,692	3,273,994	73,266	-35,290	-662	-662	12.67	1.74	-7.22	-14.56																							
2090	1.519	1.612	1.087	0.627	0.224	689,802	53,641	-107,190	-51,354	3,321,584	73,168	-34,793	-629	-629	12.69	1.74	-7.24	-14.60																							
2091	1.519	1.611	1.086	0.627	0.224	698,632	54,151	-108,663	-52,025	3,369,910	73,074	-34,302	-598	-598	12.72	1.74	-7.26	-14.63																							
2092	1.518	1.611	1.086	0.626	0.224	707,565	54,664	-110,155	-52,703	3,418,880	72,977	-33,819	-568	-568	12.74	1.73	-7.28	-14.66																							
2093	1.517	1.611	1.086	0.626	0.224	716,626	55,186	-111,666	-53,391	3,468,589	72,885	-33,341	-539	-539	12.76	1.73	-7.30	-14.69																							
2094	1.516	1.611	1.086	0.626	0.223	725,803	55,714	-113,198	-54,087	3,518,947	72,791	-32,870	-512	-512	12.78	1.73	-7.32	-14.72																							
2095	1.515	1.611	1.085	0.625	0.223	735,101	56,247	-114,749	-54,793	3,569,961	72,698	-32,403	-487	-487	12.80	1.73	-7.34	-14.75																							
2096	1.514	1.611	1.085	0.625	0.223	744,519	56,786	-116,322	-55,508	3,621,590	72,601	-31,943	-462	-462	12.83	1.72	-7.36	-14.78																							
2097	1.513	1.611	1.085	0.625	0.223	754,064	57,332	-117,916	-56,232	3,673,843	72,505	-31,487	-439	-439	12.85	1.72	-7.38	-14.82																							
2098	1.512	1.611	1.084	0.625	0.223	763,737	57,885	-119,530	-56,966	3,726,705	72,408	-31,036	-417	-417	12.87	1.72	-7.40	-14.85																							
2099	1.511	1.611	1.084	0.624	0.223	773,534	58,441	-121,168	-57,711	3,780,169	72,305	-30,591	-396	-396	12.89	1.72	-7.42	-14.88																							
2100	1.510	1.611	1.084	0.624	0.223	783,467	59,006	-122,827	-58,464	3,834,306	72,204	-30,151	-376	-376	12.92	1.71	-7.44	-14.91																							

SOURCE: Author's calculations.

## **Appendix D: OASI Benefit and Tax Projections**

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This analysis simulates Old Age and Survivors Insurance (OASI) program outcomes in future years under present program provisions and under certain alternative policies. These projections identify the effects of the program on OASI taxpayers and beneficiaries by age and track the associated implications for the OASI trust fund and the long-run financial balance of the program. In conjunction with comprehensive administrative data on historical taxes and benefits by age, these projections enable estimates of the lifetime money's worth and redistributive effects of specific policies on past, present, and future birth cohorts. The projections in this analysis are derived from and consistent with the data and relationships underlying the intermediate projections of the annual Trustees Report. When projecting the effects of alternative policies, of course, aspects of the Trustees Report projections that are specific to the present program are modified as appropriate. This appendix provides a general description of the determination of OASI program variables in the present analysis at the aggregate and required disaggregate level within and beyond the Trustees Report projection period. Some implementation details are omitted for the sake of brevity and expositional clarity.

### **Social Security Area Population**

The Social Security area population by gender, age, and year in the present analysis is based on the corresponding detailed projections underlying the annual Trustees Report.<sup>81</sup>

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<sup>81</sup> The Trustees Report population projections were available by single year of age except for an age 100+ group. In the present analysis, the population in each age 100+ group is allocated to single ages 100 through 120 using an approach consistent with the Trustees Report mortality rate projections, which are available by gender, year, and single year of age through age 119.

These population data are denoted here as  $N_{s,a,t}^S$ , where the  $s$ ,  $a$ , and  $t$  subscripts respectively represent gender, age, and the projection period.

### **Covered Employment**

Employment is derived from the Social Security area population by applying gender-, age-, and year-specific labor force participation rates and unemployment rates as projected in the annual Trustees Report. In each projection year, a proportional adjustment is applied across all gender and age groups to derive OASI covered employment from total employment. Specifically, OASI covered employment by gender, age, and year is derived as

$$(1) E_{s,a,t}^S = c_t N_{s,a,t}^S P_{s,a,t} (1 - u_{s,a,t}) ,$$

where  $c_t$  denotes the projected ratio between OASI covered employment and total employment in each projection year,  $p_{s,a,t}$  denotes the projected gender-, age-, and year-specific labor force participation rate, and  $u_{s,a,t}$  denotes the corresponding unemployment rate.

