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Pay-As-You-Go Social Security and the Aging of America: An Economic Analysis

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Because it is a mature pay-as-you-go retirement system, Social Security provides current and future workers with below-market returns. These workers bear the burden of the unfunded liability arising from windfall gains to past retirees. Alan D. Viard uses these principles to examine the effects of three demographic developments: the low birthrate since the baby boom ended in 1965, the impending retirement of the baby boomers, and the downward trend in old-age mortality. The low birthrate reduces Social Security's long-run rate of return as the unfunded liability is spread across fewer workers. The boomers' retirement does not pose a separate problem, but marks the end of the temporary gains provided by the high birthrate during the boom. Because the downward mortality trend does not change Social Security's long-run rate of return or the number of workers across whom the unfunded liability can be spread, it need not change any worker's burden. However, policy responses to the trend are likely to shift burdens from earlier generations to later ones.

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Three demographic developments are combining to increase the population share of older Americans: the low birthrate since the baby boom ended in 1965, the impending retirement of the baby boom generation, and the downward trend in old-age mortality. The impact of these developments on the pay-as-you-go Social Security system—in which each generation of workers supports the preceding generation's retirees—has been the topic of much public discussion. Proper analysis of these issues requires understanding the economics of pay-as-you-go retirement systems.

A pay-as-you-go system provides a long-run below-market rate of return equal to the growth rate of national labor income. The total burden imposed on current and future workers by these below-market returns comprises the system's unfunded liability, which is the cost of the windfall gains provided to past retirees who contributed little to the system. The economic effects of demographic developments depend on how they impact the growth rate of national labor income and the allocation of the unfunded liability.

A lower birthrate reduces Social Security's long-run rate of return by slowing the growth rate of the workforce and national labor income. Stated differently, a lower birthrate increases the system's burden on each worker because the unfunded liability is spread across a smaller number of workers.

The baby boomer retirement does not pose a separate problem from that posed by the low post-1965 birthrate. The high birthrate from 1946 to 1965 increases Social Security's rate of return by boosting the growth rate of the workforce and national labor income; it spreads the unfunded liability across a larger number of workers. These effects are temporary, however, because the high birthrate was temporary. The retirement of the baby boom cohorts will bring these gains to an end, leaving the system to face the effects of the low post-1965 birthrate.

Unlike birthrate changes, the downward trend in old-age mortality does not change the growth rate of national labor income. Since this trend does not change the unfunded liability or the number of future workers, it is economically possible to respond without changing any worker's burden. However, such a response requires that aggregate benefits be *reduced* as the number of retirees rises. If, as is likely, aggregate benefits are instead left unchanged or increased, the burden of the unfunded liability is shifted from current to future workers. Because existing law fails to specify a permanently feasible response to this trend, the ultimate response and its economic implications will be determined by future legislation.

To explain these conclusions, I turn to the textbook two-period overlapping generations model of pay-as-you-go retirement systems.

PAY-AS-YOU-GO SOCIAL SECURITY

Operation of System

Each generation lives for two periods of about 30 years each. People work during the first period of life and retire during the second period. Each generation is numbered by its working period; generation 1 works in period 1 and retires in period 2.[1]

[1] Samuelson (1958) first used an overlapping generations model (but with three rather than two periods) to study Social Security; see Auerbach and Kotlikoff (1987, 146–50) and Blanchard and Fischer (1989, 111–13) for recent expositions.

In each period, real labor income per worker is twice as large as in the preceding one due to productivity growth. If each worker in period 1 earns $100, then each worker in period 2 earns $200 and each worker in period 3 earns $400. Also, each generation of workers is 50 percent larger than the generation that preceded it. So, if generation 0 consisted of 67 people, generation 1 consists of 100 people, generation 2 consists of 150, and generation 3 of 225. The retiree–worker ratio is always two-thirds.

Together, productivity and population growth cause real national labor income to triple from each period to the next. National labor income is $10,000 in period 1 (100 workers earn $100 each), $30,000 in period 2 (150 workers earn $200 each), and $90,000 in period 3 (225 workers earn $400 each).

Assume that starting in period 1, workers are required to pay a 10 percent tax on their earnings to finance a new pay-as-you-go retirement system. All taxes are used to pay benefits to current retirees rather than to finance investment. In period 1, generation 1 workers pay a $1,000 tax, which is transferred to generation 0 retirees. In period 2, $3,000 is transferred from generation 2 workers to generation 1 retirees, and so on (rows a through d of Table 1). Each retiree's benefit is three-halves of each worker's tax payment, reflecting the two-thirds retiree–worker ratio.

The impact of this retirement system on generation 0's well-being is simple. This generation receives a $1,000 benefit but paid no tax because the program did not exist when these people worked. Generation 0 enjoys a $1,000 "start-up bonus."

Rates of Return

Now consider generation 1 and its successors. Table 1 reveals that each generation receives a real retirement benefit three times as large as its tax payment, thereby earning a 200 percent per-period real return. This return matches the per-period growth rate of national labor income. This example illustrates the central finding in the economic literature on pay-as-you-go retirement systems: If the tax rate is stable, each generation's rate of return equals the growth rate of labor income. Aaron (1966) shows that this finding extends to models in which people live for many periods.

Generation 1 and its successors gain (lose) from the system when this rate of return is higher (lower) than the market return they can earn

Table 1
Pay-As-You-Go Retirement System

	Generation number				
	0	1	2	3	4
	Benefit (+) or tax (–)				
(a) Period 1	+1,000	–1,000			
(b) Period 2		+3,000	–3,000		
(c) Period 3			+9,000	–9,000	
(d) Period 4				+27,000	–27,000
	Burden = tax – (benefit ÷ 5)				
(e) Burden		400	1,200	3,600	10,800*

* Reflects benefit of 81,000 received by generation 4 in period 5, not shown.

by investing in capital. If the long-run growth rate of labor income, which is also the long-run growth rate of the overall economy, exceeds the average rate of return on capital, the pay-as-you-go system helps each of these generations, as well as generation 0. Economists describe such an economy as dynamically inefficient because it is possible to help some generations without hurting any; the pay-as-you-go system is one way to do this.

However, in a dynamically efficient economy, where the growth rate of labor income (and, hence, the economy) is less than the rate of return on capital, generation 1 and its successors are harmed by the pay-as-you-go system. This is the relevant case for the United States, where the average real return on capital exceeds the 3.37 percent real growth rate for employee compensation and proprietors' income observed from 1929 to 2001 (1.23 percent for the working-age population plus 2.14 percent for real labor income per working-age person). Estimates of the pretax return on capital include 5 percent (Caldwell et al. 1999, 119), 6 percent (Elmendorf and Mankiw 1999, 1633; Aaron 1999, 98; Cutler 1999, 124), 6.2 percent (Bosworth 1996, 98), 6.9 percent (Cooley and Prescott 1995, 19), and 7 percent (Summers 1990, 120).[2]

Although the numbers used to construct Table 1 are chosen largely for arithmetic convenience, their magnitudes are reasonable. If each period lasts 30 years, the implied annual growth rate of national labor income is 3.66 percent (1.35 percent population growth plus 2.31 percent real wage growth). It is convenient to assume that capital investment yields a fivefold payoff (principal plus 400 percent return) in the following period, which implies a 5.36 percent annual return.

Unfunded Liability

Generations 1 and later suffer a burden due to the system's below-market returns. Each generation's burden equals its tax payment minus the present discounted value of its benefit; the latter is the benefit divided by 5, the investment payoff.[3] These burdens (row e) triple from each generation to the next, growing at the same pace as national labor income. Each generation's burden equals two-fifths of its tax payment.

