# The Legacy Debt Associated with Past Social Security Transfers

by Dean R. Leimer*

*A number of studies have used estimates of historical and projected lifetime net transfers (benefits less taxes) by birth cohort under the Old-Age and Survivors Insurance program to calculate and compare the aggregate present-value sum of such transfers for selected birth-cohort groups. Those calculations indicate that, from a program accounting perspective, the earliest generations of program participants received large transfers from later generations of participants. Some recent studies have referred to this cumulative transfer to the earliest generations as a "legacy debt" and characterized it as a burden borne by the later generations. This article clarifies the legacy debt concept and discusses the conditions required for a legacy debt to exist in a meaningful economic sense.*

## Introduction

A number of studies have used estimates of historical and projected lifetime net transfers (benefits less taxes accumulated or discounted using market-based interest rates) by birth cohort under the Old-Age and Survivors Insurance (OASI) program to calculate and compare the aggregate present-value sum of those transfers for selected birth-cohort groups. Using historical and projected OASI Trust Fund interest rates, such calculations confirm that, from a program accounting perspective, the earliest generations of program participants received positive lifetime net transfers, while later generations are projected to experience negative lifetime net transfers. Some recent studies have referred to the cumulative net transfer to the earliest cohorts as a "legacy debt" and characterized it as a burden borne by later program participants. Based on that perspective, some of those studies have suggested that a portion of the legacy debt be repaid to distribute the burden more fairly across cohorts. This article clarifies various aspects of the legacy debt concept, in particular by distinguishing between "actuarial" and "real" legacy debt concepts and by identifying the conditions required for a real legacy debt to exist in a meaningful economic sense.

The next section of the article discusses the actuarial legacy debt concept and provides some estimates of its size. The subsequent two sections discuss the extent to which those actuarial estimates are meaningful indicators of any real legacy debt associated with past program transfers, either in terms of any effect of the program on private saving or in terms of the relationship between rates of return under the program and market interest rates for present and future program participants. The final section summarizes the discussion.

**Selected Abbreviations**

| | |
|---|---|
| OASDI | Old-Age, Survivors, and Disability Insurance |
| OASI | Old-Age and Survivors Insurance |
| OCACT | Office of the Chief Actuary |
| PAYGO | pay-as-you-go |

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## Actuarial Measures of the OASI Legacy Debt

The notion that OASI has created a legacy debt arises because the program historically has been financed primarily on a pay-as-you-go (PAYGO) basis rather than a fully funded basis. In a fully funded program, payroll taxes paid by workers are invested in government securities or other market assets and accumulated to fund the benefits that those workers and their eligible dependents receive when they retire or become other types of beneficiaries—each birth cohort or generation of workers effectively pays for its own benefits through the accumulation of those prior investments. In OASI, by contrast, payroll taxes paid by current workers have been used largely to finance the benefits of current beneficiaries. In particular, OASI taxes collected during the early years of the program were used to finance benefits to earlier-born beneficiaries who had not paid program taxes over their entire working lives. The OASI PAYGO approach allowed relatively generous benefit payments to those earlier-born beneficiaries.[1] Diamond and Orszag (2004, 69–70) argue that these relatively generous benefits were "a humane response to the suffering imposed by World War I, the Great Depression, and World War II on Americans who came of age during those years, and it helped to reduce unacceptably high rates of poverty among them in old age" and "not only helped the recipients themselves but also relieved part of the burden on their families and friends, and on the taxpayers of that era, who would otherwise have contributed more to their support." Although they received relatively generous Social Security benefits, many of these early beneficiaries bore the burden of supporting aged parents, a burden that the program substantially lessened for later generations. In addition, the burden of supporting aged parents fell unevenly across workers in those earliest generations, while later generations benefited from the program's provision of collective insurance against many such risks faced by individuals and families.[2]

Regardless of the motivation behind or the social merits of those generous early benefits, the PAYGO financing approach had the potential to create what has been called the legacy debt, a measure of the relative generosity of the Social Security program to the earliest participant cohorts.[3] An actuarial estimate of the OASI legacy debt as of a given valuation date for a specific group of the earliest cohorts affected by the program is typically calculated as the present-value sum of aggregate accumulated historical and discounted projected lifetime net transfers (benefits less taxes) under the program for all birth cohorts in that group. The historical or projected net transfers are usually accumulated or discounted to the valuation date using the OASI Trust Fund interest rate. The present-value sum of the lifetime net transfers across all cohorts in that cohort group represents an estimate of the cumulative effect of the net transfers to those cohorts on the size of the OASI Trust Fund as of the valuation date. The expected present-value sum of lifetime net transfers for those cohorts would have been zero had the program been fully funded from the start.[4]

In mathematical terms, an actuarial valuation of the legacy debt as of the end of year $T$ ($L_T$) might be expressed as

$$L_T = \sum_{c=x}^{y} \sum_{a=0}^{M} N_{c,a} \left( \frac{f_T}{f_{c+a}} \right)$$

$$\text{with} \quad f_i = \prod_{t=1937}^{i} (1 + r_t),$$

where $c$ is the birth year of an included cohort, $x$ is the birth year of the earliest cohort affected by the program, $y$ is the birth year of the last cohort included in the legacy debt valuation, $a$ is a given age from birth (0) through the maximum attainable age ($M$), $N_{c,a}$ is aggregate OASI net transfers across all members of cohort $c$ at age $a$, $r_t$ is the OASI Trust Fund interest rate in year $t$, and $f_i$ is the accumulated OASI Trust Fund interest rate factor from the program's first year (1937) through year $i$. For simplicity, all net transfers are assumed to occur at year-end.

Historical program data on annual net transfers by cohort can be used for part of the actuarial legacy debt calculation, but annual net transfers by cohort beyond the historical period are typically based on projections consistent with a recent *Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and the Federal Disability Insurance Trust Funds* (hereafter, the *Trustees Report*). The *Trustees Report* presents an official actuarial projection of the financial status of the Social Security program based on annually updated economic, demographic, and program assumptions. When the current *Trustees Report* projects the OASI Trust Fund to be out of long-run financial balance, projected outcomes by cohort under alternative policies designed to restore the program's projected long-run financial balance[5] could also be used in actuarial legacy debt estimates—the estimates would then be conditional on the adoption of those particular policies, to the extent that they affect

the cohorts included in the estimates. Most typically, however, actuarial legacy debt estimates in the literature have included only those cohorts unlikely to be significantly affected by such future program changes.