### **Taxable Earnings**

The OASI projections in the present analysis use Trustees Report projections of annual aggregate employee taxable wages ( $H_t^E$ ), employer taxable wages ( $H_t^R$ ), and self-employment taxable income ( $H_t^{SE}$ ). In each of these taxable earnings categories, the corresponding average taxable earnings for each gender and age group in each projection year are simulated by applying relative average taxable earnings weights differentiated by

gender and age in each year ( $\pi_{s,a,t}$ ).<sup>82</sup> Given these relative average taxable earnings weights, the average taxable earnings subject to each type of OASI tax by gender, age, and year are given by

$$(2) e_{s,a,t}^E = \pi_{s,a,t} \pi_t H_t^E; \quad e_{s,a,t}^R = \pi_{s,a,t} \pi_t H_t^R; \quad e_{s,a,t}^{SE} = \pi_{s,a,t} \pi_t H_t^{SE},$$

where  $\pi_t$  is a period-specific effective taxable earnings factor that depends on the gender and age composition of covered employment and ensures that aggregating average taxable earnings in each category across covered employment by gender and age yields the Trustees Report projections of annual aggregate taxable earnings for that taxable earnings category in that year; *i.e.*,

$$(3) \pi_t = \frac{1}{\sum_s \sum_a E_{s,a,t}^S \pi_{s,a,t}}.$$

For use in the subsequent computation of primary retirement benefits, the average OASI taxable earnings by gender, age, and year that are creditable for use in the benefit formula are then assumed equal to

$$(4) e_{s,a,t} = e_{s,a,t}^E + e_{s,a,t}^{SE}.$$

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<sup>82</sup> These average taxable earnings weights are projected over time by gender and age using estimates derived from constrained non-linear regressions on annual historical cross-sections of average taxable earnings per worker by gender and age. The cross-sections used were drawn from the 2000 1% Continuous Work History Sample (CWHHS) and covered the period from 1984 through 2000. The regression data were limited to the 1984-2000 historical period because over that period there were no major changes in OASDI earnings coverage and the annual taxable maximum was automatically adjusted by the national average wage index. Separate regression equations for males and females were used to estimate the corresponding cross-section average taxable earnings profiles in each projection year. The male earnings regression allowed for both (1) age-specific effects that modify the shape of the relative cross-section profile over time and (2) proportional cohort-specific effects on the cross-section profile across successive ages as particular cohorts move through their work lives. Conditional on the projected cross-section profile of average taxable earnings for males, a second regression model was estimated and used to project age-specific changes in the relationship between the female and male average taxable earnings cross-section profiles over time.

## OASI Taxes on Earnings

The total OASI payroll taxes paid in each projection year by gender and age are denoted as  $T_{s,a,t}^P$  and are given by the sum of the OASI employee, employer, and self-employment income taxes. Specifically,

$$(5) T_{s,a,t}^P = \tau_t^E e_{s,a,t}^E E_{s,a,t}^S + \tau_t^R e_{s,a,t}^R E_{s,a,t}^S + \tau_t^{SE} e_{s,a,t}^{SE} E_{s,a,t}^S,$$

where  $\tau_t^E$  and  $\tau_t^R$  respectively represent the projected employee and employer tax rates on OASI taxable wages and  $\tau_t^{SE}$  represents the projected OASI self-employment income tax rate in each projection year. The total OASI payroll taxes paid in each year by age are derived by summing across both genders; *i.e.*,

$$(6) T_{a,t}^P = \sum_s T_{s,a,t}^P.$$

The  $\tau_t^E$ ,  $\tau_t^R$ , and  $\tau_t^{SE}$  OASI tax rates scheduled under present law can be modified exogenously or endogenously in the OASI projections, depending on the alternative policy under consideration.

## Retirement Benefits

The number of retirees in current payment status in each projection year by gender, age, and age at entitlement is based on corresponding projections underlying the annual Trustees Report.<sup>83</sup> The corresponding variable is denoted here as  $R_{s,a,j,t}$ , where the  $s$ ,  $a$ ,  $j$ ,

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<sup>83</sup> The projected Trustees Report data were available by year, gender, single year of age (except for an age 95+ group) and age at entitlement (by single year of age with a separate category for disability conversions). This analysis allocates the number of retirees in each of the age 95+ groups to single years of age in the same relative proportions as found in the age distribution of the corresponding projected population in that year.

and  $t$  subscripts respectively represent gender, age, age at entitlement (including a separate category for disability conversions), and the projection period.