The proportional burden is similar with more realistic life-cycle assumptions. If a pay-as-you-go system yields a 3 percent return, a worker who pays $1 annual tax for 45 years can receive a $7.89 annual benefit for 15 years. If the market return on capital is 5 percent, the present value of the taxes is $17.89 and that of the benefits is only $8.77; the $9.12 burden is about 51 percent of the taxes.

Returning to the two-period example, discounting each generation's burden back to period 1 and summing across the infinitely many affected

[2] The relevant return is the pretax return, because society receives this return, even if individual savers do not. Another complication arises because the growth rate and the rate of return on capital are uncertain; for more details, see Zilcha (1991). Abel et al. (1989) offer a simple criterion that accounts for uncertainty and verifies that the U.S. economy is dynamically efficient.

[3] I discuss only the direct effect of the taxes and benefits. By reducing capital accumulation, the retirement system also raises the rate of return on capital and lowers the wage rate, which further helps generation 0 and further harms later generations. See Auerbach and Kotlikoff (1987, 148–53). I also ignore any labor supply distortion induced by the system.

generations yields $1,000.[4] This is the period 1 value of the system's "unfunded liability." In each later period, the unfunded liability is the present value of the burdens on current and future workers, discounted back to that period. The unfunded liability triples each period, growing at the same pace as national labor income.

Since the $1,000 period 1 liability equals the start-up bonus given to generation 0 in that period, the net present value of the system's effects on all generations is zero. (Geanakoplos, Mitchell and Zeldes [1998, 146] demonstrate that this zero-present-value result holds for any growth rate of labor income and any rate of return on capital, if the latter exceeds the former.) The losses to later generations do not reflect economic inefficiency; resources are being redistributed to generation 0, not wasted. Society faces a trade-off: Establishing the system helps generation 0 but harms later generations.

In this simple example, the system reaches its final 10 percent tax rate immediately in period 1, and only generation 0 gains. An alternative is to gradually phase in the system; for example, if a 5 percent tax rate is imposed in period 1, with the 10 percent rate starting in period 2, generation 0 gains less while generation 1 also gains. Workers receive returns greater than the growth rate of labor income (and possibly the return on capital) as long as the tax rate during their retirement exceeds the tax rate during their working years. Returns settle down to the growth rate of labor income only for workers who enter the system after it matures (the tax rate stops rising). In the United States, the system was repeatedly expanded after it began in 1937, providing above-market returns to more than one generation.

Numerous studies confirm the high returns to early cohorts and the below-market returns facing current and future workers in the United States. Leimer (1995, 11–12) estimates real annual returns of 37 percent for the cohort born in 1876, 12 percent for the one born in 1900, 5 percent for the one born in 1925, and, similar to Caldwell et al. (1999), only 2 percent for those born from 1950 to 2050.[5] The unfunded liability of the U.S. system is about $10 trillion.[6]

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[4] No further discounting for generation 1's $400 burden is needed; dividing by 5, generation 2's $1,200 burden has a period 1 present value of $240; dividing by 25, generation 3's $3,600 burden has a period 1 present value of $144; and so on. Each discounted burden is 0.6 times as great as the one preceding it; the infinite series sums to $400/(1 – 0.6) or $1,000.

[5] These studies compute returns for the entire cohort. Others, such as Siems (2001, 9–12), Nichols, Clingman, and Glanz (2001), and Steuerle and Bakija (1994, 98–132), obtain similar results by comparing the treatment of hypothetical members of each cohort. While the simple model assumes that generation 0 receives benefits without having paid any taxes (earning an infinite rate of return), the U.S. system paid benefits only to those who paid *some* taxes. However, the first beneficiaries paid taxes for only a few years.

[6] Estimates include U.S. Council of Economic Advisers (2002, 92) ($10 trillion), U.S. Treasury Department (2002, 58) ($9.6 trillion on Jan. 1, 2001), Goss (1999, 33) ($7.9 trillion in October 1997), Geanakoplos, Mitchell, and Zeldes (1998, 147) ($9.7 trillion in 1997), and Greenspan (1998, 34) ($9.5 trillion in 1997). The unfunded liability of the pay-as-you-go Medicare system (to which the analysis of this article also generally applies) may be even larger than that of Social Security.

MATURE PAY-AS-YOU-GO SYSTEMS

The above discussion refers to the effects of introducing and expanding the system until it reaches maturity. Since those decisions have already been made in the United States, it is useful to examine a mature pay-as-you-go system.

Trade-off Between Current and Future Generations

I begin by considering a decision between continuing the system and the (extreme) alternative of immediately abolishing it. At the beginning of period 2, abolition may seem optimal. Generation 0 (the only one that gained from the system) is dead, and the burdens on generations 2 and later are unchanged from those listed in Table 1. However, the impact on generation 1 has changed because it has already paid its $1,000 tax to generation 0. Although generation 1 would be better off if the system had never been established, it now prefers that the system continue. Abolition imposes a $3,000 "transition cost" (in the form of lost benefits) on generation 1.

In period 2, the system has a $3,000 unfunded liability, which is the sum of its burdens on generations 2 and later, each discounted back to period 2. Abolition, therefore, gives these generations a present-value gain of $3,000, which equals the transition cost imposed on generation 1. The net present value of continuing the system, like that of establishing it, is zero. Society confronts a trade-off similar to that in period 1: Continuing the system helps generation 1 but harms later generations. The only difference is that generation 1 does not seek a start-up bonus but merely a below-market return on its past taxes.

A mature pay-as-you-go system's unfunded liability is the unavoidable cost of the start-up bonus given to early participants. If the system continues, each generation suffers below-market returns, which can be viewed as the cost of servicing the liability. If the system is abolished, current generations pay a one-time transition cost of the same present value, which can be viewed as the cost of retiring the liability. In the United States, the $10 trillion transition cost of abolishing pay-as-you-go Social Security would be more than one year's national labor income. Of course, shrinking rather than abolishing the system reduces the transition cost, while also reducing the gain to future generations.

Immediately reducing or eliminating generation 1's benefit is not the only way to shrink or abolish the pay-as-you-go system. A less abrupt option is to tax generation 2 to pay generation 1's full benefit while informing generation 2 that its benefit will be reduced or eliminated next period. This option shifts the transition cost to generation 2 and reduces its period 2 present value; it also reduces the present value of the subsequent gains, which are enjoyed only by generations 3 and later. Gradually phasing out the system spreads the transition cost across several generations, just as a gradual phase-in spreads the start-up bonus. If desired, part or all of the transition cost can be moved outside the Social Security system; generation 1's benefit can be paid while generation 2's payroll taxes are eliminated, if these generations bear $3,000 of other tax increases or spending cuts. These options may ease the transition, although they do not avoid the fundamental trade-off between current and future generations.

Deciding whether to move away from a pay-as-you-go system requires an evaluation of the needs, rights, and obligations of different generations. Some economists argue that the gains to future generations from shrinking or gradually abolishing the U.S. pay-as-you-go system justify the transition cost to current generations.[7] Other economists disagree.[8] Of course, economists cannot conclusively resolve these issues.[9]

Prefunded Retirement Systems

In the above example, after the pay-as-you-go system is abolished, each member of generation 2 keeps the money that he or she would otherwise have paid to generation 1 and may consume or save the funds as he or she pleases. Such a policy is politically unlikely, however, because it undermines social protections provided by the pay-as-you-go system. Pay-as-you-go systems generally protect workers if they retire, become disabled, or live longer than expected, even when they fail to willingly save or buy disability insurance and annuities or when they make poor investment decisions. Also, pay-as-you-go systems often redistribute resources within each generation by attempting to give higher returns to lower-wage workers.