Diamond (2004) provides a rough estimate of $11.5 trillion for the 2002 present value of the actuarial legacy debt. That estimate represents the accumulated and projected present-value sum of lifetime OASI net transfers for all cohorts born through 1949 (attaining age 55 in 2004) based on the assumption that those cohorts are unlikely to experience significant effects from future legislation to bring the program into long-run financial balance. Diamond derives this legacy debt valuation from estimates developed in Leimer (1994) of aggregate lifetime OASI net transfers under present law for individual birth cohorts, evaluated as of 1989 using the OASI Trust Fund effective interest rate.[6] Using the more recent estimates in Leimer (2007) of aggregate lifetime OASI net transfers under present law for the same birth cohorts produces an actuarial legacy debt estimate of about $11.2 trillion when evaluated as of year-end 2001.[7] The top panel of Table 1 shows that this year-end 2001 legacy debt valuation equals about 5.7 percent of the present value of future Old-Age, Survivors, and Disability Insurance (OASDI) taxable payroll[8] projected by the Social Security Administration's Office of the Chief Actuary (OCACT) over the *Trustees Report* 75-year projection period as of that valuation date.[9] The $11.2 trillion year-end 2001 present value, accumulated to year-end 2014 using the OASI Trust Fund effective interest rates between 2001 and 2014,[10] implies an actuarial legacy debt present value as of year-end 2014 of about $20.9 trillion for cohorts born through 1949. This year-end 2014 valuation represents about 5.0 percent of the corresponding present value of future OASDI taxable payroll over the 75-year projection period and about 3.2 percent of future taxable payroll over the infinite projection period.

**Table 1.**
**OASI actuarial legacy debt estimates for two cohort groups and two year-end valuation dates**

| Date | Valuation (trillions of dollars) | Valuation as a percentage of the present value of future taxable payroll | |
|---|---|---|---|
| | | 75-year projection period | Infinite projection period |
| ***Cohorts born through 1949*** | | | |
| 2001 | 11.2 | 5.7 | -- |
| 2014 | 20.9 | 5.0 | 3.2 |
| ***Cohorts born through 1931*** | | | |
| 2001 | 13.0 | 6.7 | -- |
| 2014 | 24.4 | 5.8 | 3.7 |

SOURCE: Author's calculations based on Leimer (2007) estimates of OASI lifetime net transfers for individual birth-year cohorts.

NOTE: -- = not available.

The legacy debt has also been defined to include only the earliest birth cohorts that are projected to receive positive lifetime net transfers from the program when calculated using the trust fund interest rate.[11] That definition leads to a higher actuarial legacy debt estimate because the cohorts born after 1931 included in the Diamond (2004) measure are projected in Leimer (2007, Appendix Table A-1) to experience negative lifetime OASI net transfers when calculated using the OASI Trust Fund effective interest rate. The Leimer (2007) lifetime net transfer data suggest a year-end 2001 actuarial legacy debt valuation of about $13.0 trillion for the cohorts born through 1931, representing about 6.7 percent of the present value of future OASDI taxable payroll over the 75-year projection period as of the beginning of 2002 (bottom panel of Table 1). Accumulating that year-end 2001 legacy debt estimate forward to year-end 2014 using the OASI Trust Fund effective interest rates between those dates produces an estimate of about $24.4 trillion for those cohorts, or about 5.8 percent of the corresponding present value of future OASDI taxable payroll over the 75-year projection period and about 3.7 percent of future taxable payroll over the infinite projection period.

Conceptually, these actuarial legacy debt measures are related to a PAYGO program's closed group unfunded liability. That liability is typically defined as the aggregate present value of projected future program costs (including administrative expenses) less taxes over the remaining lifetimes of *all current* program participants (the closed group) as of a given valuation date, less the value of any trust fund associated with the program as of that date. As such, a closed group unfunded liability estimate represents the amount by which the program's trust fund would have to be increased to attain full funding for *current* program participants. Historical program costs and taxes are represented in the unfunded liability measure through their effect on the size of the program's trust fund as of the valuation date. OCACT publishes such estimates, referred to as the "closed group transition cost" or "unfunded obligation for past and current participants" (for example, Schultz and Nickerson 2015). However, the OCACT estimates

are for the combined OASDI program rather than for the OASI program alone, and those estimates include many more recent birth cohorts than are typically included in legacy debt measures. In addition, the actuarial legacy debt is generally defined as the cumulative lifetime net transfers to a fixed group of cohorts, so that the valuation of that debt will grow over time at a rate equal to the interest rate used in the valuations—usually, the OASI Trust Fund effective interest rate. By contrast, closed group unfunded liability measures for successive years reflect a cohort group (current program participants) that changes over time. One effect of this difference is that the growth rate over time in a PAYGO program's closed group unfunded liability is more closely related to the growth rate of the program's tax base than to the trust fund interest rate.[12] As such, the OCACT closed group unfunded obligation measure, while conceptually related, has important differences from the actuarial legacy debt measure.

When considering actuarial legacy debt measures in the context of program reform, it is important to remember that the legacy debt measure is generally defined as excluding any birth cohorts that are likely to be significantly affected by future policies enacted to bring the program into long-run financial balance. By that definition, then, restoring long-run financial balance will *not* significantly change the estimated actuarial legacy debt. Any further policy adjustments designed to repay a portion of the actuarial legacy debt under these assumptions (in effect, reducing the unfunded liability of the program beyond that required for long-run solvency) would place an *additional* burden on later generations. In other words, repaying a portion of such an actuarial legacy debt as an element of program reform, as some suggest, would require larger financing adjustments than are needed simply to restore long-run financial balance. Those larger financing adjustments would place an additional burden on the cohorts putatively harmed by the legacy debt creation and consequently require justification over and above restoring long-run financial balance. Stated more generally, the actuarial legacy debt is not an indicator of the long-run financial balance of the OASI program, despite the frequent linkage of the two in the literature.[13] Even if the program were projected at present to be in long-run financial balance, a legacy debt defined over some group of the earliest cohorts would still exist and could be carried forward indefinitely without affecting the program's long-run financial status.[14]

Studies focusing on the actuarial legacy debt concept have emphasized that the legacy debt can be viewed from two different perspectives *for a PAYGO program that is in long-run financial balance*. The first perspective considers the lifetime effects of the program on selected earlier program participant cohorts (where "selected" refers to the cutoff cohort used in the legacy debt calculation); this is the predominantly backward-looking cohort perspective defined and discussed above. The second perspective considers the lifetime effects of the program on the subsequent present and future program participant cohorts, a predominantly forward-looking cohort perspective. Some studies have illustrated the equivalence of these two perspectives using the example of a PAYGO retirement program that is in long-run financial balance with tax revenues and benefit expenditures that are temporally constant proportions of economic output in a simplified theoretical economy. In the simplified theoretical economy, (1) economic and demographic growth rates and the market interest rate are constant and known with certainty and (2) the market interest rate (generally interpreted as the rate of return to capital) exceeds the economic growth rate.[15] Because the market interest rate exceeds the growth rate in economic output (and the program's tax base), the present-value sum of *all* past and future net transfers (expenditures less taxes accumulated or discounted using the market interest rate) under the PAYGO program into the indefinite future is zero under these assumptions. As such, granting positive lifetime net transfers to the earliest cohorts necessarily results in negative lifetime net transfers to later cohorts.[16]

From the perspective of the later (present and future) cohorts participating in the OASI program, the actuarial legacy debt is sometimes characterized as the present-value cost of the below-market lifetime returns (negative lifetime net transfers) that they can expect to receive from the program under such assumptions (for example, Geanakoplos, Mitchell, and Zeldes 1999; Diamond and Orszag 2004, 2005). Alternatively, from the perspective of the program or economy as a whole, the OASI legacy debt is sometimes likened to the difference between the portion of the OASI Trust Fund attributable to the cohorts included in the legacy debt calculations and the (much larger) portion that would be attributable to those cohorts if the program had been fully funded from the start (for example, Diamond 2004; Diamond and Orszag 2004, 2005).

