Social Security's Financial Outlook and Reforms: An Independent Evaluation

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I. Introduction

I.1 Social Security's Worsening Outlook

Social Security is often described as a "foundational" element of the nation's social safety net. Almost all Americans are directly affected by the program and many millions primarily depend on its benefits for supporting themselves during retirement.[1] But the program's financial condition has worsened considerably since the last recession, which began in 2007. In that year, the Social Security trustees estimated that the program's trust fund would be exhausted by 2042. The trustees' annual report for 2011 brings the trust fund exhaustion date forward to 2038. Indeed, the programs revenues fell short of its benefit expenditures in 2010 and it appears unlikely that significant surpluses will emerge again under the program's current rules. If the program's finances continue to worsen at this rate, it won't be long before the debate on reforming the program assumes an urgency and intensity similar to that during 1982-83, when imminent insolvency forced lawmakers to implement payroll tax increases and scale back its benefits.

But Social Security reforms should also be implemented under accurate and full information about the program's financial condition. Also needed is a proper appreciation of the effects of alternative reforms on the program's overall financial condition and on the costs and benefits imposed on various participants' future finances—the young and old, rich and poor, male and female, and so on.[2] But official evaluations of the program's fiscal condition and its projected finances are conducted using methods and metrics that should be considered long outdated. Moreover, analyses of distributional effects, especially over participants' lifetimes under current policies, are not included in the trustees' annual reports on Social Security's finances. Although the topic of Social Security almost always generates a robust debate, it is likely to be misguided under the projections and analysis provided by the program's trustees and actuaries. The purpose of this paper is to highlight the availability of better methods and metrics for evaluating Social Security's future

finances and for assessing the reforms that have been proposed by lawmakers, academics, budget analysts, and others.

Not only do I believe that official projections of Social Security's financial condition are inaccurate, there appears to be a general reluctance to remedy the situation—even on the part of experts specifically appointed to do so. For example, the just-released 2011 report of Social Security's independent Technical Panel on Assumptions and Methods (TPAM) fails to review, assess, or even comment on key methodological issues involved in projecting Social Security's future finances. Without a public airing of the problems that such methodological shortcomings may introduce into official projections, we are likely to continue making erroneous judgments and implementing misguided Social Security policies.

Full public disclosure: the TPAM is appointed by the Social Security Advisory Board (SSAB) but operates independently of it. In my current capacity as a SSAB member, I am partly responsible for the composition of the 2011 TPAM. The SSAB took great pains in selecting TPAM members for 2011 to ensure a proper balance of expertise by including economists, actuaries, demographers, and microsimulation modelers, including those with a strong background in research on the Social Security program.

Although the 2011 TPAM report contains methodological recommendations for deriving particular demographic and economic "assumptions" that are used by the program's trustees for making Social Security's financial projections, it does not evaluate the trustees' methodology for putting them together to produce those projections. To me, however, it appears that the trustees' methods contain some rather significant shortcomings. For example, the TPAM 2011 report ignores issues such as the degree of detail that should be incorporated in the trustees' assumptions that are used to construct demographic and economic projections; how those assumptions are integrated

with each other to generate financial projections; whether important interactions between them are adequately captured; whether intermediate demographic, economic, and financial outcomes are reasonable; whether methods of integrating the assumptions are internally consistent and robust for various projection horizons (the short-term, 75 years, and in perpetuity); whether basing some of the assumptions exclusively on historical data is adequate as opposed to conditioning them on projected U.S. demographic and economic features; and so on. A particular choice among alternative methods for determining and combining economic and demographic assumptions could alter the results substantially because it conditions the interplay between those forces over time differently from other choices. How should one choose among the alternatives?

Because Social Security directly covers 94 percent of the working population (some state and local government workers are not covered, for example), and the program's taxes and benefits constitute a sizable portion of most participants' budgets, it exerts a significant impact on the economy.[3] The potential for inappropriate or inadequate Social Security policy adjustments is already quite large, given that it is subject to a massive political tug-of-war between its supporters and detractors. Inaccurate financial projections and inadequate metrics that further bias future policy decisions with the potential to adversely affect millions of people makes it all the more important to project and report Social Security's financial condition using appropriate methods and metrics.

Many lawmakers, scholars, and others have proposed Social Security reforms—following their particular preferences about the program's future scope and operation. Some reform proposals have been financially evaluated ("scored") by Social Security actuaries to estimate their effects on popular measures—such as the date of trust-fund exhaustion and annual balances of tax receipts and benefit payments, and so on. Official reform-scoring exercises are based upon the same—and in my

view, outdated—actuarial methods used by the program's trustees to prepare Social Security's financial projections under current policies and laws.

I.2 Assumptions and Methods in Projecting Social Security's Finances

The shortcomings in current assessments of Social Security's financial condition are fundamental: the actuarial methods and models that the trustees use are inadequate and ill-suited for making accurate financial projections. I don't say this lightly; I am well aware of the serious and severe consequences of making an unfounded charge. The reason for existing shortcomings is the absence in the trustees' projection methods of several essential ingredients, primarily the recognition that for key variables—such as fertility, mortality, productivity growth, interest rates, and others—assumptions based exclusively on historical data are not adequate. Future demographic and economic changes, and important interactions among these key variables, must be explicitly taken into account when deriving future demographic and economic outcomes under a given set of (current or alternative) policies through the projection horizon. Instead, under the official methodology, many of these items are based exclusively on historical data and fixed ahead of time as the trustees' "ultimate long-range assumptions." Another shortcoming is that the trustees' actuarial methods lack a coherent framework for integrating and aggregating demographic and economic factors from the microeconomic (individual) level. Finally, the trustees' projection methods are based on a seemingly arbitrary decision about the degree of detail to incorporate in estimating the "assumptions" (levels or rates of change) to be applied to the population in future years for deriving Social Security's financial outcomes.

The trustees' current methods involve making parametric assumptions, including future rates of change, (called the trustees' "ultimate long-range assumptions") about particular demographic and

economic attributes of the population based on observed historical trends and applying them mechanically "by cell" to the existing population to derive its evolution through time.[4] As the population evolves, however, the fixed parametric assumptions continue to be applied, regardless of whether they are appropriate for the projected future condition of the population.[5] Take assumed future fertility rates as an example. The trustees do not distinguish female fertility rates by race and education level, even though fertility rates have historically differed considerably along those dimensions. Assuming a given overall fertility rate in future years and applying it mechanically to future female populations will produce a particular population projection. But if fertility rates differ systematically by female race and education, the projected population's composition will change, with more fertile groups gaining greater representation.[6] And this change will affect the future overall fertility rate, making it different from the assumed value based exclusively on historical data.

Such changes in the population's projected composition also have implications relative to other technical assumptions—for example, mortality rates, labor-force participation, labor productivity, and so on—that are also based exclusively on historical data and fixed during all but the initial few years during the 75-year projection period under the trustees' methods. For example, labor productivity would tend to decline if faster-growing population groups exhibit more tenuous labor-force attachments, work part time rather than full time, have smaller propensities to acquire education, have larger likelihoods of remaining single rather than marrying, and so on—attributes that are associated with lower worker productivity. The trustees' methods ignore the effects of future changes in the composition of the population on future labor productivity and earnings growth. Instead, they assume that long-term productivity growth will be constant—as determined from historical averages—except for a short-term transition through the abnormal phase of any ongoing business cycle. Under a proper methodology, however, future labor productivity should be conditioned on the composition and attributes of the future population.[7]

In making future projections, rhe trustees' use a "cell based" method, which is based on relatively crude distributions by age and gender categories. [8] This method, although easy to execute, severely constrains the type of demographic and economic processes that could be estimated and projected, including interactions between them through time. A detailed "micro-simulation" approach that would enable better development and integration of key assumptions with projected demographic changes is more difficult to implement than the trustees' current methodology, but it is feasible in the United States because a wide range of microsurvey data sources are regularly compiled.

Indeed, when embedded within a growth-model framework, a carefully constructed microsimulation delivers more than just a "black box." It generates insights into the evolution of demographic and economic components that would determine Social Security's future tax bases and benefit obligations—the evolution of the number workers, the quality (earning capacity) of the workforce, the capital stock associated with differential propensities to save and hold financial and physical assets by demographic attributes, and so on. A well crafted microsimulation also provides insights into the different types of interactions among population groups for variables of interest—such as the evolution of family structures, labor-force participation rates, and education acquisition—attributes that would affect future earnings, payroll taxes, and Social Security benefits. Assuming fixed long-term growth rates or trends based only on historical data and ignoring the potentially large effects that projected demographic and economic changes may exert on those key variables makes Social Security's financial projections potentially prone to sizable errors.

I.3 Metrics for Evaluating the Effects of Social Security Reforms

The 1983 Social Security reforms attempted to fix the program's finances for the next 75 years—through 2058. But the program's total benefit expenditures already exceed its tax receipts, and the Old-Age and Survivors Insurance (OASI) Trust Fund is projected to run out by 2038, according to the program's trustees. Even current estimates of the program's financial solvency may prove optimistic if future economic growth remains slower than its long-term historical average. This result could emerge from unanticipated changes in demographic and economic outcomes–unanticipated because the trustees have not developed better projection techniques, including a well-constructed microsimulation of the U.S. population and economy.

The next set of Social Security reforms should be based on better estimations of the future course of our demographics and economy. They should also be based on a proper set of financial metrics. Measurement of Social Security's solvency and sustainability require a long time horizon–including through perpetuity—because only under such metrics can we capture the full implications of particular policy changes on the program's finances.[9] That means the trustees should retain the infinite-horizon actuarial deficit that they commenced reporting after 2002, together with the traditional 75-year actuarial deficit and the path of annual shortfalls of the program's taxes and income compared to benefit expenditures.

Evaluating particular Social Security reform proposals also demands a thorough analysis of their effects on different population groups. Because Social Security affects almost all participants throughout their lifetimes, the program's redistributive effects should be measured and compared over the lifetimes of different population groups. However, the Social Security trustees and actuaries do not report any analysis of program (or reform) effects using micrometrics evaluated over the lifetimes or various population subgroups.

The 2007 TPAM strongly recommended that the Social Security trustees move to a microsimulation-based estimation method. And the 2011 TPAM recommends adoption of micrometrics for evaluating the program's effect on particular population groups. But progress by the Social Security Administration on adopting microsimulation projection methods and, therefore, on adopting micrometrics, has been very slow. Agencies such as the Congressional Budget Office, Urban Institute, the Government Accountability Office, and others have developed microsimulations of U.S. demographics and economy. But most such efforts have either focused on narrower policy issues or are not fully independent of the trustees' data and inputs during their development. The promise that an independent microsimulation of U.S. demographics and the economy would yield substantial new insights motivated my development of the *D*emographic and *E*conomic *M*icro *Sim*ulation (DEMSIM) in 2003. The results from using DEMSIM to project and estimate Social Security's financial condition and to evaluate six Social Security reform proposals are summarized in the remainder of this paper.

II. DEMSIM

II.1 DEMSIM's Historical Simulation: 1970–2006

DEMSIM begins with a 1:5100 computer-simulated population sample that is calibrated to be representative of the U.S. population as of 1970. This is accomplished by using conditional distributions of the U.S. population according to various attributes— age, gender, race, family size and composition, education, labor-force status, disability status, etc.—as reflected in the Current Population Survey (CPS) samples from the late 1960s and early 1970s.[10] Once conditional distributions of the different individual attributes listed earlier are estimated, the distributions are used to make random draws of 15,000 "families" involving about 39,000 individuals—either single

individuals, single-headed families with one head and at least one child, or married couples with or without children—to closely replicate overall family sizes, family structures, and person attributes as contained in CPS's micro-data sample.[11] Figure 1 shows that 1970 population simulated under DEMSIM is very close in its overall size and structure to that of the CPS. Close matches between CPS and DEMSIM are also achieved for the other person attributes listed earlier. In both charts of Figure 1, notable items include:

- The baby boomers are those aged between 6 and 24 years in 1970
- Single adults' (non-family) curve is steep—in the 1970s, people married in their early 20s
- There are very few single-headed families with kids in 1970
- Single heads span ages 20–60: children split off and are eligible to marry at age 18
- The modal age for married adults (in dual-headed families) occurs during early- to mid-20s
- Dual-headed family-spouse's distribution is to the left of dual-headed family-head's distribution
- The shares of older "non-family" individuals is relatively small—augmented by survivors
- Very few people survive through their 90s
- Few single family heads means few children of single-headed families
- A sizable population of married adults implies many more children in dual-headed families

The CPS also provides wage-earnings data for its sample of individuals, but those data are unsuitable for estimating life cycle earning profiles.[12] Wage and other microdata information from the 1970 Panel Study of Income Dynamics (PSID) survey are used instead. A regression of CPS

wage earnings on CPS demographic and economic attributes (the same ones as simulated under DEMSIM) is used to calibrate the assignment of labor earnings to each 1970 DEMSIM individual.[13] Figure 2 shows the close match between the log earnings distributions from the PSID and post-assignment DEMSIM values.[14]

II.2 DEMSIM's Forward Simulation Beyond 2006

Having simulated the 1970 population attributes and labor earnings, the next step is to calibrate rules for each particular attribute—to "transition" the population forward in time by one year at a time. This exercise requires the calculation of transition probabilities for each person attribute. For individual attributes such as age, gender, and race, this is easy. Race and gender never change, and age advances by one year every year. Transition rules for other demographic and economic attributes are more complicated. For example, labor-force participation can assume any one of three states—full time, part time, and nonworking. The large panel data sample of the PSID covering years 1970 and 1971 is used to calculate transition probabilities of shifting from each labor force participation state in 1970 to each of the three alternative states in 1971. Again, a simulation using random numbers is implemented to assign a 1971 labor-force participation status to each 1970 individual of working age (age 18 and older). The transition probabilities are calculated separately for different age groups, gender, race, and education level—which captures in detail the differences in labor-force attachments by different population groups during the early 1970s. Annual transitions of other attributes are implemented in a similar manner with transition probabilities estimated from various U.S. microsurvey data sets from 1970–71.