To preserve some or all of these protections while shrinking or eliminating the pay-as-you-go system, reform plans generally call for the creation of a prefunded system. The government requires workers to pay into this system, protecting workers who might not willingly save. Like a pay-as-you-go system, the prefunded system may also provide disability insurance, compulsory annuitization, and a redistributive benefit formula.

However, the prefunded system differs from a pay-as-you-go system in one crucial respect. It invests each generation's payment to finance that generation's own benefit in the next period, rather than transferring the payment to the preceding generation's retirees. If generation 2 is required to place its $3,000 in a new prefunded system, these funds are invested to yield a $15,000 benefit for generation 2 in the next period, two-thirds larger than the pay-as-you-go benefit it replaces. Since each generation's benefits have the same present value as its taxes, there is no unfunded liability.

The creation of the prefunded system does not alter the basic tradeoff described above. Because generation 1 does not receive generation 2's taxes, it still suffers the same transition cost. (The previously discussed strategies can still be employed to ease the transition.) Generations 2 and later still escape the burdens they bore under the pay-as-you-go system because the new system provides them with market returns.

Public and Privatized Systems

The new prefunded system can be a public system in which the government invests workers' contributions or a privatized system in which

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[7] Feldstein and Samwick (1997, 136–37) invoke a utilitarian social welfare function to argue that more resources should be provided to future generations. The generational accounting literature stresses the heavy burdens future generations may face under current law and suggests that changes should be made to alleviate these burdens.

[8] Eisner (1998) argues that future generations will be wealthier than current generations and that the latter need not make additional sacrifices for the former.

[9] Elmendorf and Mankiw (1999, 1661–62) describe the uncertainties involved in applying a utilitarian social welfare function to intergenerational distribution. One legal scholar, Epstein (1992, 85), comments, "I confess that my moral intuitions are not as well developed…on this grand scale. Hard as I try I cannot determine precisely what it is that my parents owed me, or what their generation owed my generation or those yet to come. I am also somewhat overwhelmed by a similar inability to speak about what I owe my children, as distinguished from what I hope to provide for them."

each worker holds his or her contributions in an individually owned account. Supporters of public systems argue that they provide more social protections. Supporters of privatized systems argue that they provide greater individual choice and economic efficiency. The merits of these arguments often depend on the specific proposals under consideration.

Some economists, including Barro (1999) and Shoven (1999), argue that prefunded privatized systems are more politically sustainable than prefunded public systems, in which the government may be tempted to divert the assets to other purposes or give them to current retirees. Greenspan (1999) and others also warn that prefunded public systems may be vulnerable to political interference with portfolio decisions. Other economists, including Aaron (1999) and Munnell (1999), counter that these problems can be avoided with appropriate institutional safeguards. They also argue that prefunded public systems have lower administrative costs than prefunded privatized systems.

A common misconception holds that privatization raises returns without transition costs. Economists (privatization supporters and opponents alike) have repeatedly refuted this fallacy.[10] If the transition cost to retire the pay-as-you-go system's unfunded liability is not paid, any debt-financed privatized (or public) system that "replaces" the pay-as-you-go system continues to offer the same below-market returns.[11] Despite the asset accumulation within such a system, it is effectively still pay-as-you-go, due to the debt financing. (See box on page 10 titled "Privatization—No Higher Returns without Transition Costs.")

Partial or complete elimination of the pay-as-you-go system provides gains to future generations and imposes transition costs on current generations. Whether a prefunded system is established and whether any such system is public or privatized does not fundamentally change these gains and costs. Because public and privatized systems face the same trade-off between current and future fiscal burdens, privatization does not avoid (and is not an alternative to) fiscal sacrifices, such as tax increases, benefit cuts, and other spending cuts.

Solvency

So far, this discussion has ignored the issue of system solvency, which figures prominently in public discussion. In the two-period example, benefits are automatically set equal to taxes in each period. The system never "runs out of money" because it never attempts to pay a return greater than the growth rate of national labor income.

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[10] For thorough analyses, see Miron and Murphy (2001), Geanakoplos, Mitchell, and Zeldes (1998; 1999), and Mariger (1997). Also see Feldstein and Liebman (2002, 268), Biggs (2002, 42–43), Siems (2001, 14, 16–17 n.22), Liu, Rettenmaier, and Saving (2000, 271), Blake (2000, F53), Hassett and Hubbard (1999), Aaron (1999, 70), Cutler (1999, 124–27), Smetters (1999, 210–11), National Academy of Social Insurance Study Panel (1999, 69–70), Diamond (1998, 39), Murphy and Welch (1998, 146–47), Greenspan (1998, 34), Kotlikoff (1997, 214–16), and Brunner (1996).

[11] Some households face high transaction costs that prevent them from buying certain assets—such as corporate stocks—on their own. They may gain from a debt-financed privatized system, if it offers them a lower cost method of purchasing these assets. They may similarly gain from a debt-financed public system that purchases these assets on their behalf. Such gains may be smaller now than in the past, because more households are now able to purchase corporate stocks and other assets on their own. See Geanakoplos, Mitchell, and Zeldes (1998, 152–54; 1999, 137–39).

In contrast, current U.S. law does not necessarily equate taxes and benefit payments, either each year or over time; it specifies a constant tax rate, while linking each cohort's average monthly benefit to the average wage rate when it attains age 60. When taxes exceed benefits (as they have since 1983), an accounting entry known as the trust fund balance measures the cumulative surplus, on which interest is credited. The balance is reduced when the system runs a deficit. If the balance drops below zero, the system is "insolvent" and benefits are abruptly reduced to the level supported by current taxes.

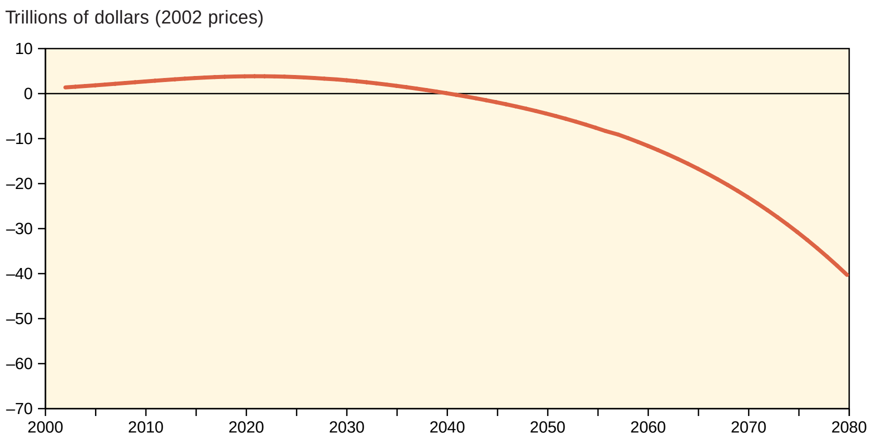
Under the intermediate projection of the U.S. Social Security Administration (2002), the trust fund balance will start to decline in 2026, with insolvency in 2041 (*Figure 1*). Benefits will then be abruptly reduced by 27 percent, unless (as expected) Congress forestalls insolvency by raising scheduled taxes or cutting scheduled benefits before that time.[12] The projected insolvency simply means that current law promises a rate of return greater than the growth rate of labor income, a promise that cannot be fulfilled.