Although illustrating a PAYGO program's potential for the relatively generous treatment of early beneficiaries, such depictions may be misleading indicators of the program's effect on later cohorts in the context of real-world business cycles, behavioral responses, and uncertain economic and demographic outcomes. From a program accounting perspective, the relatively generous benefits granted to early OASI participants clearly led to a smaller OASI Trust Fund than would have resulted if the program had been fully funded. The real economic consequences of forgoing the buildup of a larger OASI Trust Fund are not as clear—whether, for example, the smaller trust fund reflects an associated real reduction in national saving and the capital stock, as some allege. The next two sections of this article discuss how both the backward-looking and forward-looking legacy debt perspectives pose complex empirical questions that have yet to yield definitive answers. Such answers are required to determine whether the Social Security program has created a *real* legacy debt in an economically meaningful sense, rather than simply an *actuarial* legacy debt. These answers depend in part on the economic circumstances under which the program was created, the behavioral responses of program participants and their families, and the risk-and-return tradeoffs associated with the returns to market assets and the PAYGO program.

## *The Legacy Debt and the Capital Stock*

Because it is not a fully funded program, OASI may have led to associated reductions in national saving and the capital stock. For example, if OASI participants viewed their contributions to the program as retirement saving, they may have reduced their market-based retirement saving. If so, aggregate saving could have been reduced in the absence of offsetting monetary or fiscal policies because OASI taxes were used largely to finance benefits instead of being invested in government or other market assets. That is, only a relatively small amount of OASI Trust Fund assets were created over the historical period to replace the potential reduction in privately held market assets.

That possibility does not by itself imply that the relatively generous benefits provided to early OASI participants represented bad policy. The extent to which any public retirement program builds up a partial or full trust fund represents an intergenerational equity and fiscal policy decision that must be made in the context of the social and economic conditions prevailing at the time that the program begins or, more generally, over the entire course of the program. OASI began at a low point in the business cycle with an aged population in special need of financial assistance. Under such business-cycle and social conditions, the establishment of a PAYGO program that distributes early program taxes to early beneficiaries instead of saving those taxes in a trust fund might both (1) have desired intergenerational equity effects and (2) stimulate consumption and other economic activity, eventually resulting in more, not less, income and capital in subsequent periods. Such increases in private and total societal income and wealth would not be fully captured by the program and reflected in the trust fund under these conditions, of course, but could exist nonetheless.

There are other reasons why PAYGO retirement programs such as OASI do not necessarily create a real legacy debt in the form of a lower capital stock, even though the trust fund assets of such a program will be lower in an accounting sense than those in a fully funded program.[17] As a result, the existence or nonexistence of a full reserve fund in a retirement program does not by itself indicate its historical effect on national saving. For example, a program with no trust fund may have increased national saving by stimulating economic activity at a low point in the business cycle. Alternatively, a program with a full reserve fund may have had no effect or only an attenuated effect on national saving, depending on economic conditions, the behavioral responses of consumers, and the associated monetary and fiscal policy at the time of the creation of the fund. The same observations would apply, of course, to large private pension programs or other private or public economic activities that have broad macroeconomic effects.

Consequently, empirically determining the effects of public retirement programs (or other large-scale economic activities) on national saving can be very difficult, whether or not the programs or activities were fully funded and whether or not they created explicit or implicit debt from an accounting perspective. Although many studies have examined this issue in the case of the present Social Security program, the historical effect of the program on national saving still remains an open empirical question. In short, OASI did not necessarily create a real legacy debt in the form of a lower capital stock. Diamond (2004, especially 15–17) provides a succinct and excellent discussion of these issues in the context of the OASI legacy debt.

However, even if the Social Security program is believed to have created a real legacy debt in the form of a lower capital stock, other considerations may suggest that any policies designed to increase the capital stock should be implemented outside the program. Those other considerations include desirable characteristics of the program, possibly even aspects of the program's PAYGO financing itself, as discussed in the next section.

## *The Legacy Debt and the Rate of Return to Social Security*

From the perspective of its participants, the PAYGO financing of a public retirement program effectively creates a new retirement saving "asset" associated with the benefit rights generated by program tax payments.[18] The average rate of return to this asset (that is, the average lifetime rate of return for program participants) in a mature PAYGO retirement program that is in long-run financial balance is often lower than the average rate of return to many financial assets, including the projected interest rates typically used in legacy debt calculations.[19] As a result, discussions in the popular press and many technical papers often treat the PAYGO financing of mature public retirement programs as a poor "investment" choice from the perspective of the later-born participants. In this view, a legacy debt arises from the forced participation of later birth cohorts in a PAYGO program that tends to pay below-market rates of return. As indicated earlier, such a legacy debt can be measured actuarially as the expected present-value cost of the below-market returns over the lifetimes of the later birth cohorts.

Interestingly, that view, on which notions of the existence of a legacy debt are often based, is generally inconsistent with the historical record. The relationship between (1) the growth rates of economic aggregates that are tax-base candidates for a PAYGO retirement program and (2) analogous market-based interest rates, such as the rates of return to trust fund assets or to intermediate- or long-term government bonds, can be complex. That complexity arises from a variety of factors, including monetary and fiscal policy overlaid on changes over time in economic and demographic conditions. To illustrate using historical data, let aggregate wages and salaries represent a possible tax base for a PAYGO public retirement program.[20] As discussed earlier, the rate of growth over time in a mature PAYGO program's tax base is a prime determinant of the typical lifetime rate of return for later cohorts that have participated in the program over their entire lifetimes, assuming the program is kept in long-run financial balance. Over the period for which OASI Trust Fund interest rate data were available as of this writing (1940–2014), the average annual real rate of growth in aggregate wages and salaries was 3.2 percent, compared with a much lower average annual real effective rate of return of 1.6 percent to OASI Trust Fund assets (Table 2).[21] The annual real growth rate in aggregate wages and salaries exceeded or equaled the annual real OASI Trust Fund effective interest rate in 56 percent of the years during that period. Geometric mean real annual rates over that period were similar, 3.1 percent for the aggregate wages and salaries growth rate and 1.5 percent for the OASI Trust Fund rate of return. Although the disparity was not as large, the average annual real rate of growth in aggregate wages and salaries was also frequently larger than average annual real total rates of return to intermediate- and long-term government bonds over the longer historical period for which those data were available (1930–2014). The real growth rates in aggregate wages and salaries exceeded or equaled the intermediate- and long-term government bond rates of return in more than half of the years during that period. As depicted in Table 2, the average annual real rate of growth in aggregate wages and salaries over the period 1930–2014 was 3.0 percent, while the average annual real total rates of return to intermediate- and long-term government bonds were 2.4 percent and 3.1 percent, respectively. The geometric mean real annual rate of growth in aggregate wages and salaries over that period was 2.9 percent, while the corresponding geometric mean real annual intermediate- and long-term government bond rates were 2.0 percent and 2.4 percent, respectively. Employee compensation is another possible wage-related tax base for a PAYGO public retirement program; Table 2 shows similar but somewhat larger differentials for that economic aggregate.[22]

The historical outcomes depicted in Table 2 might be a poor guide to future outcomes, of course—opinions on the probable nature of these relationships in future years differ considerably. Nevertheless, it is interesting to note the general inconsistency of the assumptions used in the actuarial legacy debt calculations—assumptions that give rise to the very notion of a legacy debt—with the historical record as illustrated in Table 2.

