Social Security, Public and Private Savings

The Benefits of Flexible Funding: Implications for Pension Reform in an Uncertain World

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Aging populations are expected to put increasing strains on government budgets across the globe, but the extent of the pressure is unclear because of the substantial uncertainty surrounding estimates of pension costs several decades into the future. This article examines the implications of uncertainty over future pension costs for current decisions about how to undertake pension reforms, especially decisions involving prefunding. Prefunding can be thought of as an investment that initially entails some costs (during the transition to the new prefunded system) and then offers long-run benefits. In the face of uncertainty over long-run benefits, systems with more flexibility in the level of funding may be preferable to systems with less flexibility, because they allow policy to adapt more quickly should circumstances change.

As the proportion of the world's population 60 and older increases—from 9 percent in 1990 to 16 percent in 2030, according to World Bank (1994) projections—aging populations are expected to put increasing strains on government budgets across the globe (Lee and Skinner 1999). Substantial uncertainty surrounds estimates of pension costs several decades into the future, however. Actuaries for the U.S. Social Security Administration traditionally prepare three estimates: low cost, intermediate cost, and high cost. The intermediate estimate, commonly cited in the press, suggests a nontrivial actuarial deficit, but the low-cost estimate shows a small actuarial surplus over the next 75 years at the current payroll tax rate (U.S. Social Security Administration 2000). Many observers have objected to the manner in which Social Security actuaries reflect parameter uncertainty (Lee and Skinner 1999). But more sophisticated methodologies also show substantial uncertainty (figure 1).

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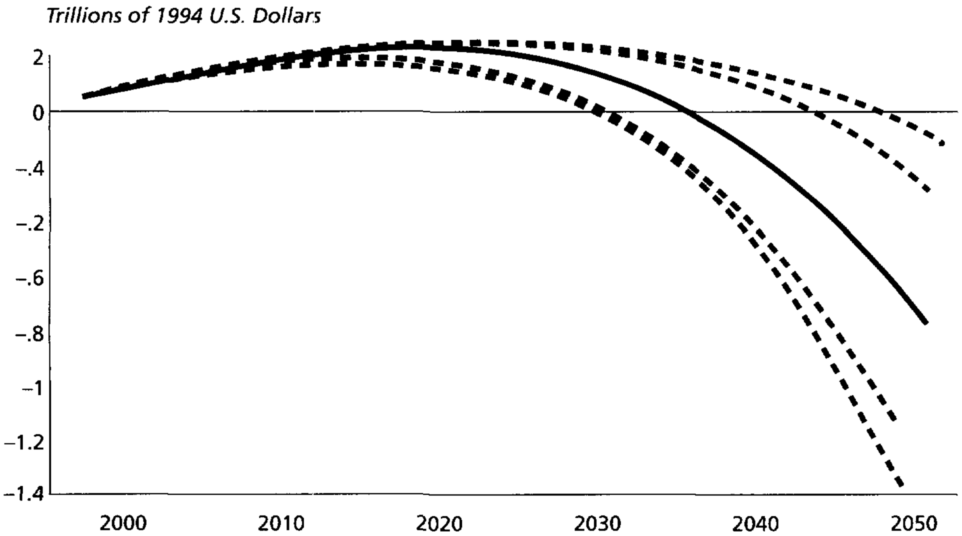
Figure 1. Central Estimate and Confidence Bands for U.S. Social Security Trust Fund Balance, 2000–50



Note: The confidence bands present the 67 percent and 95 percent confidence intervals. That is, the trust fund is projected to remain within the outermost set of lines with 95 percent confidence.
Source: Lee and Tuljapurkar 1999.

As Lee and Tuljapurkar (1998) conclude, "Rational planning for the next century must somehow take into account not just our best guesses about the future but also our best assessments of the uncertainty surrounding these guesses" (p. 393).

We examine the implications of uncertainty about future pension costs for current decisions on pension reforms. In particular, we show the importance of undertaking prefunding in a way that allows flexibility, so that the level of prefunding can be adjusted to reflect new developments.

The model we use adopts a "real options" perspective on pension reform. In this approach pension reform can be thought of as an investment that initially entails some costs (during the transition to the new system) and then offers long-run benefits. In the face of uncertainty over the long-run benefits, a key question is whether the costs can be recaptured. Systems that allow funding to be scaled up or down more easily may be preferable to less flexible alternatives, because flexibility allows policymakers to alter policy more quickly should circumstances change and thus to partially recapture the costs that had been incurred by funding in the first place. Under an inflexible system the costs of funding are much more difficult to recapture, even if it becomes obvious that the funding had been unnecessary.