Despite the attention devoted to trust fund solvency, its significance is limited. The effect of any development on the growth rate of national labor income determines its long-run impact on pay-as-you-go Social

Figure 1

Insolvency Projected to Occur in 2041

(Real trust fund balance, end of calendar year)



NOTE: Negative trust fund balances are hypothetical; they measure the magnitude of the adjustments necessary to maintain solvency.

SOURCE: Social Security Administration, http://www.ssa.gov/OACT/TR/TR02/lr6E8-2.html.

[12] If other taxes and spending remain unchanged, the current Social Security surpluses reduce the government's net debt to the public, which adds to government saving and gives the system a small temporary prefunded component. Conversely, the future Social Security deficits increase the net debt and reduce government saving. However, the current surpluses do not increase saving to the extent they trigger tax cuts or spending increases elsewhere in the budget; the future deficits will not reduce saving to the extent they trigger tax increases or spending cuts.

The trust fund is merely an accounting device that allocates resources between Social Security and the remainder of the budget. It neither amplifies nor negates any saving caused by the Social Security surplus or any dis-saving caused by the future Social Security deficits. See Biggs (2002, 7–15), Viard (2002), U.S. Council of Economic Advisers (2002, 76–77), and Smetters (1999).

Security. The effect of the development on system solvency merely determines when and how that impact occurs.

A development that lowers the growth rate of labor income must lower returns; workers must pay higher taxes or receive lower benefits. If current law automatically raises taxes or lowers benefits by the right amount, insolvency is avoided as the system smoothly implements the lower returns.[13] Absent the right automatic adjustments, insolvency occurs, eventually forcing the adoption of tax increases or benefit cuts, perhaps after political turmoil. In either case, the rate of return ultimately falls.

Examining the effects of various developments on solvency reveals whether changes to current law will be necessary. But the most important question is how the developments affect the growth rate of labor income, which determines their impact on Social Security's long-run rate of return after any necessary legislative changes are made.

LOWER BIRTHRATE

With this economic framework in hand, I turn to the implications of population aging for pay-as-you-go Social Security. The aging of America

Privatization—No Higher Returns without Transition Costs

Suppose the system is privatized with no transition cost. Starting in period 2, generation 2's $3,000 tax payment is placed in individual accounts rather than being paid to generation 1. To pay generation 1's $3,000 benefit without imposing any tax increases or spending cuts, the government must issue $3,000 of new debt. To market its debt, the government must pay the same fivefold return as capital. (With uncertainty, the risk-adjusted returns must be the same.) Suppose the government lets the outstanding debt grow at the same rate as national labor income, tripling each period.

With $15,000 due in period 3, the government rolls over the original $3,000 and issues $6,000 of new debt, while imposing a $6,000 debt-service tax on the generation 2 retirees. Generation 2's individual accounts earn market returns and grow to $15,000, but their net payoff is only $9,000 due to the debt-service tax. Similarly, generation 3 places $9,000 into individual accounts, which grows to $45,000 in period 3 but nets only $27,000 because of the $18,000 debt-service tax.

Under this privatized system, each generation's benefits are unchanged from the pay-as-you-go system. The net rate of return is still below market because the new system is actually still pay-as-you-go. It never accumulates *net* assets because the new government debt offsets the assets in the individual accounts. The unfunded liability has not been retired but merely relabeled in a more visible form as explicit government debt.[1] As Mankiw (1998) aptly notes, "private pyramid schemes don't work any better than public ones."

NOTE

[1] As Kotlikoff (1997, 224) notes, the visible nature of the debt may create pressure for tax increases or spending cuts, even if none were initially planned. If this happens, the new system is partly prefunded and offers higher returns, but a transition cost has then been paid.

[13] Current U.S. law partially does this for changes in productivity growth. Slower productivity growth reduces the growth rate of national labor income and the long-run rate of return, eventually forcing tax increases or benefit reductions. Current law automatically reduces scheduled lifetime benefits; it links each cohort's average benefit to the average wage rate when the cohort attains age 60. The adjustment is incomplete, however, because each cohort's benefits are not adjusted for subsequent wage changes.

is illustrated in Figure 2. The current ratio of the 65-and-over population to the 20–64 population is 0.21, up sharply from 0.14 a half-century ago. The Social Security Administration (SSA) projects that this ratio will rise to 0.35 in 2030 and 0.43 by 2080. The Census Bureau's projections are similar, reaching 0.44 by 2100. (The two-thirds ratio in the two-period example is too high, reflecting the example's unrealistic assumption that work and retirement last the same amount of time.) As explained below, the aging of America reflects both birth- and death-rate changes. In this section, I look at the recent decline in the birthrate and its implications for Social Security.

Demographic Impact

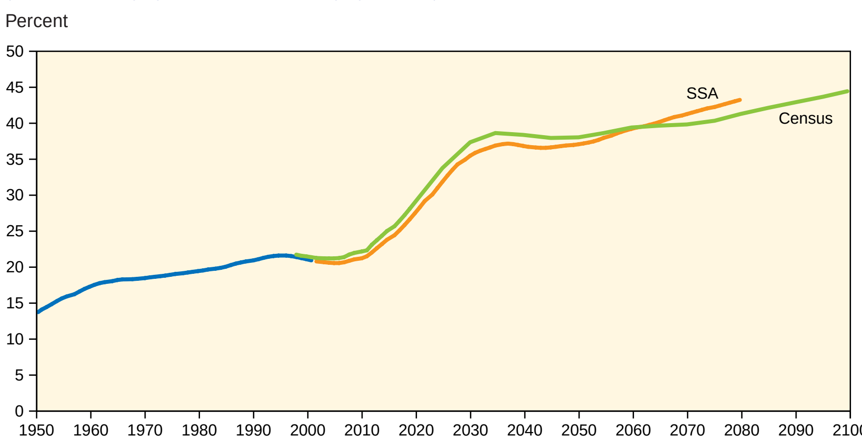
Each year's birthrate can be summarized by the total fertility rate (TFR), which is the average number of children for a woman who survives through childbearing age, if that year's age-specific birthrates persist.[14] The TFR exceeded 2.8 throughout the 1946–65 baby boom, peaking at 3.68 in 1957 (*Figure 3*). Since the baby boom ended, the TFR has been well below the values that prevailed earlier in the twentieth century. It dipped below 2 in 1972–88 and has since hovered slightly above that value. The SSA projects a slight decline to 1.95, and the Census Bureau projects a slight rise to 2.2; these projections are generally similar to other forecasts (Lee and Edwards 2002, 146; U.S. 1999 Technical Panel; and Brown 1996, 36).

The lower birthrate slows the growth of the working-age population. The link runs through the gross and net reproduction rates. The gross reproduction rate is the same as the TFR except that it includes only female births. The net reproduction rate (NRR) is similar to the gross reproduction rate but accounts for women who die before or during childbearing age. A given year's NRR equals the average number of female children a newborn female will bear during her life if that year's age-specific birth and

Figure 2

Aging of America Expected to Continue

(Ratio of 65+ population to 20–64 population)



SOURCES: U.S. Census Bureau (2000); Social Security Administration, http://www.ssa.gov/OACT/TR/TR02/lr5A2-h.html, http://www.ssa.gov/OACT/TR/TR02/lr5A2-2.html.

[14] The TFR for 2002 is the sum of the 2002 age-specific birthrate for each cohort of women aged 15 to 44. The TFR is a period rather than a cohort measure. It combines the birthrates that 30 different cohorts experienced in 2002 and does not measure the lifetime births of any given cohort.

female death rates persist. In modern countries, the NRR is a little less than half the TFR.