Average OASI benefit payments to retirees are derived as

$$(7a) \quad b_{s,a,j,t}^R = \beta_{s,j} b(a, s, t, e_{s,0,t-a}, \dots, e_{s,a-1,t-1}) \quad \text{for } a = j, \text{ and}$$

$$(7b) \quad b_{s,a,j,t}^R = g_t \mu_{s,a} b_{s,a-1,j,t-1}^R \quad \text{for } a > j,$$

where the first line represents the determination of average retirement benefit awards for new retirees under present Social Security law and the second line represents average benefits for previously retired workers. The present law benefit award computation function,  $b(\dots)$ , in equation (7a) depends on age at retirement, gender, year of retirement, and the lifetime OASI taxable earnings of the retiree to that point. To calibrate the present law benefit award computation function  $b$ , administrative data on actual average benefits for new retirees of each gender and age in the last available historical year, along with average benefits for disability conversions in that year, were used to determine a proportional adjustment factor for each gender at each age of retirement or disability conversion ( $\beta_{s,j}$ ). This proportional adjustment factor is assumed to apply to the determination of benefit awards in all projection years. Alternative benefit award computation functions could be substituted to simulate certain other benefit structures in place of the present law benefit structure.<sup>84</sup>

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<sup>84</sup> The OASI projections in the present analysis effectively assume that the relative distribution of benefit awards about the mean for each gender and age category remains constant over time such that the average benefit award for each gender and age category can be calculated from the average earnings history for that category. Some alternative benefit structures, such as “price-indexed” structures that index prior earnings and the “bend points” in the benefit formula by prices rather than wages, clearly violate this assumption and therefore cannot be simulated directly using the approach adopted in the present analysis.

Equation (7b) determines average benefits for previously retired workers. The average benefit in the previous period for a given gender, age, and age at retirement group is adjusted by a general retirement benefit adjustment factor ( $g_t$ ) applicable to all previous retirees and by a gender- and age-specific adjustment factor ( $\mu_{s,a}$ ) that reflects the effect of average retirement benefit changes over the retirement period.<sup>85</sup> Under the present benefit structure, the general retirement benefit adjustment factor  $g_t$  represents the effect of the annual automatic inflation adjustment. The gender- and age-specific benefit adjustment factor  $\mu_{s,a}$  is assumed constant over time and is derived by gender and age from administrative data on average benefits for retirees in recent retirement cohorts who had benefits in current payment status at successive year-ends. Aggregate benefits to retirees by age in each projection year can then be derived as

$$(8) B_{a,t}^R = \sum_s \sum_j R_{s,a,j,t} b_{s,a,j,t}^R \cdot$$

### Secondary Benefits

OASI secondary benefits to dependents and survivors of primary beneficiaries are split into three main classes to take advantage of the corresponding level of detail available in the data underlying the annual Trustees Report projections. The three classes of OASI secondary benefits are (1) benefits to aged spouses, (2) benefits to aged surviving spouses (widows and widowers), and (3) all other OASI secondary benefits.

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<sup>85</sup> Under the present benefit structure, these average benefit changes reflect such factors as the effects of additional earnings after retirement on the benefit award, changes over the retirement period in the proportion of benefits withheld due to the earnings test, and the likely positive correlation between the size of benefits and survival probabilities.

For the first two classes, the available data underlying the Trustees Report respectively included gender-, age-, and year-specific projections of the number of aged nondivorced spouse beneficiaries in current payment status and the number of aged nondivorced surviving spouse beneficiaries in current payment status.<sup>86</sup> These relative age distributions are assumed to apply respectively to the corresponding total number of aged spouse beneficiaries (including the divorced spouse category) and the total number of aged surviving spouse beneficiaries (including the divorced surviving spouse category) in current payment status in each year as projected in the data underlying the annual Trustees Report.<sup>87</sup> For the first two secondary benefit classes, then, this approach is used to identify the number of secondary beneficiaries by beneficiary class, age, and year, denoted as  $R_{a,t}^{S1}$  and  $R_{a,t}^{S2}$ .

The corresponding average benefit by age and year ( $b_{a,t}^{S1}, b_{a,t}^{S2}$ ) received by secondary beneficiaries in each of these first two secondary beneficiary classes is provisionally derived under the assumption that the average secondary benefit by age and gender within each of these beneficiary classes remains constant over time relative to the

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<sup>86</sup> The Trustees Report data for each of these beneficiary classes included projections by single year of age except for an age 95+ group. The number of beneficiaries in each of these age 95+ groups is allocated in this analysis to single years of age in the same relative proportions as found in the age distribution of the corresponding population in that year.