Accomplishing population transitions in this manner allows the simulation of the 1971 population conditional on the status of each 1970 attribute for each simulated person. This

procedure for calibrating and executing annual transitions for each attribute is continued successively through 2006, where transition rules are calibrated to microsurvey information between 1970 and 2006. This yields a historical simulation that can be validated against actual historical microsurvey data for each attribute.

For example, the CPS population shares shown in Figures 1 and 3 reveal several interesting U.S. demographic processes that have occurred since 1970. The simulated charts in Figures 1 and 3 show that those processes are replicated in DEMSIM's simulated population, confirming its success in adequately incorporating U.S. demographic history. For example, in both CPS and simulated charts:

- The baby boomers move forward in the age distribution
- Young non-family (nonfam) curve flattens—marriages occur progressively later in the life cycle
- Single heads' (sing_hd) share of the population increases—later marriages and more divorces
- Single heads span ages 20–60: kids split off at age 18, becoming eligible to marry
- The share of non-family (nonfam) individuals at older ages increases—reflecting more divorces
- Modal age for married adults (dual_hd, dual_sp) shifts forward in the age distribution over time
- (kids_dual, kids_sing) curves reflect declining fertility post baby-boom and birth of echo boom
- Percent of population surviving into the 90s increases[15]
- Area under total curve shows population growth—division by 1970 population, not current population[16]

A close match between CPS and simulated population structures confirms that the historical simulation incorporates, sufficiently accurately, the historical evolution of attributes determining the population's structure, including ongoing interactions between them. [17] It confirms that DEMSIM appropriately incorporates the U.S. population's transition during the past three decades. It also indicates that the final years of the historical simulation adequately capture the momentum of current demographic forces built into the U.S. population and economy.

Such a validation exercise is necessary to be confident that the microsimulation is producing a reasonable trajectory for important population attributes. Similar validation exercises are performed for other variables of interest such as educational attainment, labor-force participation, marriage and divorce, earnings by age, gender, race, and so on (not shown).[18] DEMSIM's distributions of simulated attributes are found to match quite closely with those derived from microsurvey data over the historical simulation period, 1970–2006. In addition, macro-level checks, such as the growth in the size of the total population; the distribution of population subgroups by size; and total earnings and their distribution across population sub-groups by age, race, gender, education, retirement, average life-expectancy, and several other variables are also implemented to examine DEMSIM's consistency with available historical data and reasonableness relative to expectations about future demographic and economic outcomes.

III. Key Findings from DEMSIM's Forward Simulations

DEMSIM's baseline historical simulation provides a launch pad for peering into the future by carrying forward the momentum of forces and trends that currently make up the U.S. population and economy. The simulation is carried forward for many decades in order to compute long-range financial projections for Social Security. These forward simulation runs should not be viewed as

forecasts of what the future holds; rather, they are projections based on carrying forward the observed momentum of demographic and economic forces that are observable today.

III. 1. Projecting the Future Population's Size and Structure

The Social Security Administration's projections of demographic parameters—mortality, fertility, and immigration—are widely acknowledged to be the best available and are utilized by many other agencies within and outside of the federal government. However, the claim here is that those parameters are not sufficiently disaggregated along dimensions whose interactions with other population attributes could make a considerable difference to future financial projections of a program such as Social Security.

DEMSIM incorporates identical future *rates of change* in its demographic parameters—mortality, fertility, and immigration rates—as the Social Security trustees.[19] However, in the case of fertility rates, the trustees' overall fertility rates by age for years prior to 2006 are further disaggregated by female race and education levels using data from the National Center for Health Statistics (NCHS). In the case of mortality rates, the trustees' overall rates by age and gender for years prior to 2006 are further disaggregated by race, also by using NCHS data. DEMSIM does not track overall (population) rates of mortality and fertility—indeed, they would be expected to gradually drift away from those of the trustees' as DEMSIM's forward simulation progresses—reflecting the changing composition of the population by race (and female education in the case of fertility rates). The only adjustments to each female group-specific fertility rate (by age, race, and education) and mortality rate (by age, gender, and race) is that percentage changes over time in those rates are calibrated to be identical to percentage changes in the trustees' overall rates (by age and gender) over time. For example, the trustees' overall mortality rate improvements by age and gender

in a specific future year are applied to DEMSIM's mortality rates by age, gender, and race for the same year when implementing the forward simulation. Similarly, the trustees' future fertility-rate changes by female age in a specific future year are applied to DEMSIM's fertility rates by female age, race, and education level for the corresponding year when implementing the forward simulation.

The Social Security trustees decompose labor force participation rates by age and gender and not, additionally, by race and education as implemented under DEMSIM. If there are substantial observed differences in labor-force attachments by those additional attributes, changes in the composition of the future population may hold implications for future labor quality and productivity, but these effects would not be captured under the trustees' methods. A similar remark applies to education levels and propensities to acquire education by age, gender, and race—again, included in DEMSIM but not considered by the Social Security trustees. Such variables, which characterize systematic differences in economic choices (or opportunities), could be exert important influences on the future course of "effective labor inputs"—the product of labor quantity and quality. The evolution and interactions among these variables are likely to be important determinants of future family formation and dissolution, total projected labor productivity, wage earnings, tax bases, the degree of wage inequality, total Social Security benefits, and so on. It implies that the trustees' projection method ignores key determinants of the future course of Social Security's taxes and benefits. To its credit, the 2011 TPAM recommends that the trustees should elevate labor-force participation rates to their list of "ultimate economic assumptions." Unfortunately, the TPAM does not evaluate the trustees' projection method, nor does it make any alternative recommendations about how to integrate all of the trustees' assumptions within a coherent projection method.[20]

Transition probabilities and rules for all population attributes other than fertility, mortality, and immigration (three items that are calibrated as described earlier) are maintained at the same

levels (rates or trends) as during the last few years of DEMSIM's historical simulation—to capture and carry forward the momentum of forces built into today's U.S. population and economy. Figure 4 shows the future evolution of the U.S. population upon continuing DEMSIM's simulation beyond 2006 under those transition rules. The figure shows the evolution of the population's size and structure in 30 year intervals beginning in 2020. Several interesting features are visible:

- The baby boomers transition into retirement and pass away
- The age structure and population shares of children and other subgroups eventually stabilize
- There are many more "non-family" (nonfam) individuals—especially elderly ones
- A larger fraction of the population survives beyond age 90
- The projected population has a much higher fraction of older individuals compared to today
- An "aged population" is a permanent feature

III. 2. Projected Worker-to-Beneficiary Ratios

Because DEMSIM's demographic parameters—especially mortality and fertility rates—incorporate similar rates of change as the Social Security trustees' assumptions, it should produce estimates of key population ratios quite close to those of the Social Security trustees—at least for a significant initial segment of the trustees' 75-year estimation window. One population metric of special interest for pay-as-you-go financed transfer programs is the ratio of contributors (workers) to beneficiaries (retirees and survivors). Figure 5 shows that the trustees' and DEMSIM's projected worker-to-beneficiary ratios match quite closely through the mid-2050s. The match deteriorates toward the end of the 75-year period shown, because of a faster decline in labor force participation

among DEMSIM's working-age individuals stemming from growth in the proportion of minority groups that exhibit less frequent labor-force attachments during their working life spans.[21]

III. 3. Growth in Labor and Capital Inputs

DEMSIM incorporates a growth model framework that lends internal coherence to the projection of labor earnings. Under this framework, labor earnings are assumed to be equal to each worker's marginal product from working in an economy with capital and technology inherited from the past. Capital and labor services are combined in firms to produce output—a process that also produces technical improvements over time. Total output grows over time based on growth in inputs (capital and "effective labor") and technical change, the latter calibrated to historical data based on an independent academic study.[22] Each period's capital stock is calibrated to asset holdings by age and gender estimated from microdata.[23] Asset holdings vary over the lifecycle, increasing through retirement and then declining through the end of the lifespan. The ongoing retirement of the baby boomers means that asset drawdowns by them are likely to accelerate in future years. However, positive population and productivity growth means that, consistent with *projected* demographic changes, those drawdowns will be dominated by asset accumulation by younger cohorts. As a result, capital per worker is projected under DEMSIM to grow during the next several decades at an average growth rate of 1.19 percent per year, and contribute to future output and labor productivity growth.

III. 4. Labor Quantity, Quality, and Productivity

Under DEMSIM's framework, each individual's labor services depend upon the person's labor-force participation and his or her "labor quality." Each person's labor quality is associated with his or her demographic and economic attributes that are simulated under DEMSIM—age, race, gender, marital status, family size and structure, labor-force status, education level, and so on, as estimated from an earnings regression implemented using PSID panel data on earnings and person attributes.[24]

DEMSIM estimates labor quantity by simulating the assignment of full time, part time, and nonworking labor-force status to each worker in each year—again, calibrated using microdata sources. Combining labor-force status with PSID earnings regression coefficients (applicable only to those working part or full time) determines the amount of "effective labor input" contributed by each worker. Aggregating over all workers yields simulated wage and payroll tax bases in each year. This also generates projections of the economywide average wage to be used in calculating Social Security's benefit basis (primary insurance amount) for each retiree. Under this method, projected wages and growth of the wage base are made contingent on the *projected* amounts of capital, technological change, labor quantity, and labor quality.

Although it is quite important for determining the future wage base, the future evolution of the quality of the workforce has not received any attention in official projections of Social Security's finances. DEMSIM shows that the evolution of the future workforce's labor quality is likely to exert a non-trivial impact on the evolution of the payroll base. As it turns out, although projected increases in the capital stock and continual technical change will yield positive U.S. labor productivity growth, a secular projected decline in labor quality is projected to impose a significant drag on future labor productivity growth. Ignoring labor quality, DEMSIM's calibrations produce an average labor productivity growth per worker through 2080 of 1.01 percent per year—somewhat

less that the trustees' 2006 intermediate assumption of 1.10 percent per year.[25] But adding the drag generated by declining labor quality reduces annual average labor productivity growth per worker to just 0.71 percent per year. Figure 6 shows projected time profiles of the capital stock, average earnings per worker, and the index labor quality through the year 2080.

Several demographic and economic features and trends appear to contribute to the projected decline in U.S. labor quality under DEMSIM. First, the retirement of the baby boomers implies exit from the workforce of the most experienced workers who are currently at peak life cycle working and earning activity. They will be replaced over time by equally experienced, high-earning workers, but those cohorts will be smaller in size relative to the boomers and relative to the total workforce. Second, higher fertility among non-whites implies that a larger fraction of the workforce will comprise of individuals with more tenuous workforce affiliations—either through more years of non-employment or higher frequencies of part-time, rather than full-time, work. In addition, the ongoing dissolution of family structures through fewer marriages and more divorces implies a change in social structures away from those associated with higher earnings, especially by male household heads. Under DEMSIM's projections, these labor-quality-reducing tendencies more than offset the quality-increasing effects from a better-educated future workforce. These broad trends appear to have important implications for future growth of output and tax bases, but remain unrecognized and underappreciated among analysts concerned with Social Security's (and the nation's) future economic prospects.

III. 5. Social Security's Financial Condition over the Next 75 Years

DEMSIM's calculations of Social Security (OASI) benefits are based on a careful individual-level calculation of benefits given each individual's wage history.[26] As such, it takes into account the impact of future changes in the distributions of wage earnings.

Social Security's benefit formula is based on each covered worker's earnings history. It indexes past earnings up to the taxable limit by a wage index of (projected) average economywide wage earnings, calculates average earnings over 35 highest years of indexed earnings, and applies a highly progressive "bend-point formula" to derive the "primary insurance amount" (PIA). The PIA is the retirement benefit for those who elect to begin benefit collection at full retirement age. It is modified for early and late benefit collection (as distinct from retirement), and constitutes the basis for calculating auxiliary benefits flowing from each worker's earnings—spousal, divorcee, child, survivor, etc. Thus, the progressivity of the bend-point formula influences all types of OASI benefits. It implies, in particular, that under a given time series of average economywide wages, changes in wage inequality will alter benefits per dollar of total wage earnings.

How would this work? Under the current bend point formula, each additional dollar of average monthly indexed earnings (AIME) generates additional PIA (benefits) of 90 cents for those with low earnings (and, therefore, low AIME) during their lifetimes. The marginal AIME-to-PIA conversion rates are 32 percent for those with moderately high AIME and 15 percent for those with highest AIME's. Thus, a person's total benefits increase with AIME, but the rate of increase declines as AIME increases. This means that a (mean preserving) decline in inequality (of AIME or wages) would *increase* benefits per dollar of wages and, conversely, a more unequal wage distribution would decrease benefits per dollar of wages.

DEMSIM projects that the United States is likely to experience a reduction (possibly, a slow rate of increase) of wage inequality during the next two decades as the baby boomers—who are

currently in their highest earning phase of their life-cycle—retire. Later, once the boomers are fully retired and positive labor productivity growth increases total earnings, but more workers exhibit lower labor-force attachments and other attributes associated with lower productivity, cross-section wage inequality is likely to reverse course (or accelerate).

Compositional changes in the attributes of the U.S. work force that are projected under DEMSIM suggest, therefore, that benefits per dollar of payrolls and payroll taxes would increase rapidly at first—until baby boomers' transition into retirement is completed. During the 2030s, however, the pace of this increase will slow. Under DEMSIM, wage inequality continues to increase gradually after 2030. Nevertheless, benefits continue to outpace payroll taxes because of projected increases in longevity and retirement life spans in the long term. DEMSIM's pattern of faster increases in benefits relative to payroll taxes during the next two decades, followed by a slow but steady long-term increase in the gap between benefits and payroll taxes, is shown in Figure 7. DEMSIM's projected OASI tax-receipts trajectory is consistently lower than the trustees' trajectory through 2080.[27] However, DEMSIM's total-benefit trajectory surges initially, at a faster pace compared to the trustees' trajectory. The rate of increase matches that of the trustees after the 2030s—which is not surprising because the rate of longevity increases in the long term is similar to that of the trustees'.