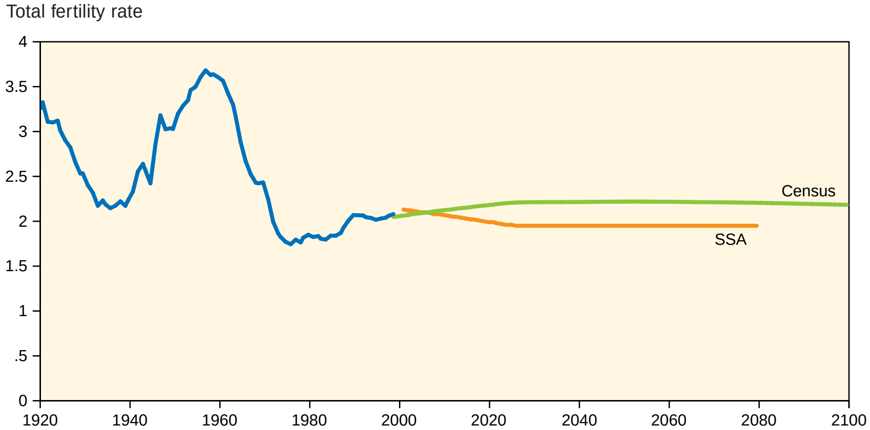
With stable age-specific birth and death rates and no immigration, the growth rates of the population and each age group eventually converge to a constant, called the intrinsic rate of natural increase. The approximate intrinsic rate is

(1) Intrinsic rate of natural increase ≈ {natural log (NRR)} / A,

where A is the average age at which women in each cohort give birth (see Spiegelman 1968, 290 footnote). The formula is exact if all births occur at age A or if the NRR is 1. If A is 27, the approximate intrinsic rate is 2.57 percent with an NRR of 2 (TFR slightly above 4) and 1.50 percent with an NRR of 1.5 (TFR slightly above 3). With an NRR of 1 (TFR of 2.11), each newborn female bears one female child and the intrinsic rate is zero.

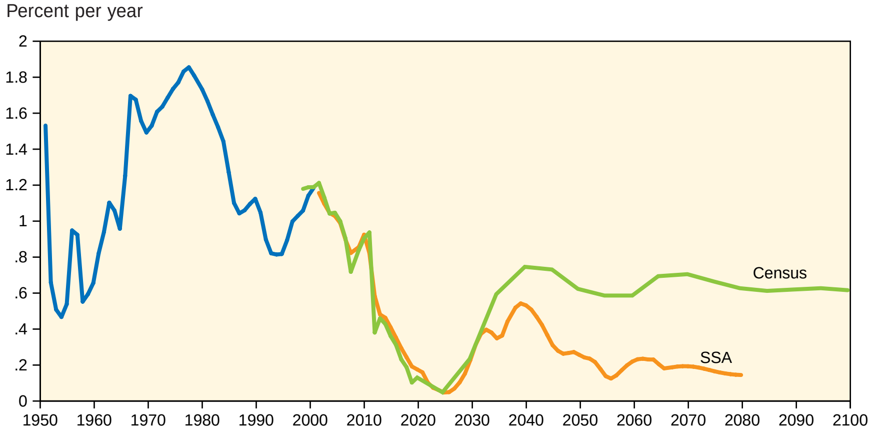
The impact of the birthrate can be seen in Figure 4, which graphs the annual growth rate of the 20–64 population. The current growth rate of

Figure 3
Birthrate Expected to Remain Below Historical Values



SOURCES: U.S. Census Bureau (2000); Social Security Administration, http://www.ssa.gov/OACT/NOTES/AS112/tab3.html, http://www.ssa.gov/OACT/TR/TR02/lr5A2-h.html, http://www.ssa.gov/OACT/TR/TR02/lr5A2-2.html.

Figure 4
Growth Rate of Population 20 to 64 Years Old Slows



SOURCES: U.S. Census Bureau (2000); Social Security Administration, http://www.ssa.gov/OACT/TR/TR02/lr5A2-h.html, http://www.ssa.gov/OACT/TR/TR02/lr5A2-2.html.

1.2 percent is below the 1.5 to 1.8 percent pace of the 1970s, when the boomers attained working age. Reflecting its forecast of low birthrates, the Census Bureau projects growth of only about 0.6 percent throughout much of the next century. Because of its even lower birthrate forecasts, the SSA projects growth rates just above zero.[15]

By slowing population growth, the low birthrate also contributes to population aging. If all individuals live for 80 years and there is no immigration, the ratio of people aged 65–80 to those aged 20–64 is 0.178 with steady 2 percent annual population growth, 0.245 with 1 percent growth, and 0.333 with zero growth.

Impact on Social Security

To see the implications of a low birthrate for Social Security, consider the effects of starting a system with the same $1,000 start-up bonus, but with a permanent population growth rate of zero rather than 50 percent per period. Table 2 shows this case, with population constant at 100, listing new numbers in bold and the original numbers, if different, in parentheses. The lack of population growth raises the retiree–worker ratio from two-thirds to one.

I assume that the birthrate decline does not change real wages or the marginal rate of return on capital, an issue I address below. Then, the birthrate decline reduces the growth rate of national labor income and Social Security's long-run rate of return from 200 to 100 percent per period. Workers must pay higher taxes or receive lower lifetime benefits.

Table 2

Effect of Lower Birthrate on Pay-As-You-Go Retirement System

	Generation number				
	0	1	2	3	4
(a) Size of generation	**100**	**100**	**100** (150)	**100** (225)	**100** (337)
	Benefit (+) or tax (–)				
(b) Period 1	**+1,000**	**–1,000**			
(c) Period 2		**+2,000** (+3,000)	**–2,000** (–3,000)		
(d) Period 3			**+4,000** (+9,000)	**–4,000** (–9,000)	
(e) Period 4				**+8,000** (+27,000)	**–8,000** (–27,000)
	Burden = tax – (benefit ÷ 5)				
(f) Burden		**600** (400)	**1,200**	**2,400** (3,600)	**4,800*** (10,800)*
(g) Per capita burden		**6** (4)	**12** (8)	**24** (16)	**48*** (32)*

* Reflects benefit of **16,000** (81,000) received by generation 4 in period 5, not shown.

[15] The intrinsic rate of natural increase is generally negative under SSA's projected birthrate. However, immigration still allows the working-age and overall population to grow slightly. Changes in immigration have roughly the same effects on pay-as-you-go Social Security as changes in births, except that the effects occur more quickly.

If the tax rate remains 10 percent and taxes still equal benefits in each period, the aggregate transfers steadily decline relative to their original values (rows b through e). Dividing by generation size reveals that each worker pays the same per capita taxes as before, as they must since the tax rate and wage are unchanged. However, due to the higher retiree–worker ratio, each retiree receives benefits one-third smaller than before. Each generation earns a per-period return of 100 percent rather than 200 percent, matching the lower growth rate of national labor income.

Compared with Table 1, generation 1's burden is larger, generation 2's is unchanged, and later generations' burdens are smaller (row f). Discounting and summing the burdens still yields $1,000, which equals the start-up bonus, in accordance with the zero-present-value result.

Dividing each generation's burden by its size reveals that *per capita* burdens are uniformly 1.5 times larger than before (row g). Paying the same taxes but receiving lower benefits, each worker suffers a greater burden. (The 1.5 ratio arises because the gap between the rate of return on capital and the growth rate of labor income is 1.5 times larger than before, 300 percent rather than 200 percent.) Each worker's burden is greater because the $1,000 unfunded liability is spread across a smaller number of workers. With a fixed aggregate liability (equal to the start-up bonus) and fewer people to bear it, an increase in some or all workers' burdens is inescapable.