<sup>87</sup> The number of beneficiaries in the nondivorced category of both the total spouse and surviving spouse beneficiary groups vastly outweighs the corresponding number in the divorced category. For example, the 2002 *Annual Statistical Supplement* reports that the total number of nondivorced wives of retired workers with benefits in current payment status at year-end 2001 was about 2.6 million, compared to a total of about 120 thousand divorced wives of retired workers with benefits in current payment status at that point. The analogous data at year-end 2001 for aged nondivorced (nondisabled) widows was about 4.3 million compared to about 300 thousand aged divorced (nondisabled) surviving wives.



corresponding average benefit for retirees of the same age and gender.<sup>88</sup> These provisional average benefits are then adjusted proportionally across all applicable age and gender groups in each projection year to ensure that simulated aggregate secondary benefits of each class equal the aggregate projected for that class in the Trustees Report (or other policy projection) for that year. In effect, provisional  $b_{s,a,t}^{S_n}$  for the first two secondary beneficiary classes are first computed from the relationship  $b_{s,a,t}^{S_n} = k_{s,a}^{S_n} b_{s,a,t}^R$ , where  $n$  refers to secondary beneficiary class 1 or 2, the  $b_{s,a,t}^R$  refer to the average retirement benefit across all retirees of that age and gender in that year, and the  $k_{s,a}^{S_n}$  are determined from administrative benefit data in the last available historical year. The provisional  $b_{s,a,t}^{S_n}$  are then adjusted proportionally across all age and gender groups for consistency with the Trustees Report (or alternative policy) projection of aggregate secondary benefits of that class in that year. For use in subsequent simulation calculations, these adjusted  $b_{s,a,t}^{S_n}$  are then combined across gender to derive the corresponding weighted average  $b_{a,t}^{S_n}$  by age and year. Together, then, the number of secondary beneficiaries by beneficiary class, age, and year ( $R_{a,t}^{S1}, R_{a,t}^{S2}$ ) and the respective average benefit received by those secondary beneficiaries ( $b_{a,t}^{S1}, b_{a,t}^{S2}$ ) determine the aggregate benefits received by secondary beneficiaries of the first two classes in each year; *i.e.*,

$$(9) \quad B_{a,t}^{S1} = b_{a,t}^{S1} R_{a,t}^{S1} \quad \text{and} \quad B_{a,t}^{S2} = b_{a,t}^{S2} R_{a,t}^{S2} .$$

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<sup>88</sup> Since aged surviving spouse beneficiaries can be as young as age 60, average aged surviving spouse benefits at ages 60 and 61 are each provisionally assumed to remain constant over time relative to the corresponding average benefit for age-62 retirees of the same gender.

Less information is available in the Trustees Report projections for the age allocation of the third class of all other OASI secondary benefits.<sup>89</sup> Consequently, OASI secondary benefits of the third class by age and year are simulated in the present analysis as

$$(10) B_{a,t}^{S3} = b_{a,t}^{S3} R_{a,t}^{S3},$$

where the number of secondary beneficiaries of the third class  $R_{a,t}^{S3}$  and their average benefits  $b_{a,t}^{S3}$  are derived under the assumptions that (1) the proportion of persons of each age and gender receiving secondary benefits of the third class remains constant over time subject to any additional proportional adjustment across all age and gender groups in each projection year required to achieve the Trustees Report (or other policy) projection of total secondary beneficiaries of the third class in that year and (2) average secondary benefits of the third class at each age and gender remain constant over time relative to average secondary benefits of the third class at each other age and gender, with average secondary benefits of the third class proportionally adjusted across all age and gender groups in each projection year to achieve the ratio of aggregate secondary benefits of the third class to aggregate retiree benefits as projected by the Trustees Report (or other policy).

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<sup>89</sup> Based on monthly benefits in current payment status as of year-end 2001, for example, Tables 5.A1 of the 2002 *Annual Statistical Supplement* indicate that what are denoted here as the third class of monthly secondary benefits constituted about 23 percent of all monthly secondary benefits at that time. This proportion remains below 28 percent in all of the Trustees Report projection periods and stabilizes at less than 24 percent near the end of the Trustees Report projection period.

Given the determination of aggregate secondary benefits for each of the three secondary benefit classes, aggregate secondary benefits of all types are simply given by their sum

$$(11) \quad B_{a,t}^S = B_{a,t}^{S1} + B_{a,t}^{S2} + B_{a,t}^{S3} .$$

Unless simulating the effects of an alternative policy that dictates otherwise, the OASI projections convert the Trustees Report nominal aggregate benefits projected for each secondary class in each simulation year to the corresponding proportion of the aggregate retirement benefits projected in that year. This approach has the effect that a simulated adjustment in retirement benefits or awards in a given projection year under an alternative policy leads to a corresponding proportional adjustment in the secondary benefits projected for that year. Of course, other aggregate constraints on each class of secondary benefits could also be imposed, depending on the policy being simulated.