More broadly, the question of the existence of an economically meaningful legacy debt persists even if one assumes that future PAYGO program rates of return will generally fall below analogous

**Table 2.**
**Real annual growth rates for selected economic aggregates compared with selected market-based real annual interest rates, by historical period (in percent)**

| Type of economic aggregate or interest rate | Arithmetic mean | Geometric mean | Percentage of years in which the interest rate is exceeded by or equals the real annual growth rate of— | |
|---|---|---|---|---|
| | | | Wages and salaries | Employee compensation |
| | | ***OASI Trust Fund (1940–2014)*** | | |
| Economic aggregate | | | | |
| Wages and salaries | 3.2 | 3.1 | . . . | . . . |
| Employee compensation | 3.4 | 3.3 | . . . | . . . |
| Interest rate | | | | |
| OASI Trust Fund effective rate | 1.6 | 1.5 | 56.0 | 58.7 |
| | | ***Government bonds (1930–2014)*** | | |
| Economic aggregate | | | | |
| Wages and salaries | 3.0 | 2.9 | . . . | . . . |
| Employee compensation | 3.3 | 3.2 | . . . | . . . |
| Interest rate | | | | |
| Government bonds | | | | |
| Intermediate-term | 2.4 | 2.0 | 57.6 | 57.6 |
| Long-term | 3.1 | 2.4 | 54.1 | 56.5 |

SOURCE: Author's calculations.

NOTES: The historical periods reflect the years for which corresponding interest-rate data were available as of the analysis date.

. . . = not applicable.

market-based interest rates or if one compares PAYGO program rates of return to the much higher rates of return to capital (rates which also exhibit higher intertemporal variability). Standard financial analysis indicates that portfolio diversification can lead to optimum portfolios that include certain low-return assets. Diversifying a nation's total retirement asset portfolio through the addition of a PAYGO program, for example, might actually increase the expected rate of return of that portfolio over a broad range of risk, even if the PAYGO program's rate of return generally falls below market-based rates of return. Depending on the interrelationships among market asset and implicit PAYGO program rates of return, a PAYGO program with a relatively low rate of return might still be an attractive "asset" comprising a significant share of a nation's total retirement portfolio. The recent turmoil in the financial and housing markets emphasizes the potential advantages of including a retirement income asset that is less volatile than many market-based assets.

A number of studies have suggested that the potential attractiveness of including a PAYGO program in a nation's retirement portfolio is consistent with historical data for the United States. For example, Leimer and Pattison (1998) present a standard mean-variance analysis of historical annual real rates of return over the period 1930–1997 for six broad financial asset classes[23] with and without a PAYGO retirement program asset (represented by the real annual growth rate in aggregate employee compensation). They find that the PAYGO program asset comprised a dominant share (that is, the largest asset share, as high as 70 percent) of the highest-return asset portfolio across nearly half of the historical range of standard deviations. They find similar results, some with even higher PAYGO program asset shares, for the post–World War II period (1947–1997) and the more recent subperiod 1974–1997.

The appendix of this article adopts the general approach of Leimer and Pattison (1998) but uses data for the period 1930–2009. Those data include annual real total rates of return to the same six broad financial asset classes with and without a PAYGO program asset represented by the real annual growth rate in aggregate wages and salaries.[24] When asset shares are constrained to be nonnegative, the (standard deviation, mean rate of return) coordinates for the PAYGO program asset fall slightly outside the portfolio efficiency frontier that is attainable without that asset (Appendix

Chart A-1).[25] Based on this metric, the PAYGO program asset by itself is superior to *any* combination of the included financial asset types at that level of portfolio risk—from an alternative perspective, the PAYGO program asset cannot be replicated by any combination of these market assets. More generally, the inclusion of the PAYGO program asset in the retirement asset portfolio shifts the portfolio efficiency frontier outward in this analysis across essentially the entire range of standard deviations. The PAYGO program asset constitutes a dominant share of the optimum portfolio over much of that standard deviation range, reaching a maximum optimum share of over 55 percent (Appendix Chart A-2).[26]

Again, such results illustrate how a PAYGO program might represent an important, even dominant, share of a nation's optimum retirement portfolio over a substantial portion of the portfolio risk range. This "portfolio-enhancing" potential may be particularly important over a broad lower portion of that range, which is especially relevant for a public program such as Social Security that is intended to provide a modest but predictable base of retirement income, consistent with a relatively conservative investment strategy.[27] These results are only illustrative, of course, given the limitations of the mean-variance approach,[28] the limited extent of the historical record, uncertainty concerning the long-run relationships between market rates of return and the growth rates in potential PAYGO program tax bases, and the effect of economic policy on those relationships.

Studies using other approaches have also suggested that potential welfare gains might be associated with PAYGO retirement programs in the context of real-world stochastic asset returns. In their estimates of consumer expenditure functions based on cross-sectional data, Leimer and Richardson (1992) find that consumers may associate a negative risk premium with the implicit Social Security "asset," a result consistent with the premise that Social Security reduces overall portfolio risk. Using various parameterizations of a mean-variance model for several countries in the context of stochastic asset returns, Dutta, Kapur, and Orszag (2000) illustrate the potential risk-diversification advantages of unfunded pension systems. Some analyses based on overlapping generations (OLG) models find that PAYGO programs can be portfolio enhancing in the context of economic uncertainty (for example, Enders and Lapan 1982; Gordon and Varian 1988; Barbie, Hagedorn, and Kaul 2000; Krueger and Kubler 2002, 2006; Matsen and Thøgersen 2004; de Ménil, Murtin, and Sheshinski 2006; and Gottardi and Kubler 2011).[29] Other analyses based on OLG models but using different assumptions and welfare criteria do not support a conclusion that PAYGO social security programs improve welfare, often because of potential reductions in capital accumulation. More generally, Leimer (2011) notes that the potential risk-sharing advantages of a PAYGO retirement program can be obtained without the potential crowding-out effect on capital accumulation, through program design or offsetting economic policy.