An Illustrative Example

Consider a country with a pay-as-you-go pension system for which actuarial and economic analysis indicates that the social welfare cost will rise to 2 percent of

GDP next period. As just one motivating example for the social cost, assume that payroll taxes distort labor market choices and that the pay-as-you-go pension system is financed through payroll taxes that are higher than they would be in its absence.[1]

The social welfare costs are highly uncertain, however, because of uncertainties over fertility, mortality, productivity, and other economic variables, uncertainties that affect the cost rate of the pay-as-you-go pension system and therefore the social welfare costs from the distortions caused by payroll taxes. The social costs could be 1 percent of GDP or 3 percent of GDP, with 50 percent probability of each; the expected value is thus 2 percent of GDP. We assume that the social costs next period will be perpetuated into the future indefinitely.

By raising national saving today, the government can increase GDP next period and reduce the social welfare costs of the pension system as a percentage of GDP. Let us assume, again for simplicity, that broad prefunding would reduce the cost of the pension system to 1 percent of GDP next period and that there would then be no uncertainty over the welfare cost from period to period. (We use "broad prefunding" in the sense of Orszag and Stiglitz (2001) to mean an increase in national saving. Pension reforms that do not engender broad prefunding are unlikely to have any significant macroeconomic benefits.)

The benefit of broad prefunding is that it reduces the expected tax rate and therefore (in this simple model) the labor market distortion in the long run. Indeed, Feldstein and Samwick (1998) highlight this reduction in tax rates as a key advantage of funding.[2]

Such broad prefunding has a cost, however: the additional revenue necessary to produce it. In the absence of nondistortionary taxes, raising the additional revenue necessary to prefund the pension system will impose deadweight losses on the economy during the initial phase. (Broad prefunding requires some type of additional revenue; pure debt financing is not consistent with an increase in national saving. The source of additional revenue could be chosen to minimize the additional deadweight losses, but absent the availability of nondistortionary taxes at the margin, some additional deadweight loss is necessary.)

We assume that the temporary cost of increased distortions in the short run is equal to a one-time cost of 10 percent of GDP, which includes both the cost of paying down the implicit debt under the pay-as-you-go system and the cost of financing the pension system in the period during which the transition cost is borne. The unfunded implicit debt of the pay-as-you-go system is a stock that could be many multiples of GDP. Bravo and Uthoff (1999), for example, calculate implicit pension debts of more than 200 percent of GDP for Brazil in 1990 and more than 300 percent of GDP for Argentina in 1990. The social welfare costs of paying down the debt may thus be substantial in the short run, depending on the form of taxation used to do so.

Now consider a social planner trying to decide whether to prefund the pension system. At a real social discount rate of 5 percent, the expected present value (expressed relative to GDP) of the prefunding is:

(1)
$$-10+\sum_{t-1}\frac{2-1}{1.05^t}=-10+20=10$$

The prefunding thus appears to be socially beneficial. Several points about this example are noteworthy:

- The existing pay-as-you-go pension system is expected to become more costly over time, but there is uncertainty about how costly it will be.
- Prefunding is socially beneficial, but focusing solely on the expected differential between the pay-as-you-go system and the prefunded system in the long run is misleading. A full analysis must take into account the transition costs of moving from the pay-as-you-go to the prefunded system.
- The analysis is undertaken in terms of social welfare costs, not financial costs. The net present value of a pay-as-you-go system across all generations is always zero (Geanakoplos, Mitchell, and Zeldes 1999). This zero net present value condition implies that there is no free lunch from prefunding in net present value terms, but it does not require that the impact on social welfare be zero. Indeed, most economists support prefunding because they believe that it boosts social welfare. The social welfare implications depend on a broader array of considerations—including intergenerational and intragenerational redistribution concerns—than the financial zero net present value condition might suggest (Orszag and Stiglitz 2001). We assume in this example that the prefunding is socially beneficial, consistent with the beliefs of many economists.

This example seems to capture the essence of the argument for prefunding—that the existing pay-as-you-go system is expected to become more costly, that prefunding can reduce the long-run cost, and that prefunding improves social welfare. The example conforms generally to the argument often put forward in favor of prefunding. Feldstein and Samwick (1998), for example, note that the long-run reduction in tax rates and deadweight losses from prefunding follows only after an extended period (23 years in their base-case scenario) in which overall contribution rates and deadweight losses are higher than under the existing system.