DEMSIM's payroll taxes and OASI benefit expenditure estimates for 2006 turn out to be quite close to the trustees' estimates (within 6 percentage points). But DEMSIM's and the trustees' projections diverge in future years, as shown in Figure 7. Compared to the trustees' (2006) projections of OASI taxes and benefits, DEMSIM produces a larger future gap between the two. Table 1 shows that the 75-year open group liability (OGL) equals almost $7.0 trillion under DEMSIM's projections—70 percent larger than the trustees' estimate of $4.1 trillion.[28] Note also

that the trustee's total benefit expenditure profile exhibits a much smaller surge in benefits from the retirement of the babyboom generation compared to DEMSIM's profile—a result of insufficient detail and modeling of underlying demographic and economic processes. As is evident from Figure 7, a larger share of the Social Security's imbalance arises before 2050 under DEMSIM's compared to the trustees' projections.

Table 1 shows that Social Security's 75-year OGL equals $7.0 trillion under DEMSIM—or 3.4 percent of the present value of payrolls during 2006–2080. This is much larger than the trustees' (2006) estimate of 1.9 percent. DEMSIM's estimate implies that maintaining Social Security solvency over the 75-year time horizon requires policymakers to either increase OASI payroll taxes by 3.4 percentage points—that is, increase OASI tax receipts by 31 percent—immediately and permanently. Alternatively, benefits would have to be reduced by 22 percent immediately and permanently. [29]

DEMSIM estimates Social Security's trust fund exhaustion date to be 2029, much sooner than the trustees' (2006) date of 2042. The trustees' latest (2011) estimate of the trust fund exhaustion date is 2038. It remains later than DEMSIM's estimate of 2029, but is approaching closer to the latter over time. The earlier trust fund exhaustion date under DEMSIM may be the result of a more pronounced effect of baby-boomer retirements on the path of projected benefits. I would conjecture that because the trustees' intermediate projections are optimistic relative to DEMSIM's baseline projections, the trust fund's official exhaustion date will continue to move closer DEMSIM's projected date of 2029 as official estimates are updated over time.[30]

III. 6. Social Security's Financial Condition Calculated in Perpetuity

Although 75 years is the standard "budget window" for assessing Social Security's financial condition, the trustees have begun publishing the infinite-horizon open group liability estimate of the program's unfunded obligation since 2003.[31] The infinite-horizon OGL has many advantages and disadvantages over its 75-year counterpart. The advantages are that it comprehensively reflects the implications of the current rules for a program that is intended to last forever (in principle). It also avoids underestimation of the program's total obligation under the 75-year OGL estimate, which includes payroll taxes during the 75-year window but excludes the post-75th-year benefit obligations created for those taxpayers. In addition, ignoring the program's financial shortfalls after 75 years is tantamount to implicitly—but inappropriately—assuming a balanced outlook after the 75th year. Truncating the estimates after 75 years implies an infinite discount rate on post-75th year benefits, whereas a more gradual reduction in the weight attached to out-year net obligations—by simply continuing to compound the discount factor—seems to be more appropriate. The disadvantages of the infinite-horizon imbalance calculations is that many people do not comprehend the relevance of such a long time horizon and believe that uncertainty about the future is so large as to render that estimate useless for policymaking. To me, however, the key, and policy-relevant, advantage of the infinite-horizon metric is that it avoids underrepresentation of the program's total imbalance. The best solution is to report both the 75-year and the infinite-horizon metrics.[32]

As I have argued elsewhere, the infinite-horizon open-group metric alone is insufficient to fully reflect Social Security's financial condition.[33] The addition of the complementary closed-group liability (CGL) is necessary. The CGL is the contribution to the OGL obligation by past generations and all currently-alive individuals—that is, it excludes Social Security's transactions with future generations. Since OGL includes the net contribution of all generations(past, present, and future) and the CGL includes the net contribution of only the past and current generations, the difference between them isolates the net contribution of future generations. Thus the two metrics reflect the

program's total fiscal imbalance (OGL) and its distribution along broad generational lines (CGL and OGL-CGL).

Table 2 shows that the infinite-horizon OGL equals 4.8 percent. Eliminating the infinite-horizon OGL, therefore, requires an immediate and permanent increase in payroll taxes of 4.8 percent, or by 43 percent of all future OASI tax receipts. Alternatively, OASI benefits would have to be reduced, immediately and permanently, by 29 percent.

Table 2 also shows OASI's closed group liability. At $14.2 trillion, the CGL is larger than the infinite-horizon open-group liability ($13.4 trillion). That means DEMSIM estimates that past and presently-alive generations (as of 2006) would receive OASI benefits in excess of their Social Security tax payments during their lifetimes to the tune of $14.2 trillion. Because this amount is more than total excess OASI benefits being promised to all (past, present, and future) generations—the OGL of $13.4 trillion—it implies that future generations will collectively pay $0.8 trillion more in payroll taxes over their lifetimes than they would receive in lifetime OASI benefits (both measured in constant 2006 dollars as a present discounted value as of 2006).

Note that, if preserving current Social Security tax and benefit rules for those presently alive promises to award excess benefits of $14.2 trillion to past and living generations, that excess must be paid for by future generations. That is, preserving current Social Security rules for current generations promises to bequeath an additional fiscal burden of $13.4 trillion to future generations, increasing their total fiscal burden on account of OASI from $0.8 trillion to $14.2 trillion.

Finally, at $14.2 trillion, the CGL is also much larger than the OASI trust fund, which equaled $1.7 trillion in 2006. Thus, public-policy pronouncements frequently aired by Social Security's political supporters—that the "many billions" in the program's trust fund means that its finances are "secure"—ring rather hollow when the trust fund is juxtaposed against the amount

required to fully fund the program's benefit obligations to today's generations—an additional $12.5 trillion. Continuing the status quo in Social Security policies would make the program's obligations to current generations firmer. Hence, it would also make the imposition of larger fiscal burdens on future generations more certain.

III. 7 Projections of Social Security's Annual Cash Flow Imbalances

Present value imbalances between projected revenues and expenditures inform us about the program's overall financial condition but do not reveal the time profile of annual deficits. Obviously, the closer in time that annual imbalances are projected to emerge, the more urgent would be the need to restore financial solvency through policy changes. Social Security's 75-year annual imbalances profile—the difference in annual non-interest expenditures and annual tax receipts under DEMSIM's baseline projections—is shown in Figure 8. Annual imbalances increase rapidly through about 2040, but the rate of growth slows and becomes negative as reductions in benefit expenditures from dying baby boomers outpaces expenditure increases from progressively longer-lived retirees.

Once the boomers pass away, however, annual imbalances resume an upward trajectory because of continuing increases in longevity that are built into the Social Security Administration's mortality projections. Around 2035, when the retiree population is mostly comprised of baby boomers, annual imbalances are projected to rise to almost 6 percent of annual payrolls. Toward the end of the 75-year horizon, DEMSIM projects annual imbalances to be 8 percent of annual payrolls. As Table 1 shows, however, the average tax rate increase required to close the 75-year funding gap equals 3.4 percent of payrolls.

III. 8. Micromeasures of Social Security's Fiscal Burdens

Social Security's taxes and benefits affect individuals' budgets each year. Because it is a lifetime program—affecting disposable incomes when working and when retired—it is important to evaluate those effects under current Social Security policies and under alternative reforms. The two key micrometrics employed here are the Social Security "lifetime net tax rate" and the Social Security "retirement wealth" metric. The lifetime net tax rate is the excess of lifetime payroll taxes paid over lifetime benefits received, calculated as a share of a person's lifetime earnings. This is the pure-tax component of payroll taxes surrendered to the government through (forced) participation in Social Security. The term "lifetime" summarizes the fact that all items are calculated as present discount values as of each person's year of birth.[34]

The "retirement wealth" metric equals lifetime Social Security benefits received as a share of lifetime earnings. It is the amount of lifetime earnings sequestered through Social Security to pay for retirement expenses under current laws. The two micrometrics under DEMSIM's baseline projections are shown in Table 3 for 15-year birth cohorts among post–World War II (postwar) generations.[35] Because future benefits are not fully funded out of the existing trust fund plus projected tax receipts, two versions of the retirement wealth metric are shown: one under present-law "scheduled benefits" and one under "payable benefits," given projected tax receipts.

Table 3 shows that participation in Social Security imposes a significant fiscal burden on post-war generations. Those born before 1960 (most of the baby boomers) are projected to pay the smallest lifetime net tax rates—just over 5 percent of the present value of lifetime earnings calculated as of their years of birth. Lifetime net tax rates are projected to increase for those born after 1960 through the 1991–2005 birth cohort to peak at 6.14 percent. These generations paid—and will pay—higher payroll taxes than their predecessors, but their benefit increases will be

considerably less rapid than those of the first post-war cohort shown. Under current tax and benefit schedules that are incorporated in DEMSIM's baseline projections, most of those born in this century (2006 and later) will experience declining lifetime net tax rates as they enjoy successively longer retirement and benefit collection life spans.

Table 3's retirement wealth metrics show that for successive generations, the gap between retirement wealth on a scheduled basis and that on a payable basis grows wider. This is consistent with Figure 8, which shows an increasing gap between annual revenues and expenditures except for a brief period of decline during the 2040s. It shows that payable retirement wealth is a smaller fraction of lifetime earnings for those born later in time. Indeed, the gap between scheduled and payable retirement wealth increases consistently for successive birth cohorts. On a payable basis, Social Security sets aside about 3 percent of lifetime earnings for retirement for those born shortly after 1960, but that share declines to 2 percent for those born after 2005.

IV. Evaluating Social Security Reforms: Macro- and Micromeasures

Given that Social Security policy changes are unavoidable, how should we choose between the myriad Social Security reform proposals out there? Many individuals, ranging from lay observers to lawmakers in Congress, have proposed Social Security reforms. Each such reform proposal includes several reform elements encompassing changes to both Social Security taxes and benefits. And all such proposals affect the future finances of retirees, workers, and future generations; men and women; high- and low-earners; whites and minorities; and recipients of different types of Social Security benefits differently.

Social Security reform elements are of two major types—those primarily seeking to improve the program's financial solvency and those focused on alternative goals—to achieve a better distribution of taxes and benefits, to reduce the government control over retirement saving through privatization, to secure greater benefits for survivors to avoid poverty among the very old, to improve work incentives, and so on. Policy changes that are primarily motivated by non-solvency-related objectives seek to exploit the opportunity presented by the fact that the program must be reformed because it is, in fact, approaching insolvency quite rapidly. Including both types of policy changes in reform proposals—as is done in all of the reform proposals evaluated using DEMSIM—is justified because, although the program's proponents tout its social insurance benefits and poverty reduction among retirees, it also exerts ancillary effects that are economically undesirable.[36]

Six Social Security–reform proposals are selected for evaluation using DEMSIM's simulation and projection of future U.S. demographic and economic features. They are among the most frequently cited reform proposals from across the political spectrum—two of which are popular among political liberals, two among centrists, and two by politically conservative analysts. Taken together, the proposals cover almost all specific reform options that have been proposed to date—ranging from dedicating new revenues to Social Security all the way to diverting ("carving out") existing payroll taxes to create personal Social Security accounts.

Social Security's actuaries regularly score program reforms proposed by lawmakers and others. Their evaluations, which are publicly available, are based on the trustees' cell-based methodology. [37, 38] The six reform proposals considered here are evaluated under DEMSIM in a detailed manner, closely incorporating all of the features included in each proposal. Ancillary calculations are implemented, wherever required, to estimate the parameters controlling changes to Social Security's tax and benefit rules as specified in the proposals.[39]

As described in the following sections, closer examination of these Social Security reform proposals using DEMSIM reveals many interesting features and effects, both in the aggregate and by population subgroups. Some proposals that are touted to restore financial solvency to Social Security actually change the program's financial shortfalls very little. Others touted to be "balanced" turn out to be significantly liberal-leaning in their effects and involve steep increases in fiscal burdens on future generations. Only two of the proposals deliver what their proponents claim: one offers a reasonably balanced outcome despite introducing individual accounts, and the other offers a sizable reduction in the program's financial shortfalls, mostly through staggered future reductions in benefit growth.

IV.1 Features of Reform Proposals Evaluated

The reform proposals selected for evaluation include two by politically liberal proponents. The first proposal, by Robert Ball, operates exclusively on the system's revenues and asset income. Its features include: increasing Social Security's taxable maximum earnings limit so that 90 percent of wage earnings are subject to the OASI payroll tax; dedicating all estate-tax revenues to Social Security; and investing the Trust Fund in private securities to continually increase the system's trust fund, thereby avoiding large future increases in payroll tax rates.

The second liberal proposal, by Peter Diamond and Peter Orszag, targets four main objectives: to counter forces such as increasing longevity that are pushing the system toward insolvency; to combat increasing economic inequality; to distribute equitably the "legacy debt" generated by generous benefit awards to Social Security's early participants; and to strengthen the program's social insurance functions.

Centrist proposals are ones that combine reform elements from liberal and conservative proposals in a reasonably balanced manner. One of the centrist proposals evaluated here is by Jim Kolbe, Charles Stenholm, and Allen Boyd. It has the primary objective of achieving financial solvency for Social Security through a balanced collection of tax- and benefit-side reform measures. The proposal contains 14 reform elements that alter the program's tax and benefit rules and introduces Social Security personal accounts.