Several studies have used derivative pricing techniques drawn from finance theory to estimate various market valuations related to the PAYGO asset implicit in the present Social Security program. The empirical results of this approach for dealing with stochastic asset returns, however, have yielded conclusions that are remarkably inconsistent across and even within some of the analyses, reflecting an extreme sensitivity to different assumptions and approaches. Blocker, Kotlikoff, and Ross (2008) conclude that a market valuation of Social Security's net retirement liability for a sample of working-age Americans exceeds the standard actuarial valuation by almost one-quarter. One might interpret that result as indicating that Social Security is portfolio enhancing in that an estimated market valuation of discounted prospective program benefits less taxes for participants is larger than that implied by a standard actuarial valuation. That outcome is analogous to using a rate that is lower than the actuarial interest rate in the valuation of prospective Social Security net transfers. Geanakoplos and Zeldes (2010) find that their market valuation of accrued benefits for a sample of workers and beneficiaries is only about four-fifths of that implied by standard actuarial valuation, suggesting that prospective Social Security benefits reflect greater risk in a market valuation than in a standard actuarial valuation.[30] However, the authors also note that preliminary results of an extended analysis that estimates market valuations of open group transition cost measures[31] incorporating future Social Security contributions as well as future benefit accruals show a larger deficit than that implied by a standard actuarial valuation. One might interpret that result as consistent with the view that the Social Security program is portfolio enhancing (again, analogous to using a lower-than-actuarial interest rate in the valuation). Koehler and Kotlikoff (2009) estimate a market valuation of the infinite-horizon open group liability for the OASDI program, treating the growth rates of OASDI aggregate benefits and taxes as implicit securities that are spanned by the returns on

marketed securities. Based on their preliminary results, the authors conclude that a market valuation of Social Security's open group liability may be many times larger than the standard actuarial valuation. Again, one might interpret such a result as supporting the view that the program is portfolio enhancing. However, Koehler and Kotlikoff's estimates are extremely sensitive to the alternative assumptions and methods applied as well as to the set of included market assets, resulting in radically different valuations ranging from the infinitely negative to the infinitely positive and underscoring the preliminary and difficult nature of these analyses.

The discussion thus far has focused largely on the portfolio-enhancing potential of a PAYGO program as seen from a purely financial perspective. In addition, Social Security provides social insurance that is unavailable or imperfectly available in private markets. These "market-improving" provisions of Social Security include the automatic inflation adjustment of benefits after entitlement without the default risk that would be associated with analogous insurance offered by private insurance firms, the effective provision of fair annuities without the inefficiencies of adverse selection,[32] and insurance against various types of human capital and earnings risks deriving from the redistribution of lifetime resources based on lifetime earnings outcomes. Other Social Security provisions are market improving in the sense that they address societal adequacy and equity concerns arising from undesirable market outcomes.[33] Diamond (2004) and Aaron (2011) provide excellent and more thorough discussions of Social Security's insurance features.[34]

The portfolio-enhancing potential and market-improving provisions of the primarily PAYGO OASI program may support a different interpretation of the legacy debt. OASI might actually represent an attractive "investment" option for present and future program participants based on its broader portfolio-enhancing and market-improving effects, despite offering a lower rate of return than some market assets. The extent of the potential portfolio-enhancing effect remains an open question that requires further empirical refinement.

## Conclusion

This analysis aims to clarify aspects of the legacy debt concept, which arises from the PAYGO funding of the OASI program. Although the program may have created a real legacy debt borne by later program participants in the form of a lower capital stock or below-market lifetime rates of return, it is also possible that no real legacy debt was created, or that it is substantially smaller than is often suggested. Actuarial legacy debt estimates might considerably overstate the extent to which the program has affected national saving and the capital stock when the economic circumstances existing at the program's inception, the effect of alternative policies that might have been adopted at that time to address societal equity concerns, and the possible behavioral responses of consumers are considered. The PAYGO program asset and the rates of return that the program generates for current and future participants might represent a desirable addition to a nation's retirement asset portfolio, rather than a burden to be borne. In addition, programs such as Social Security can ameliorate a variety of risks by providing social insurance that is unavailable or imperfectly available in private markets. Together, these portfolio-enhancing and market-improving program effects may offset or exceed actuarial measures of the legacy debt, so that any real legacy debt associated with the program is substantially lower or nonexistent.

Empirical research has thus far failed to provide definitive evidence concerning the size and nature of these potential opposing effects and their implications for the existence of a real, rather than simply an actuarial, legacy debt. Evidence can be found to support virtually any interpretation of the size and even the direction of a real legacy debt. Some analyses suggest that standard actuarial valuations of the legacy debt may be substantial overestimates or even be of the wrong sign while other analyses suggest that actuarial valuations may substantially underestimate the size of the real legacy debt.