If prefunding is irreversible, however, an alternative strategy may be preferable: waiting to see how the demographic and economic uncertainty resolves itself and then prefunding only if the "bad" case arises. In particular, consider the strategy of waiting until next period and prefunding only if the pay-as-you-go welfare cost turns out to be 3 percent of GDP. (If the welfare cost instead turns out to be 1 percent of GDP, the pay-as-you-go system would be perpetuated.) The expected net present value of that strategy is:

(2)
$$(0.5)-\frac{10}{1.05}+\sum_{t=2}\frac{3-1}{1.05^t}=0.5(-9.5+38.1)=14.3$$

This strategy thus produces a higher expected value than the straightforward funding strategy. This result occurs because the strategy avoids paying the transition costs in the scenario in which the social costs of the pay-as-you-go system turn out to be unexpectedly low. In that case, having paid the transition costs would (in this example) have been a mistake ex post.

The higher expected value produced in equation 2 relative to equation 1 could be seen as supporting the arguments by opponents of prefunding, who suggest that pension projections are highly uncertain and that it is therefore not worth incurring current costs to eliminate a projected imbalance. Dean Baker, of the Center for Economic and Policy Research, has stated that "it's hard to see what the benefits are of acting now. We want to plan ahead but want to have some idea of what we're planning for.... The idea that we have to do something now because 40 years from now the U.S. Social Security Trust Fund will be out of balance doesn't make sense" (cited in Pianin 2000, p. 4). He argues that internationally the expected payroll tax increase under existing pay-as-you-go systems is not as burdensome as often depicted (Baker 1999).

An alternative strategy, however, dominates the Baker approach in this model. In particular, consider a strategy that could be called "conditional prefunding."[3] Under this strategy prefunding is undertaken today but reversed tomorrow if the welfare costs under the pay-as-you-go system turn out to be 1 percent of GDP rather than 3 percent. Assuming that the 10 percent of GDP can be recaptured next period if the "good" case materializes, the net present value of that strategy is then:

$$(3) \qquad (0.5)-10+\frac{10}{1.05}+(0.5)-10+\sum_{t=1}\frac{3-1}{1.05^t}=0.5(-.48)+0.5(-10+40)=14.8$$

This conditional prefunding approach has the highest net present value of all. The reason is that it does not wait to prefund, as the Baker strategy does, when prefunding turns out to be socially beneficial and, unlike the irreversible prefunding approach, it eliminates the cost of prefunding when the prefunding turns out to have been unnecessary.

The implication is that prefunding can be socially beneficial but that systems in which prefunding can be adjusted as information changes may be superior to systems in which the level of prefunding is irreversible. As an extreme example, assume that prefunding occurs today but that tomorrow the economy becomes dynamically inefficient. Given the changed situation, the ability to reverse the prefunding could be valuable.

The examples above are predicated on full funding of the pension system. In reality, partial prefunding is more likely than either no funding or full funding. In a fully funded system the risks are asymmetric: Assuming that overfunding is precluded, the only possible adjustment is to reduce the funding level. Therefore, assuming that funding has been undertaken, the only relevant risks are ones that make undoing some of the funding more attractive. In a partially prefunded system, however, the risks are more symmetric: shocks may occur that warrant an increase or decrease in the funding level. Nonetheless, the key point carries across: flexibility to adjust the funding level is essential for responding appropriately to a pension challenge involving an expected but highly uncertain gain from a given level of funding.

The upshot of both the partially prefunded and the fully funded scenarios is that it is important to investigate precisely what makes one approach more or less flexible than another. In the context of pension reform "reversibility" means the ability to undo some of the funding—either by reducing the contribution rate below the funded path or by raising benefits above that path, thus reintroducing a pay-as-you-go component to the system.

The simple model described here clearly makes a number of restrictive assumptions. One of the most important may be that the funding level is adjusted solely in line with what a rational social planner would do. To the extent that flexible approaches to prefunding also allow such funding to be reversed for non-economic reasons—a phenomenon not addressed in the model—the argument in favor of flexible approaches may be weakened. But even in that case a tradeoff will exist between "socially rational" and "political economy" reversals.

A Deterministic Model

We now present a stylized model that captures the essential elements in the debate over a move toward fully funded private accounts. This section presents the deterministic model; the next section extends the model to include some uncertainty over the parameters. The intuitive, deterministic model provided here may be helpful in understanding the results presented later in the article.