The conclusion that a birthrate decline can significantly increase a worker's burden also holds under more realistic life-cycle assumptions. A decline of 0.2 in the TFR (less than the difference between the SSA and Census Bureau projections) lowers population growth and Social Security's long-run rate of return by 0.3 percent per year. If the return in a pay-as-you-go system falls from 3 percent to 2.7 percent, the annual benefit falls from $7.89 to $7.12 for a worker who pays $1 annual tax for 45 years. The present value of the benefits (discounted at an assumed market rate of 5 percent) declines from $8.77 to $7.91; the worker's burden rises from 51 percent to 56 percent of his or her tax payments.

Policy Implications

Although a pay-as-you-go system provides lower returns in a low-birthrate society, the implications for the decision to continue or end the system are unclear. Each future worker bears a heavier burden from continuing the system. However, because there are fewer of them, the *aggregate* burden is no larger (relative to the transition cost) than in a high-birthrate society. As shown in Table 2, the low birthrate harms all generations—the current generations who would bear the cost of ending the system and the future generations who would bear the cost of continuing it.

A complicating factor ignored in this analysis is the possibility that low birthrates may increase the capital–labor ratio, boosting real wages and reducing the rate of return on capital. As Bohn (1997, 203) and Cutler et al. (1990) note, these effects increase the well-being of each worker, potentially offsetting the heavier burden from the pay-as-you-go system. A reduction in the rate of return also means that helping future generations requires larger sacrifices by current generations.

BABY BOOM RETIREMENT

The baby boomers are now 37 to 56 years old. Although their impending retirement is widely described as a separate problem for Social

Security, this view is misleading. Table 3 modifies the low-birthrate example of Table 2 by having generation 1 give birth to a cohort twice its own size, while later generations retain a zero-growth birthrate. New numbers are in bold, and numbers from Table 2, if different, are in parentheses.

The baby boom permanently increases the population's size (row a) because generations 2 and later grow at the same rate from a higher base. National labor income is also permanently larger. The retiree–worker ratio falls to one-half in period 2, but thereafter returns to its previous value of one.

The temporary rise in the birthrate permits a temporary increase in the returns offered by the pay-as-you-go system. If the tax rate remains at 10 percent, aggregate transfers are twice as large as before from period 2 onward (rows b through e). Dividing by generation size reveals that each worker pays the same tax as in Table 2, as they must since the tax rate and wage are unchanged. Each retiree also receives the same benefit as in Table 2, except that each member of generation 1 receives double its former benefit. Generation 1 now enjoys a 300 percent return, whereas later generations still receive 100 percent returns. Generation 1's burden is smaller than that shown in Table 2, while each later generation's burden doubles (row f). Discounting and summing the burdens still yields a $1,000 unfunded liability, in accordance with the zero-present-value result.

Dividing by generation size to obtain per capita burdens (row g) reveals that generation 1's per capita burden is smaller than in Table 2, but the per capita burdens of later generations are unchanged. The boomers' retirement does not add to later workers' burdens; it merely prevents these workers from sharing the gains enjoyed by generation 1. The boomers' retirement in period 3 returns the growth rate of the working population and the retiree–worker ratio to their previous values.

The baby boom increases the number of people across whom the $1,000 unfunded liability is spread, allowing someone's burden to be re-

Table 3

Effect of Baby Boom on Pay-As-You-Go Retirement System

	Generation number				
	0	1	2	3	4
(a) Size of generation	**100**	**100**	**200** (100)	**200** (100)	**200** (100)
	Benefit (+) or tax (–)				
(b) Period 1	**+1,000**	**–1,000**			
(c) Period 2		**+4,000** (+2,000)	**–4,000** (–2,000)		
(d) Period 3			**+8,000** (+4,000)	**–8,000** (–4,000)	
(e) Period 4				**+16,000** (+8,000)	**–16,000** (–8,000)
	Burden = tax – (benefit ÷ 5)				
(f) Burden		**200** (600)	**2,400** (1,200)	**4,800** (2,400)	**9,600*** (4,800)*
(g) Per capita burden		**2** (6)	**12**	**24**	**48***

* Reflects benefit of **32,000** (16,000) received by generation 4 in period 5, not shown.

duced. Under the fixed-tax-rate policy in Table 3, these gains go to generation 1, the boomers' parents. A different policy keeps per capita benefits fixed by temporarily lowering the tax rate to 5 percent in period 2. It is then the boomers (generation 2) who enjoy a higher return and a lower per capita burden, while all other generations experience unchanged returns and per capita burdens. The period 1 present value of generation 2's gain from this policy is the same as that of generation 1's gain under the fixed-tax-rate policy.

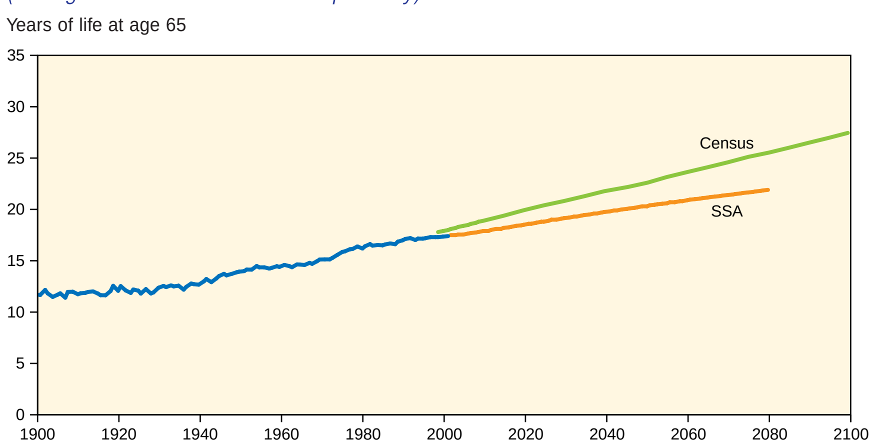
In the two-period example, the retiree–worker ratio returns to its initial value after one period. The fixed-tax-rate policy helps the boomers' parents, and the fixed-benefit policy helps the boomers; in each case, later cohorts are unaffected. I obtain generally similar results in an example with more realistic life-cycle assumptions. The retiree–worker ratio falls for 45 years after a 20-year baby boom and then returns to and slightly overshoots its initial value. The ratio follows damped oscillations around that value, with each cycle lasting 27 years, the assumed mean childbearing age. A fixed-tax-rate policy helps the cohorts born in a 45-year interval ending near the beginning of the boom, while a fixed-benefit policy helps those born in a 60-year interval roughly centered around and including the boom. For each policy, changes in later cohorts' well-being follow damped oscillations around zero with 27-year cycles. The present value of the aggregate gain is the same for each of the two policies.

The baby boom temporarily reduces the burden of the pay-as-you-go system. However, after the boomers retire, the system confronts the harsh reality of the low birthrate observed after the boom. Their retirement does not pose any problem separate from that posed by the low birthrate but simply marks the time at which the latter problem emerges.