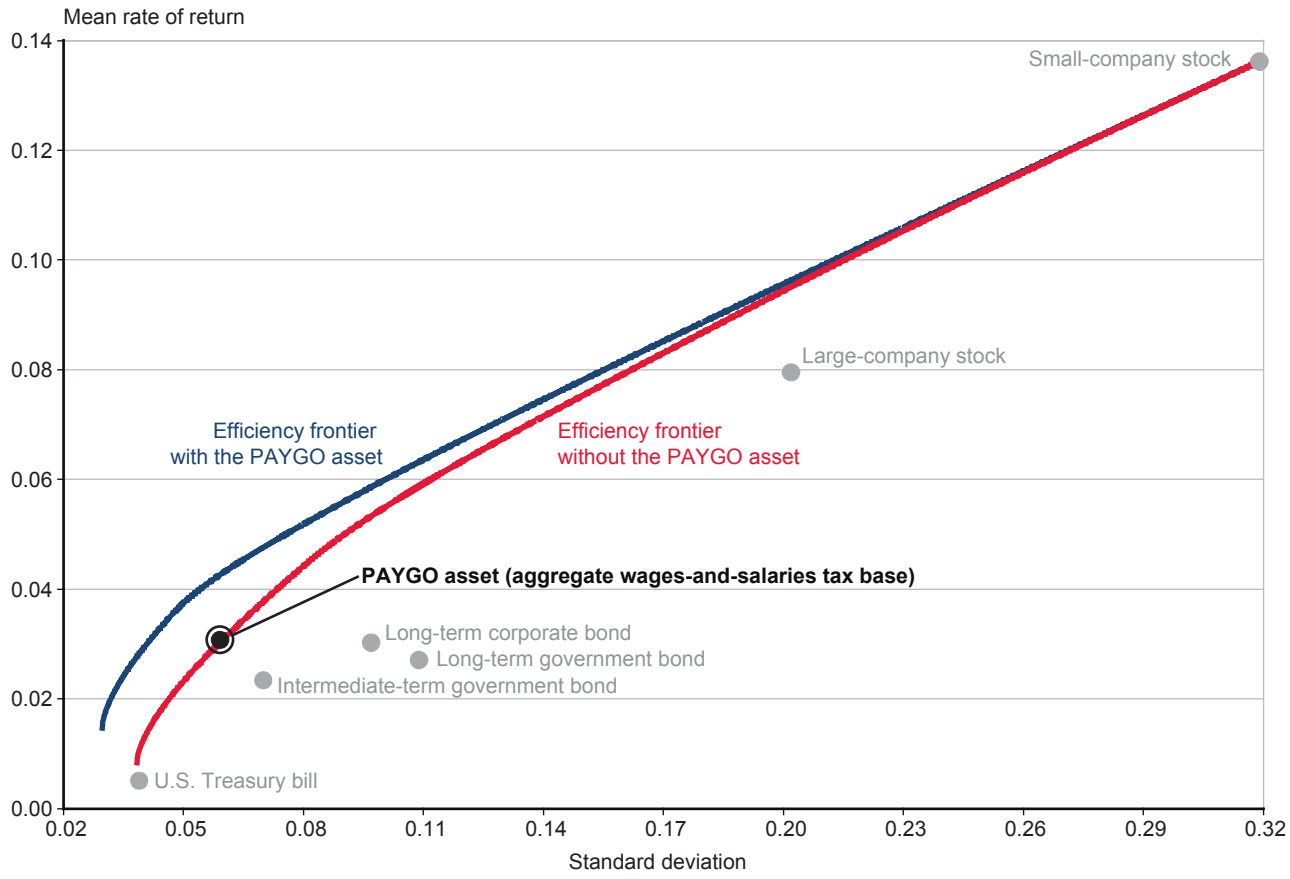
Depending on one's interpretation of the available evidence, this analysis may provide insight into the debate about how to restore long-run financial balance to the OASI program, even though the actuarial legacy debt is not an indicator of that balance. Simply restoring long-run financial balance would not have a significant effect on the actuarial legacy debt as generally defined. However, future benefit reductions designed to restore long-run program solvency may be more palatable if one believes that the program has created a real legacy debt that should not be expanded. Alternatively, future tax increases designed to restore long-run program solvency may be more palatable if one believes that the program's potential portfolio-enhancing and market-improving effects are real and worth preserving or perhaps expanding; in that case, any policies designed to increase national saving might best be implemented outside the program, even if one believes that the program has contributed to a reduction in the capital stock.

## *Appendix: Optimum Mean-Variance Retirement Portfolios With and Without a PAYGO Program Asset*

The analysis presented here adopts the general approach used in Leimer and Pattison (1998) to calculate optimum retirement asset portfolios using standard mean-variance analysis of annual real total rates of return to six broad financial asset classes and a PAYGO program asset. The present analysis updates the 1998 analysis using data for the period 1930–2009 (instead of 1930–1997) and uses annual real growth rates in aggregate wages and salaries (instead of employee compensation) to represent rates of return to the PAYGO program asset.[35] The included financial assets in both analyses are U.S. Treasury bills, intermediate-term government bonds, long-term government bonds, long-term corporate bonds, small-company stocks, and large-company stocks.[36] Charts A-1 and A-2 display the results of the mean-variance portfolio analysis (restricted to non-negative asset shares).

Chart A-1 displays the portfolio efficiency frontiers with and without the PAYGO program asset. The efficiency frontier represents the portfolio mix that provides the highest mean return for a given standard deviation or, from a different perspective, the portfolio mix that provides the lowest standard deviation for a given mean return.[37] The gray circular data points in Chart A-1 represent the (standard deviation, mean rate of return) coordinates for each of the six financial asset types over the period 1930–2009, and the black data point represents the coordinates for the PAYGO program asset over that period. For these data, the (standard deviation, mean rate of return) coordinates for the PAYGO program with a wages-and-salaries tax base lie slightly beyond the portfolio efficiency frontier that is attainable without the PAYGO program asset. Based on this metric, the PAYGO program asset by itself is

**Chart A-1.**
**Portfolio efficiency frontiers with and without a wages-and-salaries PAYGO asset based on annual real rates of return to six broad financial asset classes, 1930–2009**




SOURCE: Author's calculations.

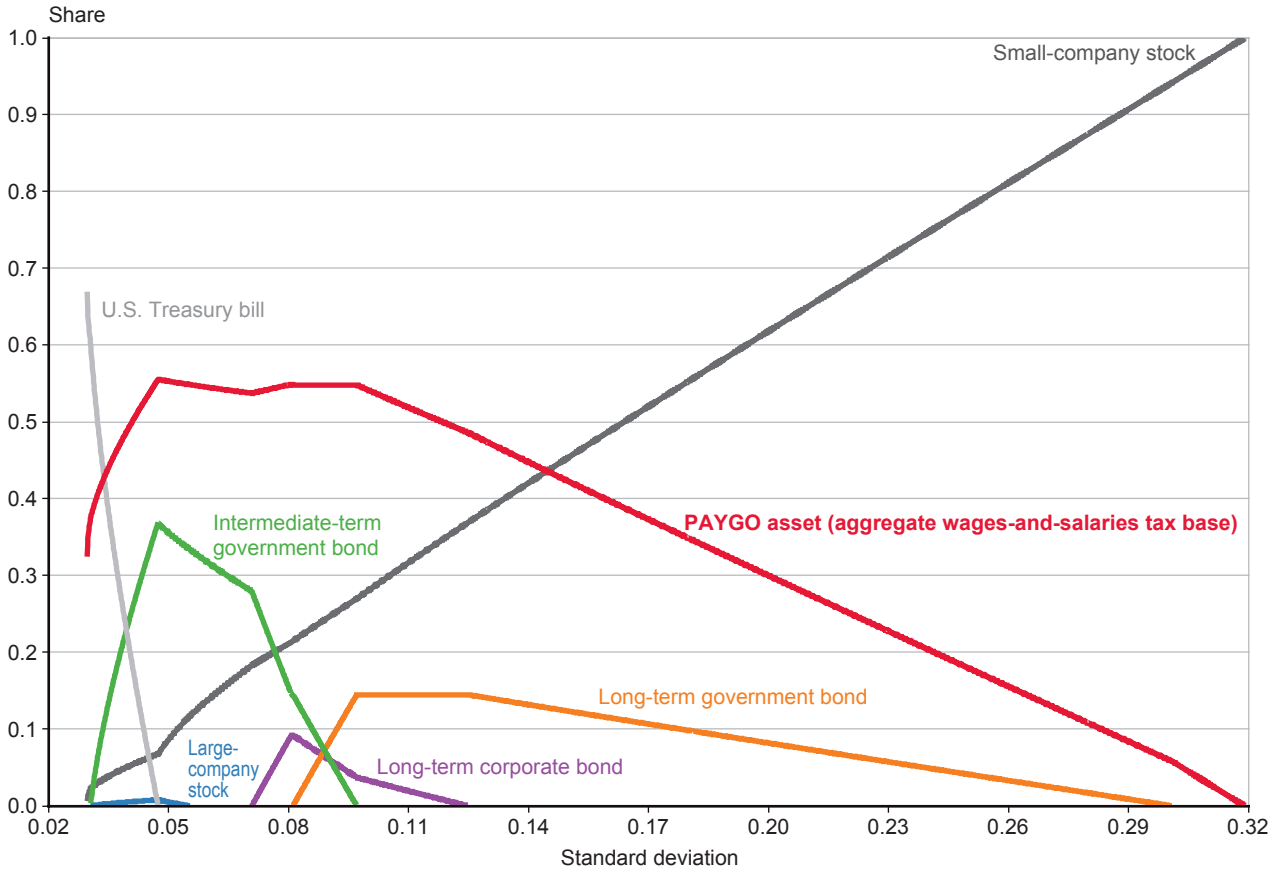
NOTE: The mean-variance analysis is constrained to exclude negative asset shares.