Pay-As-You-Go System

Consider a simple model of a pure unfunded (pay-as-you-go) pension system in which:

- f is the growth rate of the working population of a given age (related to fertility and migration).
- d is the death rate (deaths as a percentage of the population).
- N is the length of the working life.
- t is the rate of the payroll tax used to finance benefits under the pension system.
- p is the replacement rate (pension income as a percentage of previous wages).
- g is the growth rate of real wages.

Pensions are held constant in real terms once in payment. The number of workers working at time t is:

(4) $$\tilde{N}(t) = \int_0^N e^{f(t-s)} ds = e^{ft} \frac{1-e^{-fN}}{f}$$

We assume no deaths during the working life, implying that the number of new retirees in any given year is e^{ft}. The number of retirees alive at any point in time is then:

(5)
$$R(t) = \int_0^\infty \exp(-ds)\exp(f(t-s))ds = e^{ft}\frac{1}{d-f}$$

The elderly dependency ratio (the number of elderly people divided by the size of the working population) is thus:

(6)
$$\frac{R(t)}{\tilde{N}(t)} = \frac{e^{ft}\frac{1}{d-f}}{e^{ft}\frac{1-e^{-fN}}{f}} = \frac{f}{(d-f)(1-e^{-fN})}$$

For example, if $d = 0.06$, $N = 50$, and $f = 0.01$, the dependency ratio is about 0.5.

Since pensions in payment are assumed to be indexed to prices, not wages, the total pension bill as a fraction of wages at time t will be:

(7)
$$pe^{-fN}\int_0^\infty e^{-(d+g)s}e^{f(t-s)}ds$$

or

(8)
$$e^{ft}e^{-fN}\frac{p}{g+f+d}$$

In this case the social security tax rate is:

(9)
$$\tau = \frac{p}{g+d+d}\,\frac{f}{1-e^{-fN}}\,e^{-fN}$$

Funded System

We assume that our hypothetical country has a pay-as-you-go system as described above and is considering a reform in which a fully funded system would ultimately replace the pay-as-you-go system. The funding could occur either through a public trust fund or through privately managed accounts. For now we assume that the two approaches are equivalent. In the next section, when we introduce uncertainty, we explore potential differences between them.

We assume that the replacement rate under the funded system is designed to be equal to the replacement rate under the pay-as-you-go system (p). Under the funded system the contribution rate, c, would thus be defined implicitly by:

$$c \int_0^N e^{g(s-N)} e^{(r-k)(N-s)} ds = p \int_N^\infty e^{-(r-k)(s-N)} e^{-d(s-N)} ds \tag{10}$$

where r is the gross rate of return earned on the account (and annuity, after retirement) and k is the reduction in yield from administrative charges on the account (and annuity, after retirement). The contribution rate can then be expressed as:

$$c = \frac{p}{d+(r-k)} e^{-(r-k-g)N} \frac{r-k-g}{1-e^{(g-(r-k))N}} \tag{11}$$

Note that $c < \tau$ if:

$$\frac{1}{d+(r-k)} e^{-(r-k-g)N} \frac{r-k-g}{1-e^{g-(r-k)N}} < \frac{1}{g+f+d} \frac{f}{1-e^{-fN}} e^{-fN} \; .$$

The system thus illustrates the Aaron (1966) rule, which states that assuming that $k = 0$, the contribution rate under the funded system is equal to the contribution rate under the pay-as-you-go system if $f + g = r$.

Transition to a Funded System

To examine the labor market distortions caused by the change in the contribution rate in the transition to the funded system, it is necessary to specify some transition path. For simplicity, we adopt an exponential path, in which the share of retirement income provided by the funded system (rather than the pay-as-you-go system) rises exponentially. The total replacement rate (from the funded and pay-as-you-go systems together) remains constant throughout the reform process. The exponential assumption simplifies the model, but it also implies that the pay-as-you-go system never completely disappears (instead, it becomes arbitrarily small).

During the transition the total replacement rate, p, for each cohort comprises two components—the part financed by the pay-as-you-go system and the part financed by the funded system:

$$p(Y,s) = p_f(Y,s) + p_u(Y,s) \tag{12}$$

where Y is the number of years since the reform, s is the number of years since the cohort's retirement, p_f is the replacement rate from the funded component of the system, and p_u is the replacement rate from the pay-as-you-go component.