The second centrist proposal evaluated is by academic economists and think-tank analysts Jeffrey Liebman, Maya MacGuineas, and Andrew Samwick—who have (separately) served in both Democratic and Republican administrations. Their proposal also aims to achieve program solvency over 75 years by seeking compromise between liberal and conservative principles in reforming Social Security. It contains four elements: two for increasing the program's revenues, one to reduce future scheduled benefits, and one that introduces Social Security personal accounts.

Among conservative proposals, the first is by the George W. Bush's Commission to Strengthen Social Security. Its primary objective is to change the program's structure by introducing voluntary personal Social Security accounts—to move the program away from a government-operated system to one that enables citizens to own and self-direct investments for retirement financing according to their individual preferences and risk tolerances. The financial quid pro quo for diverting a part of payroll taxes into personal accounts would be an actuarially determined reduction in future benefits from the traditional Social Security system. Because the short-term cost increases are paid for during future decades, its financial effects continue well beyond 75 years, making the infinite-horizon OGL more suitable for a comprehensive evaluation of its financial implications—especially for ensuring an apples-to-apples comparison with other reform plans.

The second conservative plan evaluated here is by Rep. Paul Ryan—whose "Roadmap for America" contains a detailed Social Security reform proposal. The Ryan proposal builds on the Bush Commission's proposal by also introducing voluntary "carve-out" personal security accounts (PSA) for those younger than age 55 in 2009. It also adopts several measures to reduce the traditional system's scheduled benefits. PSA participants are guaranteed benefits equal to those they would receive under the reformed traditional system. This provision sets up a tension between providing a generous guarantee level to encourage participation in PSAs, but higher taxpayer costs if PSA returns turn out to be low for many participants. The evaluation of the Ryan reform proposal is implemented on the basis of average capital market returns, using the metrics described earlier, and does not tackle the difficult problem of estimating the cost of the proposal's PSA benefit guarantee.

IV. 2 Macro Solvency Effects: 75-Year and Infinite-Horizon Measures

Long-term system solvency effects flowing from the six Social Security reform proposals are shown in Table 4. The first row of Table 4 shows estimates of the 75-year and infinite-horizon open group imbalance estimates (as present discounted values in constant 2006 dollars) under DEMSIM's baseline. These two estimates show that limiting projections to just 75 years into the future would ignore about one-half of the total imbalance, much of it obligated by participants' payroll-tax payments under Social Security–covered employment during the initial 75 years. The first row also shows the closed-group imbalance under current laws—indicating that past and current generations together account for more than the total projected financial imbalance.

Rows two through seven of Table 4 show those three metrics calculated for each of the six reform proposals in constant 2006 dollars. More informative, however, are the percent changes from DEMSIM's baseline values shown in columns four through six of Table 4. Column four of the

table shows the percentage change in the infinite-horizon imbalance achieved under the proposal and column five shows the reduction in the infinite-horizon OGL accomplished within the first 75 years. The last column of the table shows the reduction of the closed-group imbalance achieved by each reform proposal as a share of the infinite-horizon OGL under pre-reform (current) policies.[40] It shows the amount of the existing imbalance that will be eliminated by reducing the net excess benefits of past and current generations under pre-reform Social Security policies.

These three metrics show that the proposal by Robert Ball achieves very little progress toward eliminating the program's total imbalance: it reduces the infinite-horizon imbalance by only 14.6 percent, with a little more than half of the change accomplished during the first 75 years. This result arises because the two revenue-increasing proposals—increasing the taxable ceiling to subject 90 percent of all wages to payroll taxes and dedicating estate taxes to Social Security—achieve very minor increases in revenues in the short-term. Hence, the intended sustained expansion of the Social Security trust fund from investments in private capital markets does not occur: the small trust fund increase from additional revenues cannot leverage much additional asset earnings through investments in private capital markets. The failure to increase Social Security's revenues is traced to the meager contributions expected from estate taxes and to DEMSIM's baseline, which itself incorporates an increase in the share of total wages subject to payroll taxes in future years. Under DEMSIM, the prospective retirement of the baby boomers—the exit of such a large cohort from the highest-earning stage of their life cycle—reduces earnings inequality and induces an increase in the taxable share of earnings—from 85.6 percent to 88 percent. This leaves little additional space for further increases under the Ball proposal's 90 percent target for the taxable-to-total earnings ratio. Hence, this policy also generates little additional revenues in the short term. The Ball proposal also imposes a negligibly small cost on current generations—under it, the reduction of CGL is just 0.9 percent of the infinite-horizon OGL. These results suggest that the Ball proposal would mostly

preserve the program's structural and financial status quo rather than move the program significantly toward financial solvency.

The Diamond-Orszag (D-O) proposal, in contrast, would cause a significant change in Social Security's infinite-horizon OGL—it would reduce it by 88 percent. However, less than one-half of that reduction would be achieved within the first 75 years. Moreover, the CGL would be reduced by even less—just 24.6 percent of the infinite-horizon OGL. This proposal's good performance on reducing the infinite-horizon OGL, but relatively poor performance on reducing it quickly, and its significant retrenching of the net excess benefits of today's generations arises because it predominantly operates on the tax rather than on the benefit side of the program's finances. The authors of the D-O proposal divide adjustments to counter increased longevity equally between increases in payroll taxes and reductions in scheduled benefits, but most of the other adjustments relating to inequality and legacy costs are implemented through tax increases. As will be seen in later sections, the D-O proposal implies steeply escalating lifetime net tax rates on today's young workers and future generations—those born after 1975. This reform approach, therefore, leaves current older generations relatively unharmed from policy changes for improving Social Security's financial condition.

When it was first publicized, the Kolbe-Stenholm-Boyd (KSB) proposal was described as a "model of bipartisanship." Although its authors belonged to both major political parties, which had opposing approaches to Social Security reforms, their reform proposal incorporates elements from across the political spectrum. The KSB reform proposal introduces "carve out" Social Security personal accounts, which increase the program's deficits during the early post-reform years. Those deficits are offset, however, through reductions in scheduled benefits that become progressively larger for successive retiree generations. As a result, although these reforms also achieve a significant

reduction in the infinite-horizon OGL, only about 30 percent of the reduction is achieved during the first 75 years. Moreover, the KSB proposal reduces the excess benefits of past and current generations by just 27.5 percent of the infinite-horizon imbalance, slightly larger than under the D-O proposal.

The Liebman-MacGuineas-Samwick (LMS) "nonpartisan" proposal also seeks to compromise between liberal and conservative reform principles by splitting the difference between tax increases and scheduled benefit reductions to improve Social Security's financial solvency. The personal accounts system introduced under this proposal includes equal measures of "carve-out" and "add-on" elements. The proposal's reform elements—increasing the taxable maximum earnings ceiling, accelerating increases in Social Security's normal retirement age, and altering benefit formulas to reduce scheduled benefits under the traditional Social Security system—yields an 82 percent reduction in the infinite-horizon imbalance. Similar to the D-O and KSB reform proposals, the LMS proposal also achieves less than 50 percent of the total change within the 75-year time horizon. However, it imposes a larger adjustment cost on current generations—reducing their net excess benefits (CGL) by 36.0 percent. This turns out to be 44 percent of the total adjustment imposed by the LMS proposal. Thus, compared to the other reform proposals discussed earlier (Ball, D-O, and KSB) the LMS proposal is considerably more balanced in its distribution of adjustment costs on current and future generations.

The G. W. Bush Commission's Model 2 proposal is a quintessentially conservative Social Security reform proposal, serving as the basis for building many other conservative proposals. Like the centrist proposals (KSB and LMS), its personal accounts are voluntary. However, unlike centrist plans, Model 2 includes individual-specific offsets of future traditional benefits in exchange for participation in its exclusively carve-out personal accounts system. Usually, proponents of Social

Security personal accounts characterize the diversion of payroll taxes into personal accounts and of owning, directing, and potentially bequeathing one's own retirement assets as desirable features that participants would be willing to pay for. That presents an opportunity to improve Social Security's financial solvency—by imposing a "haircut:" a *larger* than actuarially fair offset of future traditional benefits in lieu of diverting payroll taxes into personal accounts. However, Model 2 does the opposite: its benefit offset is designed to be *less* than actuarially fair through the use of an interest rate of 2 percent per year—smaller than the interest rate on long-term Treasury securities. The accumulated value of diverted payroll taxes through retirement—to be equated to the present value of future benefit offsets—would be smaller under a 2 percent accumulation rate than their actual accumulation even when invested in the least risky financial assets, such as U.S. Treasury securities. This is, obviously, an attempt to attract participation in Model 2's personal accounts system, but the subsidy to personal account participants retards progress toward making the Social Security system solvent.

Together with its other reform elements—reductions in scheduled Social Security benefits and benefit enhancements for certain low-income and vulnerable groups, Model 2's reduction in the infinite-horizon OGL is smaller than under other reform proposals (except the Ball proposal)—61 percent. Indeed, assuming 100 percent participation in its sizable and actuarially advantageous personal accounts system generates large short-term deficits and the 75-year OGL is *larger* under Model 2 by 6.5 percent of the infinite-horizon OGL. Model 2 also performs relatively poorly on the "fiscal discipline" metric: it imposes only 14 percent of its total adjustment cost on current generations—mostly by way of reductions in traditional benefits imposed on those alive near the end of the 75-year projection horizon.

The Ryan reform proposal is even more ambitious than Model 2 in implementing voluntary Social Security personal accounts—starting small, but gradually increasing the share of current-law payroll taxes that would be diverted into personal accounts. The payroll taxes that are diverted to personal accounts would be offset on an actuarially fair basis by reducing participants' traditional benefits. Under the Ryan proposal, participants who accrue very low or negative cumulative returns on their personal accounts by their desired retirement age are guaranteed to receive at least the benefits provided by the post-reform traditional Social Security system. The benefit guarantee would be based on the presumption that such beneficiaries never participated in personal accounts. For those choosing not to participate in the personal accounts system, traditional benefits would be reduced gradually by shifting to a consumer-price indexed rather than a wage-indexed benefit formula—implying a staggered increase in the size of the total reduction of scheduled benefits for successive retiree cohorts. The proposal also broadens Social Security's payroll tax base by subjecting employer health insurance payments to payroll taxes.

The gradual but eventually substantial reduction in traditional benefits and large size of personal accounts imply that the Ryan proposal would more than eliminate the program's total financial imbalance calculated in perpetuity. Indeed, assuming 100 percent participation in personal accounts, the proposal, if sustained over many decades, would eliminate Social Security's OGL. But a very small portion of the reduction would be achieved during the first 75 years—just 17 percent.

However, the Ryan reform is the most fiscally responsible among those evaluated here—it reduces the CGL by 37.6 percent. The key factor that explains the difference in the effect under the 75-year open-group imbalance versus the closed-group imbalance is the diversion of payroll taxes by future generations among those alive within the first 75 years. Their benefit reductions occur mostly outside the 75-year horizon, but their payroll tax diversions dampen the imbalance-reducing effect

under the 75-year OGL measure. Note that future generations' payroll-tax diversions are not included under the closed-group imbalance calculation.[41]

IV. 3 Macro Solvency Effects: Annual Imbalance Ratios

As noted above, 75-year and infinite-horizon OGL measures inform about the program's financial condition, but do not reveal the timing of when or how rapidly deficits would emerge in the future. Figure 9 shows the trajectory of Social Security's annual non-interest cash-flow deficits—the excess of benefit expenditures over non-interest receipts—for DEMSIM's baseline and the six alternative reform proposals. Comparison across the alternative trajectories reveals several noteworthy features: The proposals that create carve-out personal accounts (KSB, LMS, Model 2, and Ryan) produce larger deficits during the initial years after the reforms are implemented. The Ryan proposal's expansion of the payroll tax base to employer health insurance premium payments causes short-term surpluses followed by larger deficits than under DEMSIM's baseline trajectory as the proposal's personal account system grows larger and more payroll taxes are diverted from the traditional system. The projections show that larger deficits under Model 2 and Ryan proposals from sizable payroll tax diversions into personal accounts would last through the middle of this century. All proposals generate smaller long-term Social Security deficits compared to DEMSIM's baseline and they are eventually *significantly* smaller under all but the Ball proposal.

The Ball and Ryan proposals are polar opposites. Under the Ryan personal accounts proposal, assuming 100 percent participation, Social Security's annual imbalances are eliminated by 2060. Annual imbalances under the Ball proposal, however, are only slightly smaller compared to the DEMSIM's baseline—showing that it does relatively little to improve the system's short- and long-term solvency.

Finally, annual imbalance trajectories under the Liebman-MacGuineas-Samwick and Diamond-Orszag proposals are quite close to each other, reflecting the relative similarity of overall aggregate reductions in open- and closed-group imbalances that the two proposals would bring about. However, the two proposals are very different in their impact on current and future generations—as discussed in the next section.

IV. 4 Micro Effects: Lifetime Net Tax Rates and Social Security Retirement Wealth

One of the important issues relating to Social Security reform is the impact of alternative policies on population subgroups. The subgroups can be constructed along many dimensions—by gender, race, earnings levels, birth-cohort affiliation, and so on. Comparing the lifetime net tax rate and retirement-wealth metrics for population subgroups under continuation of baseline policies and under alternative reforms can inform policymakers about key trade-offs—how those groups would be affected under a policy of maintaining the status quo versus implementing a particular reform.

The traditional micrometric used in such evaluations is the annual "replacement rate," which measures the percentage of annual preretirement earnings replaced by Social Security benefits each year. Unfortunately, the replacement rate is not as relevant or important today because retirement life spans have lengthened differentially for different population groups. People with different attributes—race, gender, education, and career earning levels—now experience systematic differences in retirement and survival rates, implying that their lifetime treatment under Social Security should be the primary focus when evaluating the program's microlevel effects. Unfortunately, lifetime micromeasures are not reported by Social Security's trustees. Their micrometrics are limited to replacement rates calculated for stylized low, median, average, and

maximum earners—with career-earning profiles that are not necessarily representative of any particular population group.