DOWNWARD TREND IN OLD-AGE MORTALITY

In addition to the birthrate changes discussed above, the downward trend in old-age mortality also contributes to the aging of America charted in Figure 2. Figure 5 plots (the average of male and female) life expectancy

Figure 5
Life Expectancy at Age 65 Projected to Continue to Rise
(Average of male and female life expectancy)



SOURCES: U.S. Census Bureau (2000); Social Security Administration, http://www.ssa.gov/OACT/TR/TR02/lr5A3-h.html, http://www.ssa.gov/OACT/TR/TR02/lr5A3-2.html.

at age 65.[16] Its pace of increase has been uneven. Life expectancy rose 1.3 years in the 1940s, 0.5 in the 1950s, 0.7 in the 1960s, 1.1 in the 1970s, 0.8 in the 1980s, and 0.3 in the 1990s. In 2000, a 65-year-old could expect to live another 17.3 years. The SSA foresees a further rise of 0.5 to 0.6 years per decade, reaching 21.9 by 2080. The Census Bureau projects a rise of 0.9 to 1.0 years per decade, reaching 27.4 by 2100. This divergence indicates the uncertainty about future old-age mortality. Lee and Edwards (2002, 147), U.S. 1999 Technical Panel, and Brown (1996, 36–40) suggest that mortality reductions may exceed the SSA projection and resemble the Census Bureau projection.

Increased survival of retirees is a major contributor to the aging of America. However, a change in *old-age* mortality does not alter the growth rate of the *working-age* population plotted in Figure 4.[17]

Since a downward trend in mortality is difficult to analyze in the two-period example, I examine a single permanent change in mortality. I modify the two-period example in Table 1 by having generations 1 and later live a third period. The retiree–worker ratio rises from two-thirds to ten-ninths; in period 3, the population includes 250 retirees (100 of generation 1 and 150 of generation 2) and 225 workers.

Taxes or Per-Period Benefits Must Change, but Burdens Need Not Change

Lee and Edwards (2002, 144) note a basic distinction between changes in birth and death rates: "Longer life does not cause a fundamental resource problem. By contrast, lower fertility means that there are fewer working-age people….Population aging due to low fertility, unlike that due to low mortality, does fundamentally alter the resource constraints facing society." This distinction is important in this context.

In contrast to a birthrate decline, a mortality decline does not change the number of people across whom the burden of the unfunded liability can be spread. So, it is possible, if desired, to respond to the mortality decline without changing any person's burden. One such response is to impose the same tax rate as before, pay the same benefit in the first period of retirement, and pay no benefit in the new second period of retirement.

Even if benefits are paid in both retirement periods, it is still possible to leave burdens unchanged (*Table 4*). Permanently lower the tax rate from 10 percent to 8.696 percent in period 2 and, beginning in period 3 (the first period with two retired generations), pay three-quarters of the taxes to the young retirees and one-quarter to the old retirees. Generations 2 and later receive constant benefits over their two retirement periods. New numbers are in bold, while numbers from Table 1, if different, are in parentheses. Each generation's burden (row f) is unchanged from Table 1.

Since each generation from 2 onward pays less of its earnings into the pay-as-you-go system than in Table 1, each generation's unchanged

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[16] Life expectancy for 2002 is the average number of years that people live if they experience the age-specific death rates observed in 2002. Like the TFR, it is a period measure, which combines the death rates of different cohorts in 2002 rather than tracking deaths over time for any single cohort.

[17] Lower mortality for the working and childbearing population slightly *increases* the feasible rate of return. Lower female death rates increase the NRR (for any given TFR) and boost the intrinsic rate in equation (1). A downward trend in working-age death rates also boosts working-age population growth.

burden now represents a larger proportion of its tax payment. This larger proportional burden is not due to a lower rate of return. By paying $2,609 and receiving $5,869 in each of the two following periods, generation 2 still earns a 200 percent rate of return. (Investing $2,609 at 200 percent yields $7,826 in the next period, of which $5,869 can be withdrawn for the first benefit; reinvesting the remaining $1,957 at 200 percent yields $5,869 for the second benefit.) The rate of return is unchanged from Table 1 because the growth rate of national labor income is unchanged.

Instead, the larger proportional burden is due to the fact that each generation is exposed to the system's below-market returns for an additional period. This effect also occurs under more realistic life-cycle assumptions. For a worker who pays $1 annual tax for 45 years into a pay-as-you-go system with a 3 percent return, lengthening the retirement period from 15 to 20 years lowers the annual benefit from $7.89 to $6.33. The present value of the benefit stream (discounted at an assumed 5 percent market rate) falls from $8.77 to $8.43, compared with a present value of taxes of $17.89. The worker's burden rises from 51 percent to 53 percent of taxes, because he or she draws benefits at the below-market rate for an extra five years.

So, "neutral" responses that leave each worker's burden unchanged are possible, if desired. This is in sharp contrast to the unavoidable increase in some or all workers' burdens when the birthrate declines. However, because the longer retirement period increases the proportion of burden to taxes, the neutral response requires a reduction in the system's size. Although there are more retirees, aggregate benefits fall by 13 percent. As a result, the per-period benefits paid to generations 3 and later are 35 percent lower than in Table 1. This analysis of a single permanent mortality decline can be extended to a series of declines comprising a downward trend. A neutral response to such a trend requires a downward trend in aggregate benefits (relative to national labor income).

Table 4

Neutral Response to Longer Life in Pay-As-You-Go Retirement System

(10 percent tax rate in Period 1, 8.696 percent tax rate thereafter)

	Generation number					
	0	1	2	3	4	5
	Benefit (+) or tax (–)					
(a) Period 1	**+1,000**	**–1,000**				
(b) Period 2		**+2,609** (+3,000)	**–2,609** (–3,000)			
(c) Period 3		**+1,957** (0)	**+5,869** (+9,000)	**–7,826** (–9,000)		
(d) Period 4			**+5,869** (0)	**+17,609** (+27,000)	**–23,478** (–27,000)	
(e) Period 5				**+17,609** (0)	**+52,826** (+81,000)	**–70,435** (–81,000)
	Burden = tax – (first benefit ÷ 5) – (second benefit ÷ 25)					
(f) Burden		**400**	**1,200**	**3,600**	**10,800***	**32,400†**

* Reflects benefit of **52,826** (0) paid to generation 4 in period 6, not shown.

† Reflects benefits of **158,478** (243,000) and **158,478** (0) paid to generation 5 in periods 6 and 7, not shown.

Likely Political Response Shifts Burdens to Later Generations

Reducing aggregate benefits in response to an increase in retirees may not be politically feasible. A more politically realistic response keeps the tax rate at 10 percent, thereby holding aggregate benefits stable (relative to national labor income). If benefits still equal taxes in each period, aggregate transfers from workers to retirees are unchanged from Table 1 (*Table 5*). Paying three-quarters of each period's taxes to the younger retirees and one-quarter to the older gives each generation from 2 onward level benefits over its two retirement periods. Per-period benefits are reduced less than in Table 4 but are still 25 percent lower than those in Table 1.

Compared with Table 1, the burden on generation 1 is smaller, but those on generations 2 and later are 15 percent larger (row f). Discounting and summing the burdens confirms that the unfunded liability is still $1,000, which equals the start-up bonus, in accordance with the zero-present-value result.

Generations 2 and later suffer larger burdens, relative to labor income, than generation 1. The smaller burden on generation 1 reflects the fact that it receives the full initial benefit in its first retirement period plus an additional benefit in the following period. In effect, generation 1 receives its own start-up bonus. Later generations pay the same taxes as in Table 1 and still earn 200 percent rates of return. However, they suffer heavier burdens because, as discussed above, they are exposed to the system's below-market returns for an additional period. This analysis of a single decline can again be extended to a downward trend; the fixed-tax-rate response to such a trend benefits earlier generations while imposing steadily larger burdens (relative to labor income) on later generations.