The total payments to retirees (in terms of the average wage) from the pay-as-you-go component, $D_t(Y)$, where t is the year, are then given by:

(13)
$$D_t(Y) = \int_0^\infty p_u(t,s) e^{f(t-N-s)} e^{-ds} e^{-gs} ds.$$

If $Y = 0$, so that the pay-as-you-go component accounts for the entire pension, then:

(14)
$$p_u = \bar{p} \rightarrow D_t(0) = \frac{\bar{p} e^{f(t-N)}}{f+d+g}.$$

The exponential transition that we adopt in this model involves pay-as-you-go benefits of:

(15)
$$P_u(Y,s) = \begin{matrix} \bar{p} \text{ if } s \geq Y \\ \bar{p} e^{\mu(Y-s)} \text{ if } s < Y \end{matrix}.$$

In other words, cohorts that retire before the reform (implying that s is greater than or equal to Y) receive their entire pension from the pay-as-you-go component. Later cohorts receive a smaller and smaller share from the pay-as-you-go component. The speed with which the pay-as-you-go component declines is governed by μ.

Plugging equation 15 into equation 13, we see that the total cost of the pay-as-you-go component in year t is:

(16)
$$D_t(Y) = \int_0^Y \bar{p} e^{-\mu(Y-s)} e^{f(t-N)} e^{-(f+d+g)s} ds + \int_Y^\infty \bar{p} e^{f(t-N)} e^{-(f+d+g)s} ds$$

or:

(17)
$$D_t(Y) = \bar{p} e^{f(t-N)} \left[e^{-\mu Y} \frac{1 - e^{-(f+d+g-\mu)Y}}{f+d+g-\mu} + \frac{e^{-(f+d+g)Y}}{f+d+g} \right]$$

The pay-as-you-go contribution rate Y years after the reform is therefore:

(18)
$$\tau(Y) = \frac{D_t(Y)}{\tilde{N}(t)} = \frac{f\bar{p}e^{-fN}}{1-e^{-fN}}\left(e^{-\mu Y}\frac{1-e^{-(f+d+g)Y}}{f+d+g-\mu} + \frac{e^{-(f+d+g)Y}}{f+d+g}\right).$$

Together, the pay-as-you-go and funded components must produce an overall replacement rate of $\bar{p}$. Since the pay-as-you-go component provides a benefit of

$$\bar{p}e^{-\mu(Y+N-x)}$$

for the cohort age x years at time t, the cohort must contribute sufficiently to accumulate a fund providing a replacement rate equal to

$$\bar{p}[1-e^{-\mu(Y+N-x)}].$$

The contribution rate required for the funded component is then:

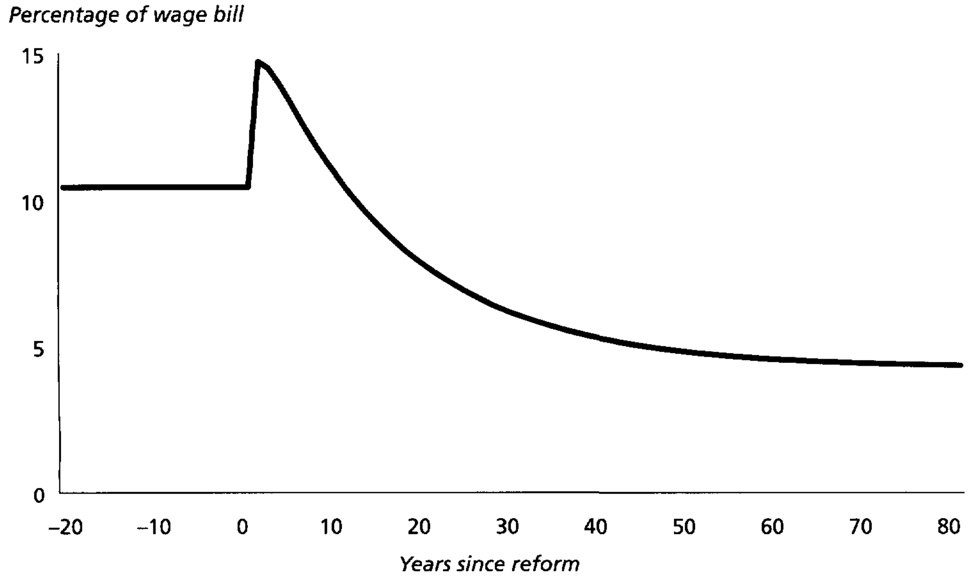
(19)
$$c(z,Y) = \frac{\bar{p}[1-e^{-\mu(Y+N-z)}]e^{-(r-k-g)N}}{d+r-k}\left\{\frac{r-k-g}{1-e^{(g-(r-k))N}}\right\}$$

where z is the cohort's age at the time of the reform. The total contribution rate for the funded and pay-as-you-go components of the system Y years after the reform for this cohort is therefore:

(20)
$$c(z,Y)+\tau(Y) = \frac{\bar{p}[1-e^{\mu(Y+N-z)}]e^{-(r-g-k)N}}{d+r-k}\left\{\frac{r-k-g}{1-e^{(s-(r-k))N}}\right\} + \frac{f\bar{p}e^{-fN}}{1-e^{-fN}}\left[e^{-\mu Y}\frac{1-e^{-(f+d+g-\mu)Y}}{f+d+g-\mu} + \frac{e^{-(f+d+g)Y}}{f+d+g}\right].$$

To obtain the aggregate contribution rate, $T(Y)$, which reflects the combined contribution rate as a percentage of total payroll, we weight equation 20 by the size of each cohort and integrate. Assuming that $f = 0.015$, $g = 0.015$, $d = 0.04$, $N = 40$, $p = 0.4$, $r = 0.06$, $k = 0.005$, and $\mu = 0.75$, the total contribution rate declines as a result of the reform (figure 2). Two observations are worth noting. First, the steady-state pay-as-you-go contribution rate (before the reform) is significantly higher than the steady-state funded contribution rate (apparent as Y increases and the pay-as-you-go component approaches zero). Second, to obtain the lower contribution rate in the long run, a transition is necessary in which the total contribution rate first exceeds the pay-as-you-go contribution rate and then falls beneath it. The reform thus involves an important intergenerational aspect: it imposes an additional burden on cohorts active in the labor market near the reform but reduces the burden on later cohorts.

Figure 2. Total Contribution Rate in Reformed Pension System



Source: Authors' calculations.

Calculating the Deadweight Loss

To examine the social welfare implications of the reform, we assume that the contribution rate is viewed as a pure tax by workers and examine the deadweight losses associated with the changing contribution rates. Several points are worth noting about this approach. First, the deadweight losses associated with a given contribution rate are more complicated than we suggest here. In particular, we assume that the full contribution rate, rather than the marginal lifetime tax rate (the contribution rate net of the present value of additional benefits), is viewed as a tax. Second, we abstract from the level of redistribution embodied in the system by examining the aggregate contribution rate, rather than the contribution rates for different workers. Third, we assume that the form of the pension system (defined benefit or defined contribution, funded or unfunded) does not affect the deadweight loss associated with any given aggregate contribution rate. Finally, the deadweight losses associated with different contribution rates are not the only channel through which pension reform could affect social welfare.

Our approach thus adopts a simplified version of the deadweight loss merely as a proxy for, or as one example of, the social welfare implications of prefunding. Other approaches to modeling the social welfare implications, as long as they involve up-front costs and long-run benefits, would produce qualitatively similar results. In computing the deadweight loss we adopt the Harberger (1964) approximation, as modified by Browning (1987):

(21)
$$DW(Y) = 0.5\varepsilon t(Y)^2 \left[\frac{w(Y)L(Y)}{1 - t(Y)} \right]$$

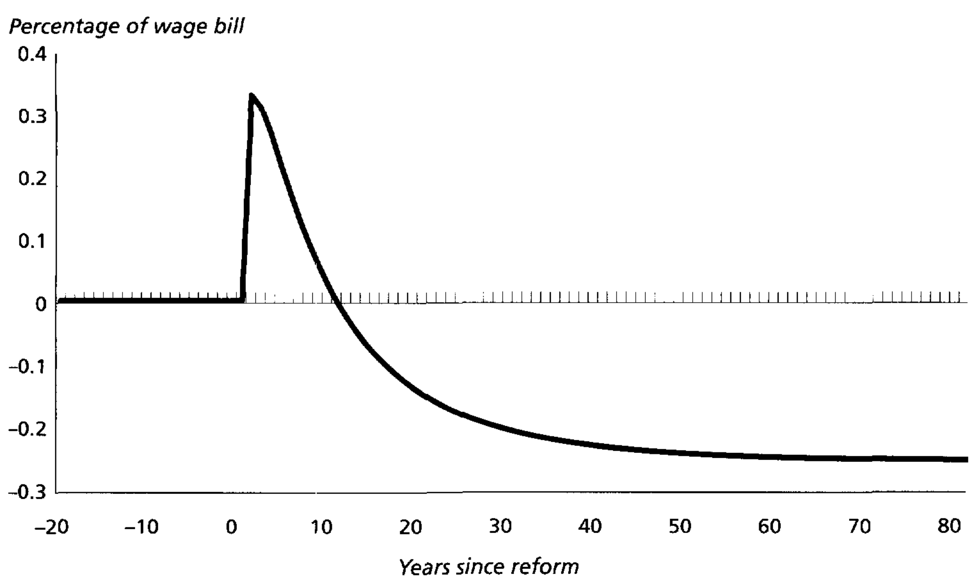
where DW is the deadweight loss Y years after the reform, ε is the compensated elasticity of total labor supply with respect to the net-of-tax return $(1 - t)$, $t(Y)$ is the total contribution rate Y years after the reform, and $w(Y)L(Y)$ is the total wage bill Y years after the reform. Following Feldstein and Samwick (1998), we assume that $\varepsilon = 0.5$. Using the same parameters as in figure 2, we obtain a time path for the deadweight loss (figure 3).