superior to *any* combination of the included financial asset types at that standard deviation. These results also imply that the PAYGO program asset could not be replicated by any combination of these market assets. More generally, including the PAYGO program asset shifts the portfolio efficiency frontier outward in Chart A-1 over essentially all of the relevant standard deviation range. That is, for any given level of risk (as represented by the standard deviation of portfolio returns for this historical period), including a PAYGO program with a wages-and-salaries tax base increases the attainable historical mean portfolio rate of return.

Chart A-2 shows the portfolio share of each asset on the efficiency frontier across the standard deviation range when the PAYGO program asset is included in the portfolio. The PAYGO program asset comprises a dominant share (that is, the largest asset share, reaching over 55 percent) of the optimum portfolio over much of the standard deviation range. These results suggest that a PAYGO program might represent a substantial, even dominant, share of a nation's optimum retirement portfolio mix, particularly over a broad lower portion of the standard deviation range. That lower portion is especially relevant for a public program such as Social Security that is intended to provide a modest but more predictable base of retirement income for workers, consistent with a relatively conservative investment strategy.

The analysis underlying Charts A-1 and A-2 imposes nonnegative asset share constraints, but the case for including a PAYGO program asset in the optimum portfolio in this example persists when those constraints are relaxed. When negative asset shares are allowed,[38] including a PAYGO program with a wages-and-salaries tax base shifts the attainable portfolio efficiency frontier outward as in the nonnegative share case, but the outward shift continues and increases over the entire tested standard deviation range. In

**Chart A-2.**
**Asset shares on the portfolio efficiency frontier with a wages-and-salaries PAYGO asset and six broad financial asset classes based on annual real rates of return, 1930–2009**




SOURCE: Author's calculations.

NOTE: The mean-variance analysis is constrained to exclude negative asset shares.

addition, the PAYGO program asset is the only asset with a uniformly positive and increasing asset share over the entire tested standard deviation range.

Analogous analyses using nonoverlapping historical investment periods of as long as 10 years were also examined. Although subject to decreasing confidence as the number of usable data points declined, all of those analyses supported the same qualitative conclusion as that suggested by Charts A-1 and A-2.

In addition to the limitations of mean-variance analysis, however, the limited historical record makes it difficult to determine the likelihood that analogous results would hold up over investment periods longer than 10 years—which may be relevant to retirement saving early in workers' life cycles. Moreover, historical rates of return might not be a good guide to future outcomes. There is considerable controversy, for example, over whether future equity returns are likely to be lower and riskier than in the past, and there is similar uncertainty concerning the interrelationships between future asset returns and growth rates in labor income. Nevertheless, this type of analysis does illustrate how a relatively low-return PAYGO program asset might be an attractive component of a nation's retirement portfolio, bringing the notion of a real legacy debt into question.

## Notes

*Acknowledgments:* The author thanks Benjamin Bridges, Jr., Michael V. Leonesio, David Pattison, and Jason Schultz for commenting on the paper or discussing various aspects of the analysis.

[1] Characterizing the benefits to earlier-born cohorts as "relatively generous" is not intended to imply anything about the adequacy of those benefits relative to the needs of the early beneficiaries, only that those benefits relative to prior tax payments were generally larger than they would have been under a fully funded program.

[2] Waldron (2015, Appendix B) discusses this "familial risk" factor as part of the motivation behind the design of the Old-Age Insurance program.

[3] The term "legacy debt" appears to have been used first by Diamond and Orszag (2004)—see Aaron (2011, 397)—but the concept considerably predated that usage of the term. Leimer (1994), for example, refers to the same general concept as a PAYGO program's "start-up dividend" (33) and discusses alternative distributions of this dividend across cohorts under alternative notions of intergenerational fairness. Geanakoplos, Mitchell, and Zeldes (1999) also discuss similar concepts of lifetime redistribution under Social Security between earlier and later cohorts based on accumulated lifetime net transfers.

[4] This statement and legacy debt calculations in the literature abstract from trust fund components other than benefit expenditures and tax receipts because the data available for legacy debt calculations exclude the other trust fund components. The other trust fund components, such as administrative expenses, could be included but would require additional assumptions about how to allocate those components by cohort. However, OASI administrative expenses have become relatively small as the program has matured and likely would not have a substantial effect on the calculations if included. In 2013, for example, OASI administrative expenses were about 0.5 percent of OASI benefit payments (Social Security Administration 2015, Table 4.A1), and OASI administrative expenses accumulated over the 1940–2013 period using the OASI Trust Fund effective annual interest rates were about 1 percent of OASI benefits accumulated over that period.

[5] For examples of such estimates, see Leimer (1994, 2007).

[6] The Leimer (1994) lifetime net transfer estimates are based on historical program data and projections using a simulation model calibrated for rough consistency with the *1991 Trustees Report* intermediate assumptions. Diamond aggregates the Leimer estimates across cohorts and updates them "to present value 2002 dollars."

[7] The Leimer (2007) lifetime net transfer estimates are based on historical program data and projections consistent with the *2002 Trustees Report* intermediate assumptions.

[8] Taxable payroll is the same for the OASDI and OASI programs but is generally referred to as OASDI taxable payroll.

[9] A rough estimate of the present value of future OASDI taxable payroll over the *Trustees Report* 75-year projection period as of the beginning of 2002 can be derived from data in Schultz and Nickerson (2015, Table 1). A footnote to Table VI.F1 of the *2015 Trustees Report* provides more precise estimates of the present value of future OASDI taxable payroll over the *Trustees Report* 75-year projection period and the infinite projection period with a valuation date at the beginning of 2015. The legacy debt year-end present values discussed here are compared to the projected taxable payroll estimates as of the beginning of the subsequent year.

[10] The OASI Trust Fund effective interest rates are available by calendar year at https://www.socialsecurity.gov/oact/ProgData/effectiveRates.html.

[11] This definition is mentioned in Aaron (2011, 397).

[12] This well-known result is easily demonstrated using an overlapping generations simulation of a PAYGO program assuming constant interest rates and constant growth rates in relevant economic aggregates.