The discussion here is limited to the effects of five alternative proposals on a 15-year birth-cohort basis—the Ball proposal is dropped, as it includes no changes to Social Security's current tax and benefit policies. Table 5 shows the results, beginning with the post-war birth cohort (those born in the years 1946–60) through those born toward the middle of this century (2036–50). The first panel of Table 5 reports lifetime net tax rates under DEMSIM's baseline and under five alternative reform proposals.

The most salient feature of the first panel of Table 5 is the rapid and significant increases in lifetime net tax rates for successive birth-cohorts under the Diamond-Orszag reform proposal compared with DEMSIM's baseline and the remaining four reform proposals. Under the D-O proposal, those born during the middle of this century would face net tax rates equaling more than 10 percent of their lifetime earnings—the result of closing Social Security's financial imbalance mainly through tax increases on future generations. Indeed, higher taxes enable increases in "payable" retirement wealth under the D-O reform compared with DEMSIM's baseline, as shown in the second panel of Table 5. The retirement wealth of even early postwar birth cohorts is increased under the D-O proposal from its benefit enhancements to "strengthen social insurance" objective. These results confirm the strong politically liberal orientation of the D-O reform proposal.

In contrast to the D-O proposal, the other four proposals do not involve significant deviations from DEMSIM's baseline lifetime net tax rates. Among the two centrist proposals, the KSB proposal imposes a smaller lifetime net tax rate than the LMS proposal, because the former predominantly relies on both benefit and tax-side changes to reduce Social Security's financial imbalance, whereas the latter partially funds personal accounts through additional contributions.

Among the two conservative proposals, Model 2 reduces lifetime tax rates by more than all of the five proposals considered here because of its significant diversion of payroll taxes into personal accounts. The Ryan proposal also includes a large personal-accounts system, but those accounts are introduced gradually and the proposal broadens the payroll tax base to increase lifetime net tax rates, especially for those born toward the middle of the current century.

It is noteworthy that lifetime net tax rates are significantly higher under the D-O proposal compared with the LMS proposal, despite the roughly similar trajectories of annual imbalances that these two proposals generate (see Figure 9). This means that depending exclusively on aggregative measures to compare reform proposals—for example, the amounts by which OGLs and annual imbalances are reduced through particular reforms—would be inadequate for comprehensively assessing their effects.

All of the five reform proposals analyzed in Table 5 involve higher levels of "payable" retirement wealth from Social Security compared to DEMSIM's baseline. It is also noteworthy that reforms involving personal accounts result in comparable levels of retirement wealth levels, on average, compared to those under the D-O proposal, which does not create personal accounts. Indeed, retirement wealth levels are consistently larger for those born after 1975 under the LMS proposal compared to the D-O proposal.

The third panel of Table 5 shows the percentage share of retirement wealth arising from traditional Social Security benefits, with the remainder provided out of personal accounts. Of course, traditional system benefits account for 100 percent of benefits under DEMSIM's baseline and under the D-O reform proposal. Among the other four reform proposals shown in Table 5, each of which involves personal accounts, the two centrist proposals generate approximately 60 percent of Social Security benefits (including retirement, survivor, dependent, and children's benefits) from the

traditional system, on average, for successive birth cohorts through the mid-21st century. The share of traditional benefits is much smaller under Model 2's reforms, approaching 30 percent for those born during the middle of this century. The traditional benefit share declines rapidly for those born after 2006 under the Ryan proposal, becoming zero for those born after 2035. Thus, in terms of changing the structure of Social Security through personal accounts, the reform proposals analyzed here broadly adhere to their political labels as liberal, centrist, and conservative.

The last panel of Table 5 shows the extent to which the five reform proposals strengthen Social Security. The metric for this is the amount by which retirement wealth is increased from the "payable" level under DEMSIM's baseline and moved closer toward its "scheduled" level. The first column of this panel shows the gap between the payable and scheduled retirement wealth levels under DEMSIM's baseline projections. For those born during mid-21st century, current payroll tax rules would finance only slightly more than 50 percent of current law scheduled benefits. The other columns show that all five reform proposals increase retirement security by increasing the payable levels of retirement wealth for successive cohorts under their rules. The results show that all proposals involving personal accounts provide similar increases in retirement wealth as under the D-O reform proposal. Indeed, among the five reforms proposals, the LMS proposal's average payable retirement wealth comes closest to the scheduled level under today's Social Security rules.[42]

V. Conclusion

Social Security's finances have been worsening for two decades, and this trend appears to have accelerated by the recession of 2007–09. Social Security's finances may improve once the economy and tax collections recover, but chances that we'll witness economic growth rapid enough to obviate the need to reform the program appear to be very small. Policymakers should have

accurate information available about the program's financial future conditional on its current policies and under alternative reform options. Providing such information is a key duty of the program's trustees, but their reports are based on decades' old methods for projecting the system's finances. Program officials have been extremely slow in developing and incorporating recent advances in making future budget projections, especially in adopting microsimulation methods for broadening understanding of how current demographic and economic trends will evolve in the future. Indeed, even those charged with the responsibility of evaluating and recommending the adoption of better projection methods—such as the 2011 Technical Panel on Assumptions and Methods—appear to have avoided making a critical assessment of the trustees' current projection methods.

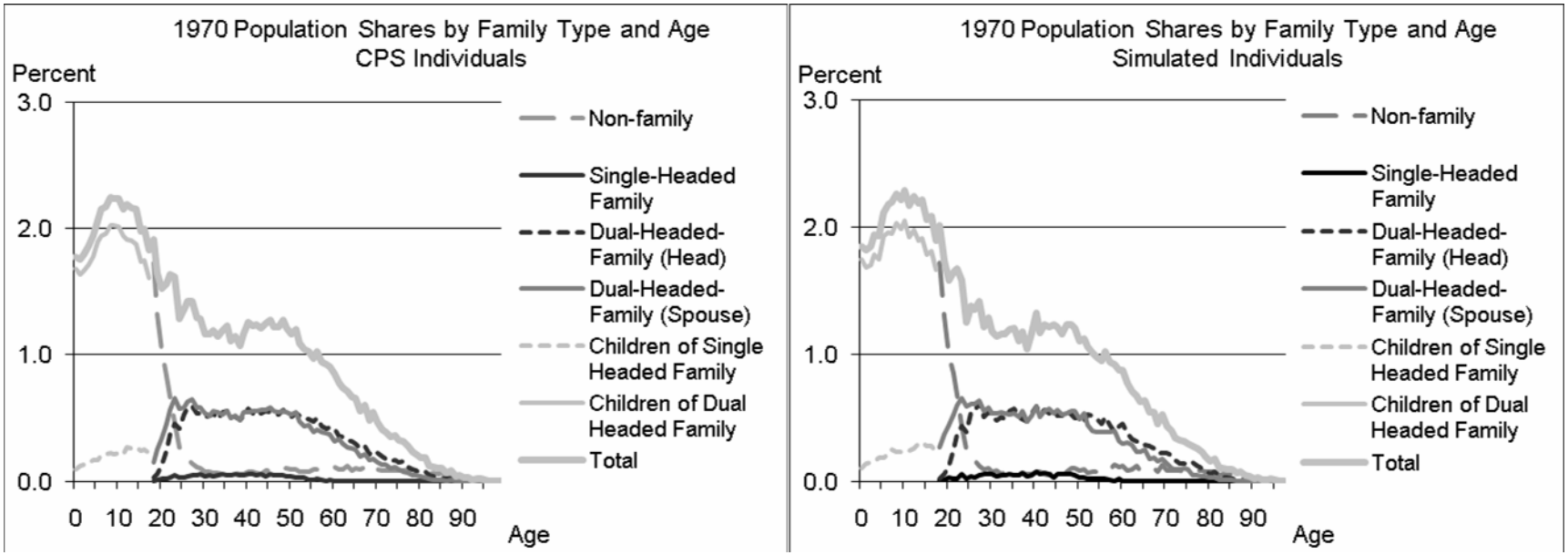
The most serious shortcoming in the trustees' methodology is the independent derivation of "assumptions" prior to combining them to derive outcomes. That means the assumptions on key variables—both demographic and economic, such as fertility, mortality, labor productivity, interest rates, and so on—are based almost exclusively on historical data and not conditioned on projected demographic outcomes. That introduces a significant potential for the trustees' prior assumptions to be incongruous with features of the future population and economy, and a high likelihood of making large errors in assessing Social Security's future financial trajectory under a given set of tax and benefit policies—whether the current ones or those specified under a particular reform proposal. A simple example is the assumption by the trustees' of constant labor productivity growth over 75 years into the future (after a short initial adjustment period between observed rates and their "ultimate assumption")—which is obviously divorced from the likely evolution of the population's future attributes—especially those closely associated with faster or slower labor productivity growth. Newer techniques involving microsimulation methods organized under an economic growth model framework allow for a more coherent specification and development of assumptions and outcomes. Such methods, far from being a "black box," can help illuminate key aspects of demographic and

economic projections that carry forward the momentum of demographic and economic forces built into the current population and economy.

Implementation of an independent microsimulation—DEMSIM—to capture and project U.S. demographic and economic forces into the future reveals several interesting features. In particular, it shows that most individual attributes such as education, marital status, labor-force attachments, education, and so on, are on balance, likely to reduce future labor quality. Thus, although future technological improvements and increases in capital per worker will increase labor productivity, a decline in labor quality is likely to impose a significant drag on future labor productivity growth. DEMSIM's simulations also show that although earning inequality will increase secularly in the long-term, it may increase slowly, and perhaps even decline initially as the baby boomers transition from their years of highest life-cycle productivity into retirement. This could increase the share of Social Security's taxable-to-total earnings ratio and would accelerate the trajectory of Social Security benefit expenditures relative to its tax receipts during the next few years.

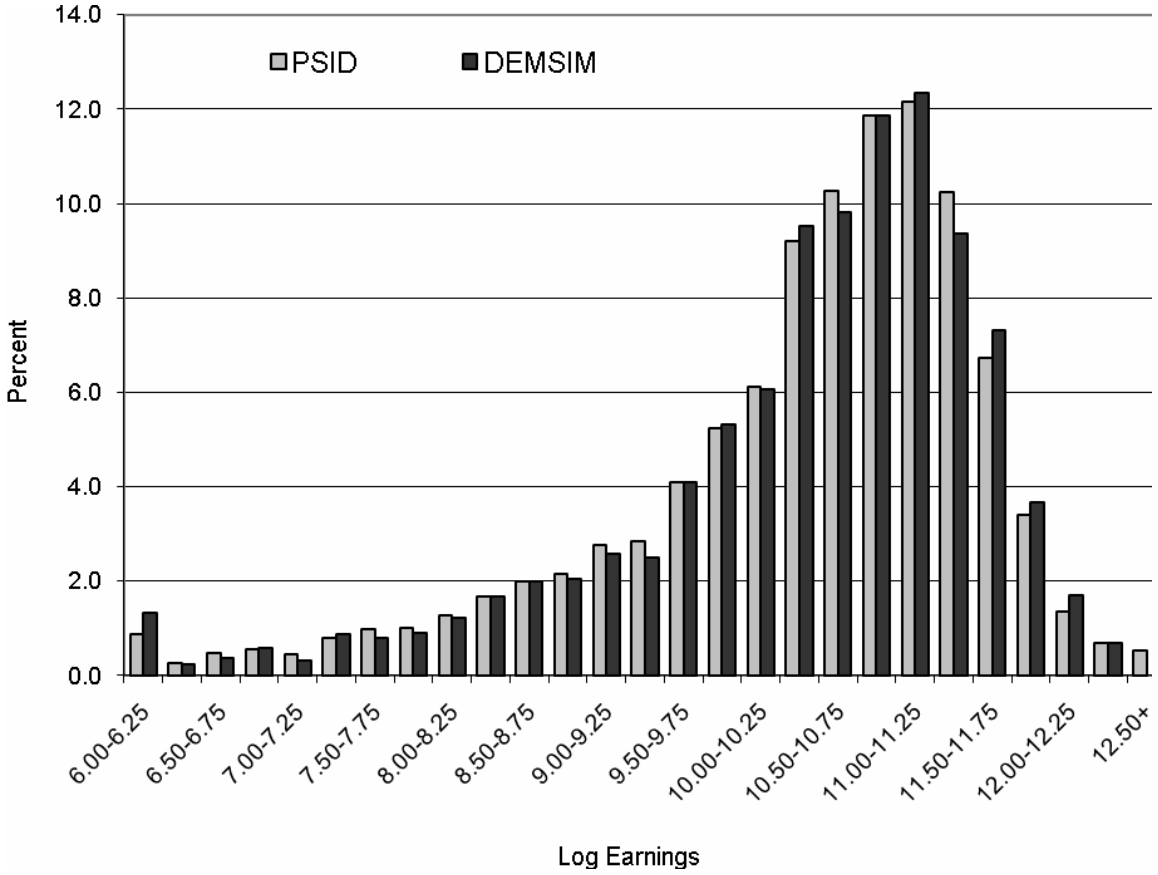
As described in this paper, using DEMSIM to evaluate selected Social Security reforms from across the political spectrum—liberal, centrist, and conservative—reveals significant differences in their impact on the program's 75-year solvency and long-term sustainability. The plans that are evaluated using DEMSIM also differ in the extent to which they impose adjustment costs on living generations as opposed to future ones, the amount by which they increase lifetime net tax rates on various cohorts by birth, and the amount of retirement wealth and security that they would provide compared the program's current rules. Such a side-by-side comparison of Social Security reform options, using appropriate macro- and micrometrics should be the preserve of the program's trustees and actuaries but, for some unfathomable reason, it is not.