The net present value of the deadweight losses presented in figure 3 can then be compared with the net present value of the deadweight losses from continuing the pay-as-you-go system. Figure 4 presents the results given a discount rate equal to the interest rate assumed above ($r = 0.06$).

As figure 4 illustrates, the present value of the deadweight losses associated with the funded system is lower than the present value of the deadweight losses associated with the pay-as-you-go system. There is thus an expected social gain from funding. To explore the potential gain from flexible funding, we now introduce uncertainty into the model.

Parameter Uncertainty

Figure 3. Total Change in Deadweight Loss Associated with Pension Reform



Source: Authors' calculations.

To highlight the effect of unexpected shocks, we assume that at some time Z after the funding has been undertaken, a shock hits the economy that affects the death rate (d) and the productivity growth rate (g). We model two different approaches to the choices facing the policymaker: inflexible prefunding and conditional prefunding that allows the prefunding to be "undone" if warranted by the changing circumstances.

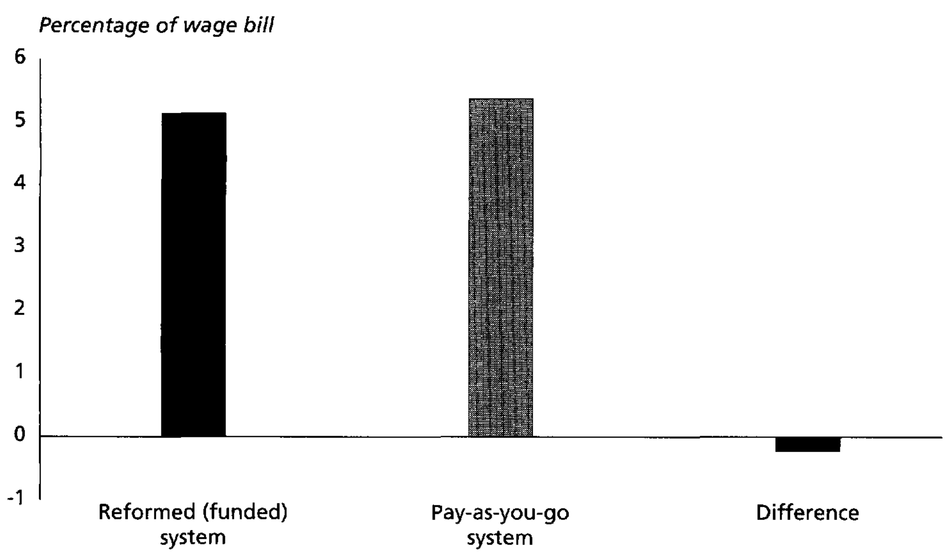
Assume that at time $Z = 30$, d rises to 0.08 and g rises to 0.035. Given these parameters, it would be worth "undoing" the funding and returning to a pay-as-you-go system. Under the conditional prefunding scenario we therefore assume that a given percentage (k) of the accumulated funding is dissipated each period by reducing the contribution rate for the funded component. Thus the conditional prefunded system evolves from an initial pay-as-you-go system to a funded system (at $Y = 0$) and then back to a pay-as-you go system (at $Y = 30$).