[13] This linkage may sometimes be primarily expositional or illustrative. Diamond and Orszag (2004, 38), for example, recognize that "Social Security reforms, unless they reduce benefits for current retirees (which no one today is

seriously proposing), will have only modest effects on the size of the legacy debt."

[14] Aaron (2011, 398) also makes this point.

[15] The second condition indicates that the saving rate in this theoretical economy is not so high that the rate of return to capital falls below the economic growth rate, an economically inefficient outcome. Under these assumptions, the rate of return for cohorts who have participated in the PAYGO retirement program over their entire lifetimes is equal to the growth rate in economic output, which serves as the program's tax base in these models. Samuelson (1958) and Aaron (1966) provide early analytical derivations of this well-known result. Under these theoretical assumptions, the rate of return for full lifetime participants in a PAYGO program is necessarily less than the market interest rate.

[16] Geanakoplos, Mitchell, and Zeldes (1999) provide an example to illustrate this result and conclude that: "In an unfunded PAYGO system every generation after the initial few *must* lose money in present value terms under social security. Because rates of return were high for the first generations, rates of return must be low for later generations" (86).

[17] For example, Congressional Budget Office (1998) discusses the variety of ways in which Social Security might affect personal saving. That study also provides a summary (and one interpretation) of the empirical evidence.

[18] This discussion would not hold, of course, for a fully funded public retirement program and would hold to a lesser extent for a partially funded program. For simplicity, the discussion assumes strict PAYGO financing.

[19] A PAYGO program becomes "mature" in this sense when retirees have participated in the program over their entire lifetimes. As noted earlier, the rate of return for participants in a mature PAYGO program that is in long-run financial balance tends to equal the growth rate in the program's tax base, assuming that the program has temporally constant tax-rate and benefit-rate structures in an environment of relatively constant economic and demographic growth rates. The assumption of relatively constant economic and demographic growth rates is generally consistent with the long-run assumptions in the annual *Trustees Reports,* which have served as the basis for projected outcomes in legacy debt calculations.

[20] OASI's historical tax base is not as useful for this discussion because of the multiple changes in coverage and tax rates over the program's history.

[21] The average annual real rates of return to intermediate-term and long-term government bonds over the period 1940–2014 were 1.8 percent and 2.5 percent, respectively.

[22] The nominal aggregate wage-and-salary and employee-compensation data used in these comparisons are from the Bureau of Economic Analysis National Income and Products Accounts (Table 2.1), current as of November 24, 2015. Nominal OASI Trust Fund effective interest rates are from the OCACT website cited in note 10. The nominal intermediate- and long-term government bond rate data are consistent with the year-end total return indices reported in Ibbotson Associates (2015). Real growth rates for the economic aggregates and real interest rates were derived using annual Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W) data from the Bureau of Labor Statistics, current as of November 12, 2015. The "real growth rate" and "real interest rate" terminology used throughout this article refers to the corresponding nominal rates adjusted for price inflation.

[23] The financial asset classes in that analysis correspond to the annual total rates of return to U.S. Treasury bills, intermediate-term government bonds, long-term government bonds, long-term corporate bonds, small-company stocks, and large-company stocks.

[24] The appendix uses the real annual growth rate in aggregate wages and salaries to represent the PAYGO program asset in part because Table 2 suggests that it might show less favorable outcomes than the growth rate in aggregate employee compensation. An update and extension of the Leimer and Pattison analysis using data for the period 1930–2014 is in progress.

[25] Leimer and Pattison (1998) find a corresponding but more pronounced relationship using aggregate employee compensation as the PAYGO program tax base. The efficiency frontier identifies the portfolio mix that provides the highest mean rate of return for a given standard deviation or, from a different perspective, identifies the portfolio mix that provides the lowest standard deviation for a given mean rate of return.

[26] When negative asset shares are allowed in the analysis, inclusion of the PAYGO program asset shifts the attainable efficiency frontier outward, as in the nonnegative share case. However, (1) the outward shift continues and increases over the entire range of tested standard deviations and (2) the PAYGO program asset is the only included asset with a uniformly positive and increasing asset share over that range.

[27] From its inception, Social Security was intended to provide a retirement income foundation that workers would supplement with private pensions and personal saving (see, for example, DeWitt 1996).

[28] See, for example, Hanoch and Levy (1969) and Tesfatsion (1976).

[29] Although Krueger and Kubler (2006) find that an unfunded social security system could provide welfare-improving intergenerational risk-sharing opportunities in their model, they also conclude that the welfare improvement is likely to be more than offset by the unfunded program's potential crowding-out effect on capital accumulation. However, Gottardi and Kubler (2011) argue that that result depends on model restrictions and the particular welfare criterion applied by Krueger and Kubler. In the

Gottardi and Kubler model, intergenerational risk sharing provides a normative justification for a PAYGO social security system when markets are complete, even if one accounts for its effects on the capital stock.

[30] This result should be interpreted in the context of the authors' assumption of a close long-run correlation between average labor earnings and market assets, which, while possibly correct, limits the portfolio-enhancing potential of a PAYGO program asset based on the interrelationships among asset returns.

[31] For definitions of various closed and open group measures of the financial status of the Social Security program used by OCACT, see Schultz and Nickerson (2015).

[32] Adverse selection is the tendency of voluntary insurance programs to attract those most likely to benefit from the insurance, resulting in a higher-cost pool of program participants and effectively excluding those at lower risk.

[33] Many of Social Security's market-improving effects derive from its tax and benefit provisions and mandatory participation rather than from its financing approach. As such, those effects might also apply to an analogous fully funded public program.

[34] Other contributors include Thompson (1983), who discusses alternative insurance-model interpretations of the Social Security program and associated implications for various policy proposals. In addition to the "familial risk" factor noted above, Waldron (2015) discusses other private market failures and risks motivating the design of the Old-Age Insurance program. Leimer and Richardson (1992); Geanakoplos, Mitchell, and Zeldes (1999); Mariger (1999); and Diamond and Orszag (2005) also discuss these issues in varying detail.

[35] The nominal aggregate wage-and-salary data are from the Bureau of Economic Analysis National Income and Products Accounts (Table 2.1), current as of August 27, 2010.

[36] The annual total rates of return to the financial asset types and the price index series used to convert nominal indices to real indices are consistent with those reported in Ibbotson (2010).

[37] The efficiency frontiers and associated optimum portfolio shares in Charts A-1 and A-2 were identified by a frontier traversal method. Given a nonnegative constraint on asset shares, the asset with the highest mean return and standard deviation represents a known endpoint on the relevant portion of the efficiency frontier. Given that point, the remaining points on the frontier can be identified with arbitrary accuracy by traversing the frontier in correspondingly small portfolio share increments. These charts use a share increment of $10^{-7}$. This frontier-traversal method was checked on test problems using standard Markowitz-Sharpe techniques for nonnegative portfolios.

[38] In the analysis with negative asset shares allowed, the minimum-variance portfolio mix was identified using the approach given in Campbell, Lo, and MacKinlay (1997).

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