Figure 1: Comparison of 1970 U.S. Population Size and Structure: Current Population Surveys and DEMSIM



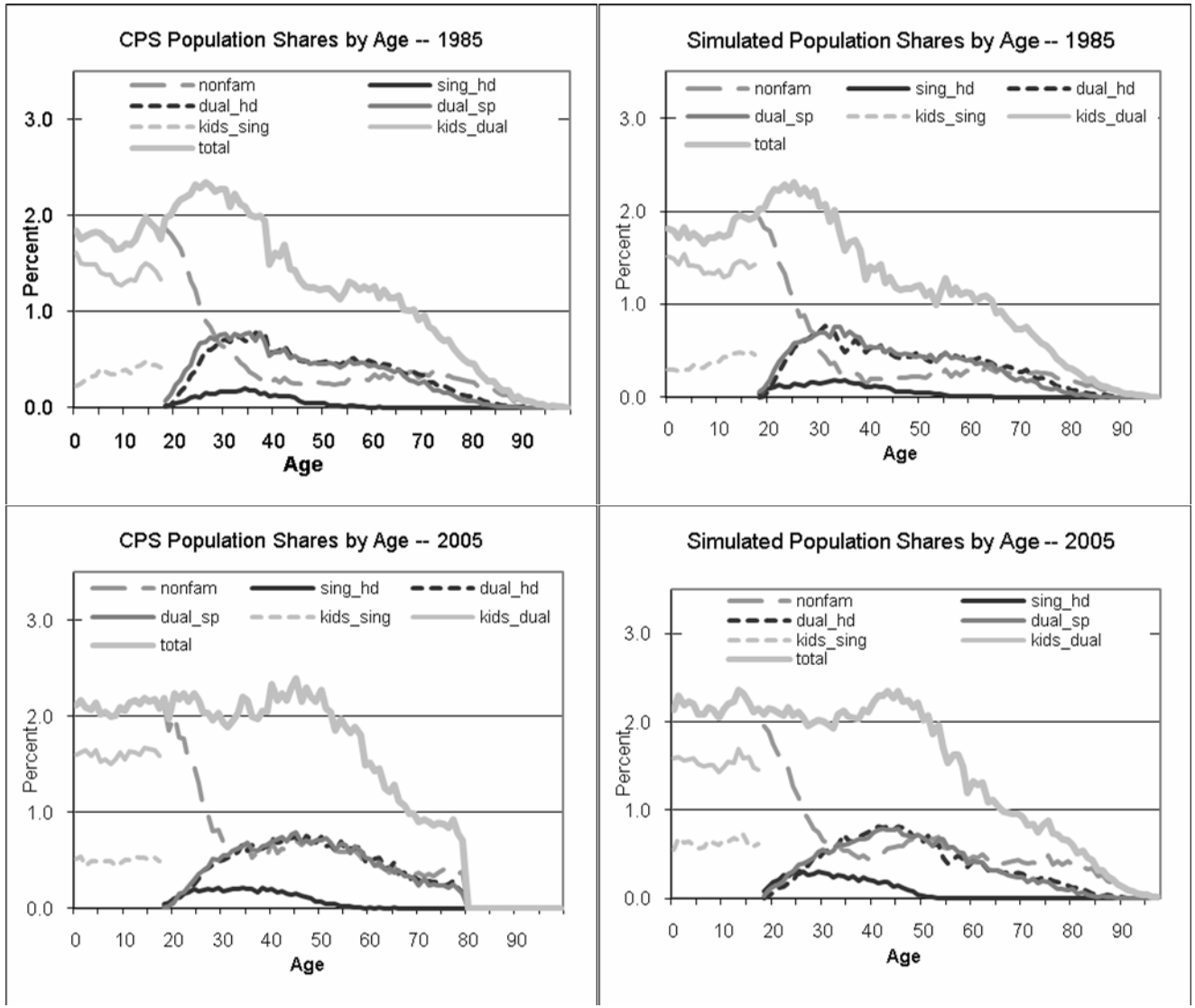
Source: Jagadesh Gokhale, *Social Security: A Fresh Look at Policy Alternatives* (Chicago: University of Chicago Press, 2010).

Figure 2: PSID and DEMSIM Log Labor Earnings Distributions (1970)



Source: Gokhale, 2010.

Figure 3: Comparison of CPS and DEMSIM Population Sizes and Structures in 1985 and 2005

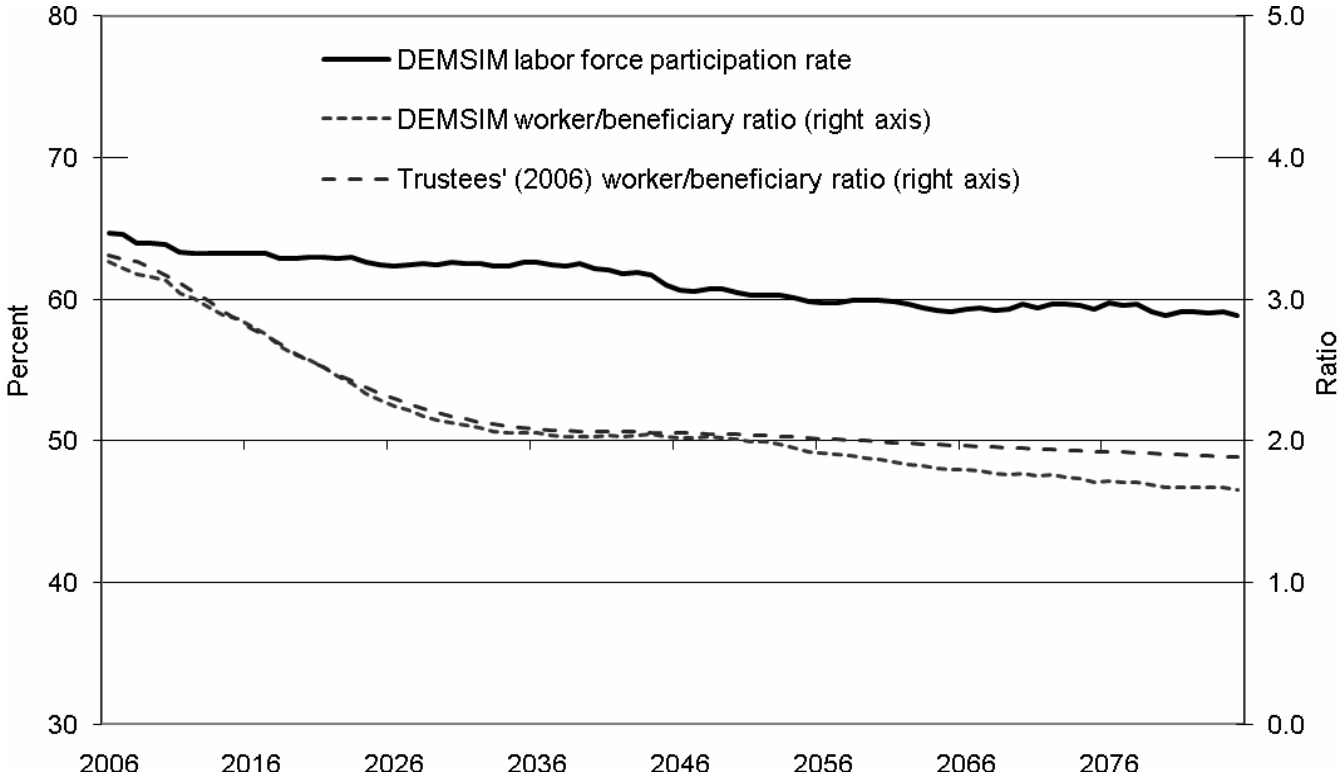


Source: Gokhale (2010).

Figure 4: DEMSIM's Forward Simulation of Population Size and Structure, Selected Years.

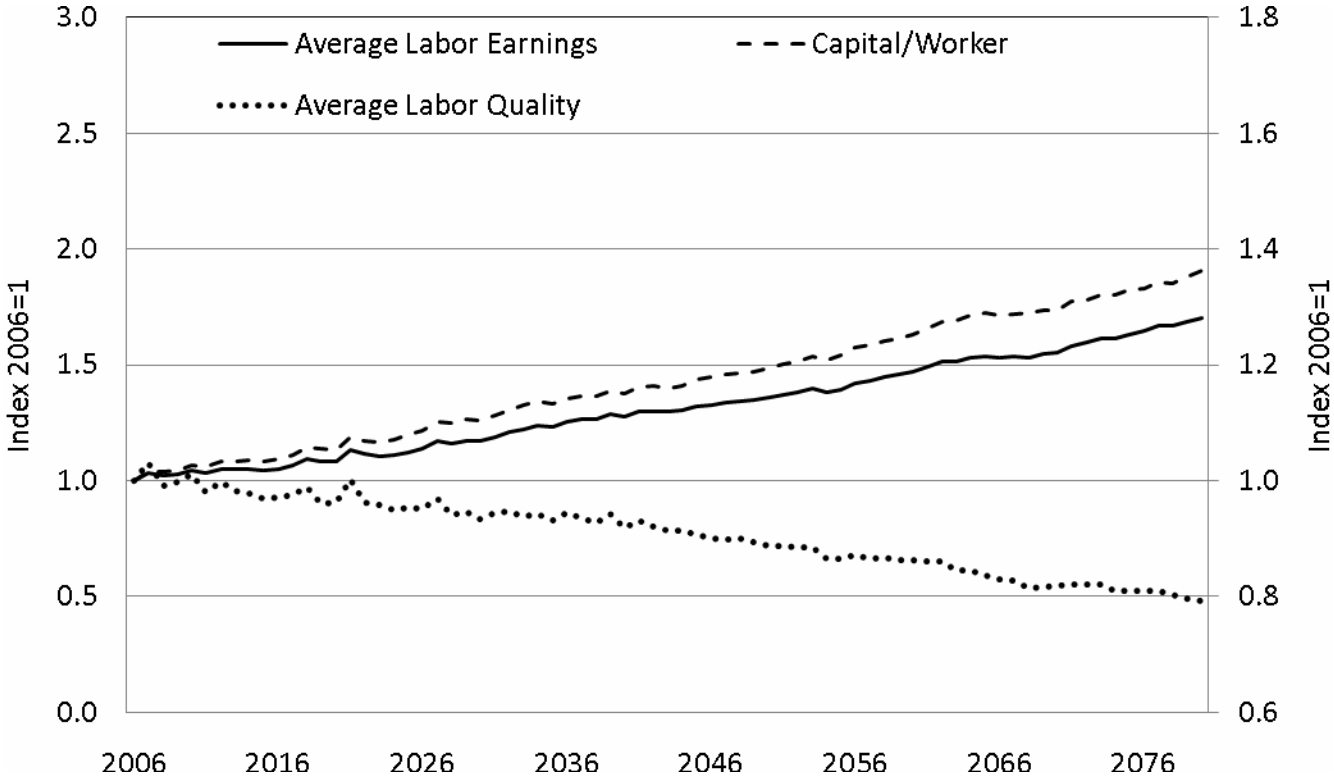
Source: Gokhale (2010).

Figure 5: DEMSIM's Labor Force Participation Rate and the Worker/Beneficiary Ratio Projections: 2006–80; Comparison with Social Security Trustees' Worker/Beneficiary Ratio Projections



Source: Gokhale (2010).

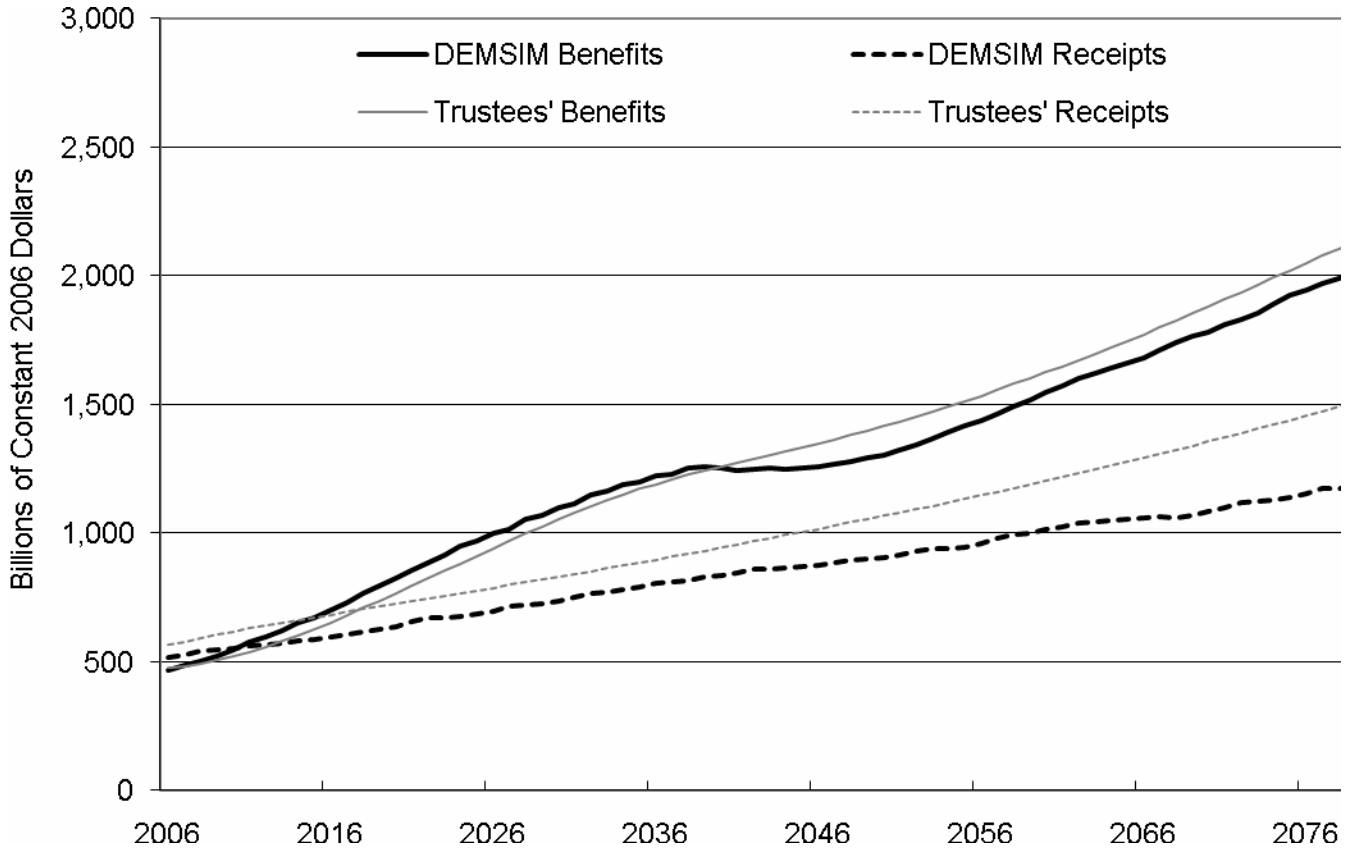
Figure 6: DEMSIM's Projections of Capital per Worker, Average Labor Earnings, and Average Labor Quality



Source: Gokhale (2010).