### **Income Taxation of Benefits**

Revenues returned to the OASI trust fund from the income taxation of OASI benefits are determined by age in each year as

$$(12) \quad T_{a,t}^B = \tau_t^B ( B_{a,t}^R + B_{a,t}^S ) ,$$

where the effective tax rate  $\tau_t^B$  is determined by the Trustees Report projection of benefit income taxation proceeds that are returned to the OASI trust fund as a proportion of total OASI benefits. This approach assumes that the effective benefit taxation rate is identical across age groups in any given projection year.

## Net Transfers

OASI program net transfers by age in each year can then be calculated as retirement and secondary benefits less OASI payroll taxes and OASI benefit income taxes that are returned to the OASI trust fund. Specifically,

$$(13) \quad J_{a,t} = B_{a,t}^R + B_{a,t}^S - T_{a,t}^P - T_{a,t}^B .$$

Aggregating across all ages gives aggregate OASI program net transfers in each simulation period; *i.e.*,

$$(14) \quad J_t = \sum_a J_{a,t} .$$

## Other Trust Fund Components and Net Surplus

The data underlying the Trustees Report also contain projections of administrative expenses, denoted here as  $A_t$ , and net financial interchange transfers with the Railroad Retirement program, denoted here as  $RR_t$ , both of which are relatively small trust fund components.<sup>90</sup> To complete the simulation of OASI trust fund components, the OASI projections in the present analysis convert the Trustees Report nominal projections of these trust fund components to the corresponding proportions of aggregate OASI benefits projected in that year. This has the effect that a simulated adjustment in OASI benefits under an alternative policy leads to a corresponding proportional adjustment in the administrative expenses and Railroad Retirement program net financial interchange

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<sup>90</sup> For example, Table 4.A1 of the 2002 *Annual Statistical Supplement* indicates that during the year 2001 the administrative expenses and transfers to the Railroad Retirement program components of the OASI trust fund respectively represented 0.5 and 0.9 percent of total OASI benefit payments in that year.

transfers. Again, other relationships involving these trust fund components could also be imposed depending on the policy being simulated.

Given the determination of the major OASI trust fund components, the net surplus for the OASI trust fund in each projection period can be identified as

$$(15) S_t^S = r_t^F F_t - J_t - A_t - RR_t ,$$

where  $F_t$  denotes OASI trust fund assets as of the beginning of the period and  $r_t^F$  denotes the rate of return to OASI trust fund assets applicable to period  $t$  as projected in the annual Trustees Report. Trust fund assets as of the beginning of the succeeding period are then given by

$$(16) F_{t+1} = F_t + S_t^S .$$

### **Data Extensions beyond the Trustees Report Projection Horizon**

Because the present analysis projects lifetime OASI taxes and benefits for past, present, and future birth cohorts with assumed potential life spans of up to 120 years each, the projection period required in the present analysis is considerably longer than that used in the annual Trustees Report. The present analysis must extend the projections of program outcomes well beyond the Trustees Report projection horizon, then, in a way that maintains consistency with the relationships underlying the Trustees Report projections.

Consistent extensions are facilitated by the nature of the Trustees Report projections over the last part of the Trustees Report projection period. After an initial transition period, the Trustees Report projections generally converge to a constant level or growth pattern, depending on the projected variable. As examples, under the intermediate

assumptions of the 2002 Trustees Report, the total fertility rate is projected to reach its ultimate level by 2026; after adjustment for changes in the age-sex distribution of the population, annual percentage reductions in total death rates are also projected to reach their ultimate average levels by 2026; the labor force is projected to attain a constant annual growth rate over the final 25 years of the 75 year projection period, reflecting the combined effect of a number of underlying variables; and other key economic and demographic variables used in this analysis are projected to attain constant values or growth rates relatively early in the Trustees Report projection period.

The projections of each Trustees Report variable of interest are analyzed at the required aggregate or age and gender disaggregate level in the present analysis, then, to identify the systematic pattern of change in the variable toward the end of the Trustees Report projection period. This pattern of change is then applied to extend the variable beyond the Trustees Report projection horizon. These extended projections are consistent with the Trustees Report projections, then, in the sense that they maintain the same systematic pattern of change found in each variable toward the end of the Trustees Report projection period throughout all subsequent projection periods.

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