These effects are reinforced under another plausible policy. Consider raising the tax rate to 13.33 percent to allow each generation to receive the same benefit in each retirement period that it receives in its single retirement period in Table 1. This policy lightens the burden still further for generation 1, because it now receives $3,000 in its second retirement period. Relative to Table 5, this policy increases the burden on all subsequent generations by

Table 5
Fixed-Tax-Rate Response to Longer Life in Pay-As-You-Go Retirement System

	Generation number					
	0	1	2	3	4	5
	Benefit (+) or tax (–)					
(a) Period 1	**+1,000**	**–1,000**				
(b) Period 2		**+3,000**	**–3,000**			
(c) Period 3		**+2,250** (0)	**+6,750** (+9,000)	**–9,000**		
(d) Period 4			**+6,750** (0)	**+20,250** (+27,000)	**–27,000**	
(e) Period 5				**+20,250** (0)	**+60,750** (+81,000)	**–81,000**
	Burden = tax – (first benefit ÷ 5) – (second benefit ÷ 25)					
(f) Burden		**310** (400)	**1,380** (1,200)	**4,140** (3,600)	**12,420*** (10,800)	**37,260**† (32,400)†

* Reflects benefit of **60,750** (0) paid to generation 4 in period 6, not shown.
† Reflects benefits of **182,550** (243,000) and **182,550** (0) paid to generation 5 in periods 6 and 7, not shown.

one-third, because they pay 13.33 percent rather than 10 percent of their earnings into the system. (The aggregate period 1 present value is still $1,000, in accordance with the zero-present-value result.) The analysis can again be extended to a downward trend; repeatedly raising the tax rate in response to such a trend imposes steadily increasing burdens on later generations.

Policy Implications

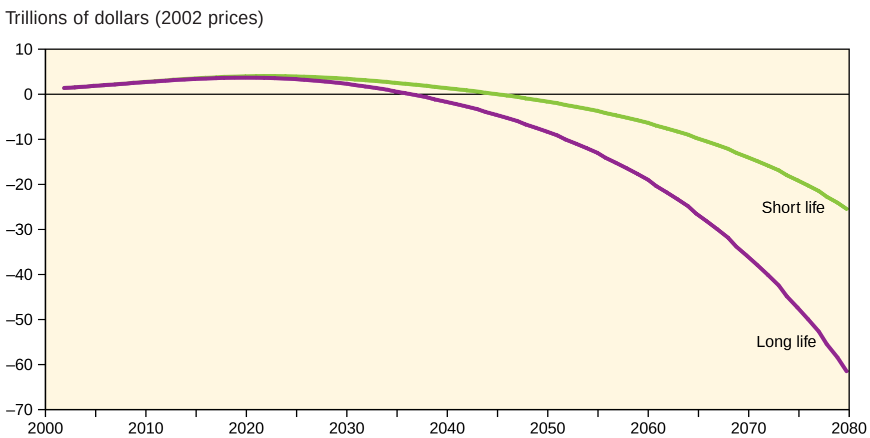
The above analysis suggests that it is important whether the system responds to longer retirements by lowering per-period benefits or raising tax rates. When Congress set current law in 1983, it anticipated a downward trend in mortality roughly similar to that now projected by the SSA. Congress' primary response to the anticipated trend was to reduce monthly benefits (relative to wages) for all cohorts born in and after 1938. However, this adjustment only maintains solvency through 2041.[18] With a downward trend in mortality, a single permanent benefit reduction or tax increase cannot maintain a pay-as-you-go system's solvency indefinitely. Instead, a downward trend in monthly benefits (relative to wages) or an upward trend in the tax rate is necessary. Current law is unsustainable because it does not address the continued downward trend in mortality expected after 2041.

The lack of automatic adjustments also implies that the pace of trust fund exhaustion is sensitive to unanticipated variations in mortality. Figure 6 displays the trust fund balance projected by the SSA for alternatives in

Figure 6

Longer Life Span Dramatically Worsens Trust Fund Balance

(Real trust fund balance, end of calendar year)



NOTE: Negative trust fund balances are hypothetical; they measure the magnitude of the adjustments necessary to maintain solvency.

SOURCE: Unpublished data from Social Security Administration Office of the Chief Actuary.

[18] When adopted, this reduction was intended to preserve solvency through 2058. Subsequent nondemographic developments, notably a rise in disability benefit claims and changes in SSA's forecasting methods, have advanced the expected insolvency date to 2041 (see Munnell 1997).

This benefit reduction is described as an increase in the "normal retirement age" from 65 to 67. However, workers can still choose to start receiving benefits at any age from 62 to 70, with larger monthly benefits available for later starting ages. The change simply reduces monthly benefits (relative to wages) available for each starting age. The change is partially effective for cohorts born in 1938 to 1959 and fully effective for later cohorts.

which life expectancy at age 65 in 2080 is 19.1 or 25.6 years (the latter resembles the Census Bureau projection) rather than the intermediate assumption of 21.9 years. Insolvency occurs in 2037 with the longer life span and in 2046 with the shorter life span.

The system's ultimate response to the downward mortality trend remains to be determined in future legislation. The U.S. President's Commission (2001, 16) presents an option with automatic reductions in monthly benefits (relative to wages) as mortality declines, an approach adopted by Germany and Sweden (Rürup 2002, 148–49; Palmer 2002, 176–78). Palley (2000) proposes automatic payroll tax rate increases. Diamond (1998, 43) supports altering both taxes and monthly benefits.

As indicated by Table 4, burdens (relative to labor income) can be equalized across current and future generations if the tax rate steadily declines as mortality falls. Compared with such a policy, the constant-tax declining-benefit policy imposes somewhat heavier burdens on future generations, as shown in Table 5. Palley's rising-tax constant-benefit approach imposes even heavier burdens on future generations. Of course, the burden on current generations falls as that on future generations rises. The choice between these options requires an evaluation of the needs, rights, and obligations of different generations. As with the effects of birthrate changes, a full analysis of the relevant trade-offs must also include possible effects of the mortality trend on real wages and the real return to capital. For example, the need to save for a longer retirement may increase the capital–labor ratio, boosting wages and reducing the rate of return on capital.

CONCLUSION

An economic analysis of pay-as-you-go Social Security provides insights into the similarities and differences of the three demographic developments that contribute to the aging of America. These insights have been overlooked in popular discussion, which has focused on whether Congress will need to alter current law to address these developments rather than how the developments ultimately affect various generations' well-being after any legal changes are made.

It is misleading to view the baby boomers' retirement as a separate problem for Social Security. Instead, it is best to view it as marking the end of the temporary gains provided by the baby boom and the emergence of the problem posed by the low birthrate observed after the baby boom. The low birthrate reduces the long-run rate of return offered by pay-as-you-go Social Security and increases the per capita burden imposed by the system, as the unfunded liability is spread across a smaller number of workers.

The downward trend in old-age mortality does not change Social Security's long-run rate of return. Because it does not change the unfunded liability or the number of people across whom that liability is spread, it is economically possible to adjust the system in a manner that does not change anyone's burden. Such a response is politically unlikely, however, because it *reduces* aggregate benefits as the number of retirees rises. More politically realistic options lighten burdens on earlier generations and increase burdens on later generations. Current law does not include any permanently feasible response to the trend, leaving the important choices to future legislation.

Recent demographic developments are likely to increase the burden that pay-as-you-go Social Security imposes on future generations. Moving away from the pay-as-you-go system would alleviate those burdens but would impose a substantial transition cost on current generations.

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