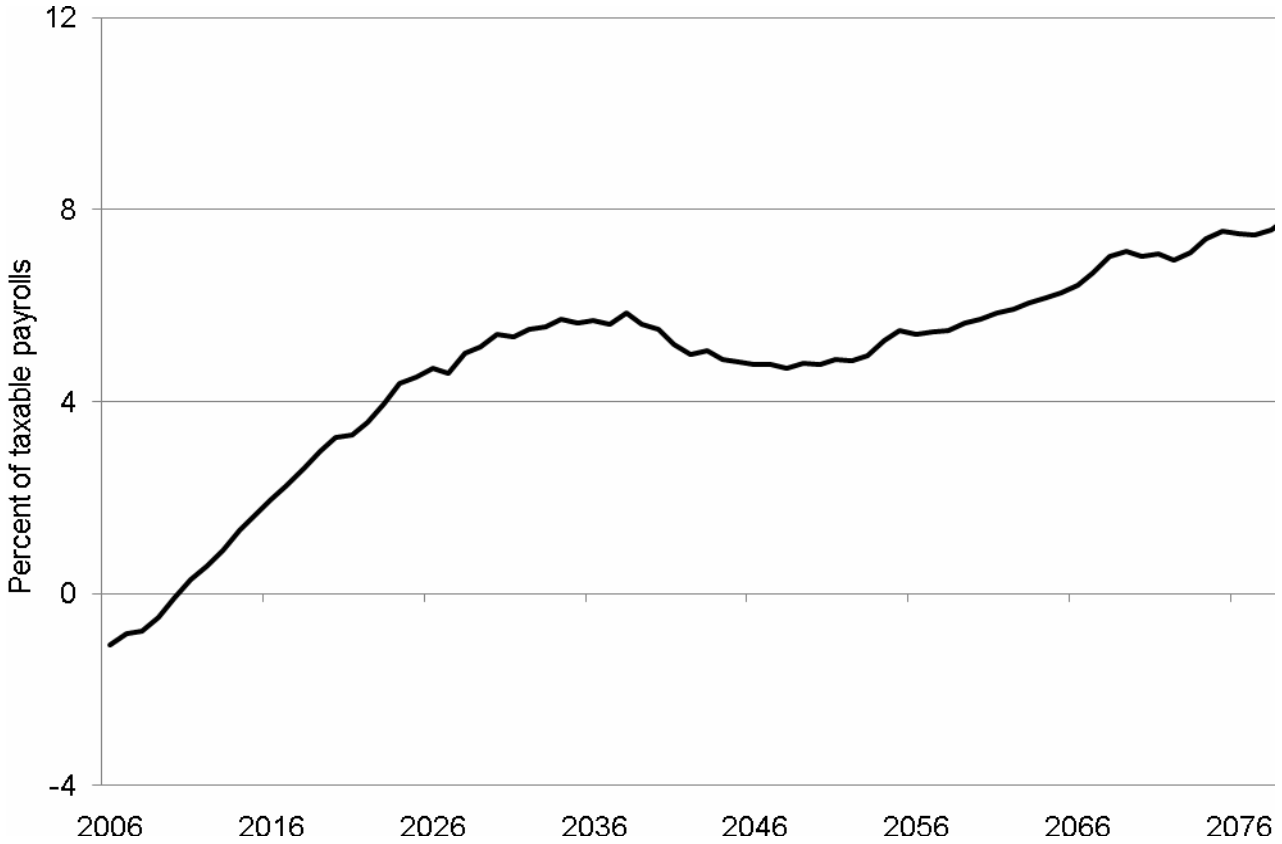
Figure 7: Comparison of Social Security Tax Receipts and Benefit Expenditures:

DEMSIM Baseline and Trustees' (2006) Intermediate Projections



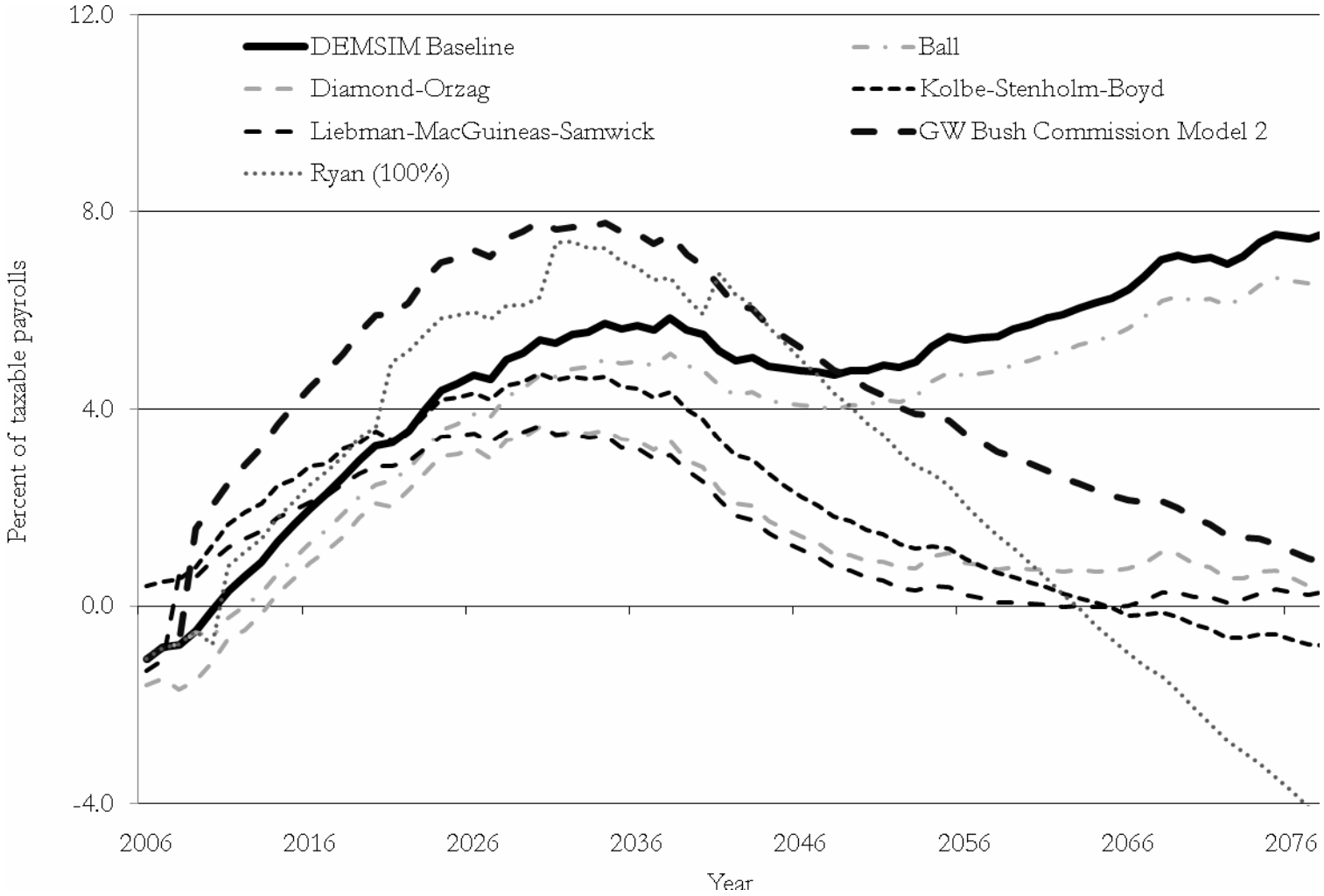
Source: Gokhale (2010).

Figure 8: Social Security's Annual Cash Flow Imbalances under DEMSIM's Baseline Projections



Source: Gokhale (2010).

Figure 9: Annual Imbalance Ratios: DEMSIM Baseline and Alternative Reform Proposals



Source: Gokhale (2010).

Table 1: DEMSIM's Optimistic, Baseline, and Pessimistic Projections of Social Security's (OASI) Financial Condition 2006–80

		Optimistic	Baseline	Pessimistic
Long Term Discount Rate Assumption (percent)		3.6	2.9	2.1
		Billions of Constant 2006 dollars Present Values Over 75 Years		
1	OASI Projected Benefits	27,795	31,231	36,338
2	OASI Projected Tax Receipts	25,454	22,836	21,372
3	OASI Total Projected Imbalance (1–2)	2,341	8,395	14,966
4	Current OASI Trust Fund	1,663	1,663	1,663
5	Present Value of OASI Trust Fund in 2080	290	253	375
6	Open Group Liability (OGL; 3–4+5)	968	6,985	13,678
7	Total Future Payrolls	232,434	208,495	195,096
		Percent		
8	OGL / Payrolls ([6/7]×100)	0.42	3.35	7.01
9	OGL/ Tax Receipts ([6/1]×100)	3.80	30.59	64.00
10	OGL / Benefits ([6/2]×100)	3.48	22.37	37.64

Source: Gokhale (2010) and author's calculations.

Table 2: DEMSIM's Optimistic, Baseline, and Pessimistic Projections of Social Security's (OASI) Financial Condition through Perpetuity

		Optimistic	Baseline	Pessimistic
Long Term Discount Rate Assumption (percent)		3.6	2.9	2.1
		Billions of Constant 2006 dollars Present Values Over 75 Years		
1	OASI Projected Benefits	50,691	45,805	48,840
2	OASI Projected Tax Receipts	41,463	30,778	26,605
3	OASI Total Projected Imbalance (1–2)	9,228	15,027	22,235
4	Current OASI Trust Fund	1,663	1,663	1,663
6	Open Group Liability (OGL; 3–4+5)	7,565	13,364	20,572
7	Total Future Payrolls	378,682	281,064	242,943
8	Closed Group Liability	9,540	14,172	20,179
		Percent		
9	OGL / Payrolls ([6/7]×100)	2.00	4.75	8.47
10	OGL/ Tax Receipts ([6/1]×100)	18.25	43.42	77.32
11	OGL / Benefits ([6/2]×100)	14.92	29.18	42.12

Source: Gokhale (2010) and author's calculations.

Table 3: Lifetime Net Tax Rate and Retirement Wealth under Scheduled and Payable Benefits by 15-Year Birth Cohorts

15-Year Cohort Birth Years	Lifetime Net Tax Rate	Lifetime Scheduled Benefit Rate	Lifetime Payable Benefit Rate
1946–1960	5.08	4.08	3.81
1961–1975	6.10	3.93	2.87
1976–1990	6.11	3.85	2.48
1991–2005	6.14	3.77	2.24
2006–2020	6.06	3.81	2.10
2021–2035	5.93	3.86	2.07
2036–2050	5.78	3.92	2.11

Source: Gokhale (2010).

Table 4: Aggregate Effects of Alternative Social Security Reform Proposals on Program Solvency

			75-year Open Group Imbalance	Infinite Horizon Open Group Imbalance	Closed Group Imbalance	Change in ∞-Horizon Open Group Imbalance from Baseline	Change in 75-year Open Group Imbalance as a Percent of Baseline ∞-Horizon Imbalance	Change in Closed Group Imbalance as a Percent of Baseline ∞-Horizon Imbalance
			Billions of constant 2006 dollars*			Percent		
			1	2	3	4	5	6
	DEMSIM Baseline		6,985	13,364	14,172	..	..	..
1	Present Value of Payrolls		208,495	281,064	145,572	..	..	..
	DEMSIM Baseline As a Percent of the Present Value of Payrolls		3.4	4.8	9.7	..	..	..
2	Liberal	Ball	5,832	11415	14,046	−14.6	−8.7	−0.9
3		D-O	1,386	1,610	10,889	−88.0	−41.9	−24.6
4	Centrist	KSB	3,369	1,841	10,498	−86.2	−27.1	−27.5
5		LMS	2,120	2,446	9,364	−81.7	−36.4	−36.0
6	Conservative	Model 2	7,851	5,247	12,233	−60.7	6.5	−14.5
7		Ryan	4,661	-983	9,152	−107.4	−17.4	−37.6

* Except when indicated in row heading.

Source: Gokhale (2010).

Table 5: Financial Effects of Implementing Social Security Reforms by 15-Year Birth Cohorts

Birth Cohort	DEMSIM Baseline	D-O	KSB	LMS	Model 2	Ryan
Panel 1	Lifetime net tax rate (%)					
1946-1960	5.1	5.1	5.2	5.5	5.0	5.2
1961-1975	6.1	6.5	5.9	6.6	5.9	6.6
1976-1990	6.1	7.0	5.6	6.6	5.3	7.0
1991-2005	6.1	7.8	5.7	6.5	4.8	6.8
2006-2020	6.1	8.7	5.8	6.5	4.7	6.5
2021-2035	5.9	9.5	5.8	6.4	4.8	6.5
2036-2050	5.8	10.1	5.8	6.4	5.0	6.8
Panel 2	Total Social Security (payable+IA) wealth as a share of lifetime earnings (%)*					
1946-1960	3.4	4.0	3.1	3.3	2.6	3.0
1961-1975	2.7	3.4	3.0	3.2	2.4	2.3
1976-1990	2.6	3.3	3.3	3.8	2.9	2.7
1991-2005	2.3	3.2	3.2	3.8	3.3	2.9
2006-2020	2.2	3.1	3.1	3.7	3.4	2.9
2021-2035	2.1	3.1	3.1	3.7	3.3	3.0
2036-2050	2.1	3.2	3.1	3.7	3.1	3.1
Panel 3	Share of traditional benefits in Social Security wealth (%)*					
1946-1960	100.0	100.0	94.0	93.8	94.7	98.0
1961-1975	100.0	100.0	78.0	76.3	73.8	82.4
1976-1990	100.0	100.0	65.3	61.7	52.8	57.4
1991-2005	100.0	100.0	60.7	57.2	41.8	29.3
2006-2020	100.0	100.0	61.0	56.9	38.2	6.7
2021-2035	100.0	100.0	61.0	56.9	35.7	0.1
2036-2050	100.0	100.0	61.4	57.5	32.0	0.0
Panel 4	Total *payable* retirement wealth as a share of current law *scheduled* benefit (%)*					
1946-1960	82.7	96.4	73.6	80.9	61.2	98.3
1961-1975	68.3	86.3	74.5	82.9	59.3	91.9
1976-1990	66.0	85.2	83.9	97.3	75.4	81.7
1991-2005	60.7	83.5	81.4	100.0	85.6	76.8
2006-2020	56.9	81.2	80.0	97.0	87.8	76.2
2021-2035	54.8	79.6	78.3	94.3	84.8	77.3
2036-2050	54.7	80.4	77.9	93.8	78.7	78.2

* Percent as of each person's benefit collection year. Assumes 100 percent participation in personal accounts systems under KSB, LMS, Model 2, and Ryan reform proposals.

Source: Gokhale (2010).

Notes:

[1] In this paper, the term "Social Security" refers to the Old Age and Survivors Insurance (OASI) program.

[2] The heavy emphasis among policymakers, analysts, and voters—mainly older generations—on the program's *overall* financial condition derives from their concern about the program's ability to pay benefits as and when they come due. From an analytical perspective, however, because Social Security primarily transfers funds among various population groups—from the young to the old, from the well-off to the poor, from males to females, and on many other dimensions—it appears even more important to assess its distributional effects across clearly defined population groups.

[3] See http://www.ssa.gov/pressoffice/basicfact.htm. The 94 percent figure on this website was current as of May 17, 2011. Payroll taxes and benefits awarded to retirees, dependents, survivors, and others change participants' trade-offs with respect to key economic decisions—working versus not (especially for secondary earners within families), retiring early versus late, saving less versus saving more for retirement, and so on. Many studies, too numerous to cite here, suggest that such collective decisions substantially influence the course of the economy.

[4] See the documentation on the trustees' method at http://www.ssa.gov/OACT/TR/2011/documentation_2011.pdf.

[5] This is clear from the flowcharts (Charts 1 through 3) in the documentation describing the trustees' methods (see previous note).

[6] For race, this is obvious. For education, this would be true if educated females' offspring are also better educated. Empirical evidence does indicate that parents' and children's education levels (human capital) are positively correlated across successive generations.

[7] It is important to recognize that one cannot use an "equilibrium growth model" for making projections of Social Security's finances. The objective is to measure the program's financial imbalance under continuation of the current policies (or laws), but such models cannot be operated without explicitly specifying a policy to close that very imbalance. However, a growth-model framework can guide the integration of various economic and demographic assumptions to derive implications for key elements in the future—especially the impact of the population's evolving demographic and economic attributes for labor productivity growth.

[8] See the documentation provided by the Social Security Administration on the projection method used by the Trustees (footnote 3) at http://www.ssa.gov/OACT/TR/2011/documentation_2011.pdf.

[9] The criticism against using perpetuity measures is that there is considerable uncertainty attached to estimation beyond the standard (already quite long) 75-year time horizon. However, the reaction to the existence of long-term uncertainty should not be to ignore it by arbitrarily truncating the projection horizon. For a full discussion of the desirability of calculations in perpetuity, see

Jagadeesh Gokhale and Kent Smetters, "Fiscal and Generational Imbalances: New Budget Measures for New Budget Priorities" (Washington: AEI Press, 2003). See also Andrew Biggs and Jagadeesh Gokhale, "Wage Growth and the Measurement of Social Security's Financial Condition," in *Government Spending on the Elderly*, ed. Dimitri B. Papadimitriou (New York: Palgrave Macmillan, 2007).

[10] To increase fidelity, CPS data from 1968–72 are used to calibrate the 1970 U.S. population characteristics.

[11] There were about 200 million people in the United States in 1970, so DEMSIM's simulated sample contains 1 individual for every 5,100 people alive in 1970.

[12] The CPS's rotating sampling procedure maintains a respondent in the sample for at most two years.

[13] The simulation method for earnings generates the same degree of cross-section earnings volatility as contained in the 1970 PSID survey data on earnings.

[14] Both the 1970 PSID and the 1970 CPS samples are drawn from the same United States population, and the population weights provided in each survey make each sample representative of the U.S. population. This is probably why PSID and DEMSIM log earnings distributions (the latter derived by applying PSID regression coefficients to DEMSIM simulated individual attributes) are so similar.

[15] In the CPS microsurvey data for 2005, the age variable is truncated at 80.

[16] The change in the U.S. population's size is displayed in an unconventional way: Because population shares are calculated relative to the total 1970 population, the areas under the total population lines increase for years after 1970 (compare the 1970 chart in Figure 1 with those in Figures 3 and 4). The DEMSIM population in 2005 is 148 percent that of the 1970 population. The corresponding trustees' estimate, reported in the 2006 annual report under intermediate assumptions, is 141 percent and the Census Bureau's estimate is 147 percent.

[17] Note that CPS microdata sample for 2005 is truncated at age 80.

[18] See Jagadesh Gokhale, *Social Security: A Fresh Look at Policy Alternatives* (Chicago: University of Chicago Press, 2010).

[19] Future rates of change for fertility, mortality, and immigration are consistent with those specified in their 2006 annual report. That report assumed constant counts of total (legal plus illegal) immigrants in future years.

[20] During a meeting of the Social Security Advisory Board that was convened to release the 2011 TPAM report (held in Washington, D.C., on September 13, 2011), the Panel's response to a query about the absence in their report of significant evaluations or recommendations on the trustees' methods was puzzling. The panel seemed to suggest, in effect, that the trustees are so far from developing and using a coherent methodology—for instance, one that uses an equilibrium growth

model for developing assumptions about future interest rate assumptions—that the panel saw no point in making methodological recommendations. The puzzle is that a large perceived gap between desired and actual methodologies used by the trustees served as a *disincentive* for the panel to evaluate and recommend methodological changes.

[21] Figure 5 shows DEMSIM's projection of labor-force participation rates. The trustees' projections were not available to the author at the time of implementing the project.

[22] The parameters of the production function are calculated from historical time series provided by Dale W. Jorgenson, Mun S. Ho, and Kevin J. Stiroh, "A Retrospective Look at U.S. Productivity Growth Resurgence," at http://www.newyorkfed.org/research/staff_reports/sr277.pdf.

[23] The Survey of Consumer Finances' (2007) microdata are used to calibrate asset holdings by age and gender in 2006. The capital stock in each future year is based on growing per-person asset holdings by age and gender at the prior year's simulated rate of labor productivity growth and aggregating over the current year's population by age and gender.

[24] The earnings regression uses PSID panel data on individual attributes and earnings between 1968 and 1993. To place earnings from different years on par with each other, PSID reported wage earnings are adjusted by subtracting the effect of (historically known or independently estimated) technological change, capital inputs, and price inflation. For details, see Gokhale (2010), chapter 5.

[25] See Gokhale (2010) for details.

[26] Social Security benefits are calculated by applying a Social Security benefit calculator (SSTBC) to the lifetime wage histories of simulated individuals. The benefit calculator is developed independently by following in detail the rules described in the Social Security Handbook. The results of the calculations are compared to Social Security's official benefit calculator to ensure an accurate match. This validation exercise is performed across hundreds of stylized cases with widely divergent attributes on age, race, gender, birth-cohort and earnings levels. SSTBC's benefit calculations are found to be within 1 percent of those of the official calculator. SSTBC calculates retirement, survivor, spousal, divorcee, and child benefits as appropriate under various eligibility configurations applicable to individuals who are members of families with widely varying structures.

[27] DEMSIM's projection of Social Security's tax receipts includes revenues from the income taxation of Social Security benefits.

[28] Social Security's 75-year OGL equals the present value of projected OASI benefits minus the present value of projected OASI taxes (the "future imbalance"), plus the terminal year's target value of the trust fund (equal to one year's benefit expenditures), and minus the value of the current OASI trust fund. The infinite-horizon estimates are made by continuing projections for a sufficient number of years in the future until present values converge to within an acceptable degree of accuracy. For these estimates, the term involving the terminal year's trust-fund value is zero by construction.

[29] Table 1 also shows estimates based on optimistic and pessimistic assumptions. The assumptions varied include rates of change in future mortality, fertility, immigration, price inflation, labor productivity, labor-force participation, education acquisition, and discount factors. See Gokhale (2010) for a detailed explanation.

[30] Social Security's 75-year actuarial deficit has increased from zero in 1983 to 2.22 percent of payrolls today—as reported in the Trustees 2011 annual report. Of this, 1.67 percentage points is attributed to the inclusion more "deficit" years into the 75-year budget window and the remainder to changes in assumptions and other technical changes after 1983. However, this past "good performance" of the trustees' actuarial methods resulted under relative demographic stability since 1983. It does not invalidate the critique that the trustees' method, which does not condition financial estimates on the projected characteristics of the future population, is likely to undergo much more significant changes than in the past.

[31] Note that convergence of present values is guaranteed when the discount rate exceeds the growth rate of the variable being considered (annual benefits or tax receipts). Social Security (OASI) benefits grow with the size of the retiree population, increases in longevity, and growth in real benefits per beneficiary. Social Security tax receipts grow at the rate of worker population growth plus labor productivity per worker. Both growth rates are projected to be less than the 2.9 percent discount rate applied to future inflation-adjusted dollar flows.

[32] A competing metric of "sustainable solvency" proposed by some analysts—whereby the system's unfunded obligation must be smaller than a predetermined threshold and the Trust Fund must be increasing toward the end of the 75-year horizon—could also be misleading. See Jagadeesh Gokhale and Kent Smetters, "Measuring Social Security's Financial Outlook within an Aging Society," *Dædalus* (Winter, 2006): 91-104.

[33] Jagadeesh Gokhale and Kent Smetters, *Fiscal and Generational Imbalances: New Budget Measures for New Budget Priorities* (Washington: AEI Press, 2003).

[34] An important issue concerns the discount rate to be used to compute Social Security lifetime net tax rates. Under the reasonable view that the alternative allocation of payroll tax dollars for participants would be to (optimally) consume or invest them in private assets of moderate riskiness -- a basket of bonds and stocks -- a 5.0 percent inflation adjusted annual discount rate is used. This rate is intermediate to the long-term inflation adjusted annual return on risky stocks (7.0 percent) and the annual return on "riskless" U.S. Treasury bonds of 3.0 percent. Since Social Security's yearly internal rate of return is about 1.0 percent on payroll taxes for today's young workers, a discount rate larger than 1.0 percent applied to OASI taxes and benefits makes the present value of taxes (that occur earlier in the lifetime) larger than the present value of benefits. This implies a *positive* lifetime net tax rate for those generations notwithstanding the fact that the Social Security internal rate of return is also *positive* for them under the program's current rules. It bears emphasizing, however, that the point of the exercise is to compare outcomes under current program rules and under alternative reforms using the selected metric. Whether the metric selected is the internal rate of return or the lifetime net tax rate, a comparative assessment of the fiscal treatment of different population groups --by birth-year, age, gender, race, and so on -- under current Social Security laws and under alternative reforms would be quantitatively and qualitatively unchanged.

[35] Gokhale (2010) contains more detailed information on both micrometrics distinguished additionally by gender, race, and lifetime-earnings levels.

[36] Since the 1980s, many academic studies have documented the program's negative effects on national saving and work effort. National saving is reduced because the program transfers resources from young and future resources toward retirees who consume a larger share of resources available to them. See Jagadeesh Gokhale, Laurence J. Kotlikoff, and John Sabelhaus, "Understanding the Decline in National Saving: A Cohort Analysis," Brookings Papers on Economic Activity (Winter, 1996): 315-407. In addition, the program's negative effects on work effort, especially through earlier retirement, is documented in Sheldon Danziger, Robert H. Haveman, and Robert Plotnick, "How Income Transfer Programs Affect Work, Savings and Income Distribution: A Critical Review," *Journal of Economic Literature* 19, (September 1981): 975–1014. See also *Social Security Programs and Retirement around the World: Fiscal Implications of Reform* eds. Jonathan Gruber and David A. Wise (Chicago: University of Chicago Press, 2007).

[37] The Office of the Chief Actuary website provides official scores for Social Security reforms at http://www.ssa.gov/OACT/solvency/index.html.

[38] The 2007 Technical Panel on Assumptions and Methods made strong recommendations for updating the Social Security trustees' methods, especially by adopting a primarily microsimulation approach, but the actuaries' progress has been extremely slow in this regard.

[39] For details, see Gokhale (2010).

[40] Note that the denominator is the infinite-horizon imbalance, not the closed-group imbalance as in Gokhale (2010).

[41] The same explanation applies to the 75-year open-group and the closed-group imbalances under the G. W. Bush Commission's Model 2 proposal.

[42] The retirement wealth-to-lifetime-earnings ratios shown in Table 5 are averages for the birth cohorts defined in the first column of the table.