More specifically, we assume that after period Z the conditional prefunding system returns to being a pay-as-you-go system. The total cost of funding the ultimate pay-as-you-go component under the conditional prefunding approach can be broken down into three components:

- Payments to pensioners who retired fewer than $Y - Z$ years ago and thus receive a pay-as-you-go pension.
- Payments to pensioners who retired between $Y - Z$ and Y years ago and thus receive a partially funded pension.
- Payments to pensioners who retired more than Y years ago and thus receive a pay-as-you-go pension.

In other words, total expenditure under the conditional prefunding system as a function of the current wage is:

Figure 4. Present Value of Deadweight Losses



Source: Authors' calculations.

(22)

$$D_t(Y,Z) = \int_{0}^{Y-Z} \bar{p}e^{f(t-N)}e^{-(f+d+g)s}ds + \int_{Y-Z}^{Y} \bar{p}e^{-\mu(Y-s)}e^{f(t-N)}e^{-(f+d+g)s}ds + \int_{Y}^{\infty} \bar{p}e^{f(t-N)}e^{-(f+d+g)s}ds.$$

The total pay-as-you-go contribution rate can then be calculated from equation 18. But the conditional prefunding approach can also use the prefunded reserve in reducing tax rates. We assume that the way in which the prefunded reserve is decumulated is governed by:

(23)

$$\tau_t(Y,Z) = \frac{D_t(Y,Z) - \kappa_t F_t(Y,Z)}{\tilde{N}(t)}$$

where F is the size of the prefunded reserve and κ is an adjustment parameter, which may vary over time to prevent the contribution rate from becoming too small. The prefunded reserve thus falls over time based on decumulations to temporarily reduce the contribution rate for the pay-as-you-go component.

We show the contribution rates for this scenario, assuming that $\kappa = 0.1$, $f = 0.015$, $N = 40$, $p = 0.4$, $r = 0.05$, $k = 0.005$, and $\mu = 0.75$ (figure 5). The contribution rate under the conditional funding approach falls sharply when the shock hits and then gradually rises. Intuitively, the higher productivity growth rate and death rate raise the attractiveness of the pay-as-you-go system (in terms of its deadweight losses) relative to a funded system.

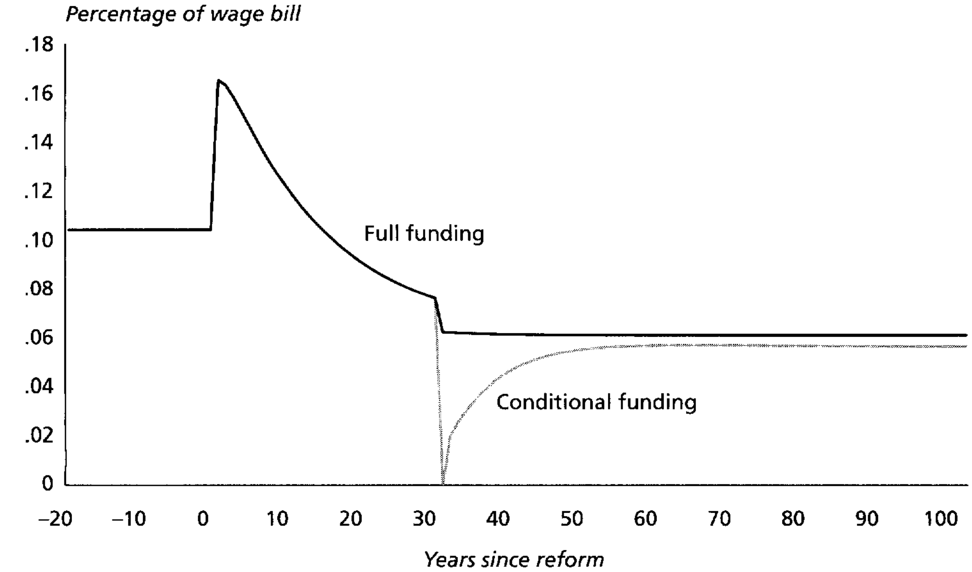
Given the new parameters (after $Y = 30$), the steady-state contribution rate under a pay-as-you-go system is lower than the steady-state contribution rate under the funded system.

The conditional funding approach takes advantage of this new environment by effectively reversing the funding, temporarily allowing a very low contribution rate. The full funding approach, which is too rigid to respond fully to the changed situation, is affected only slightly (the higher death rate, for example, reduces the contribution rate required for a given replacement rate under the funded system). The present value of the deadweight losses under the two approaches is greater under the fully funded system (figure 6).

The more formal model presented in this section delivers the same basic message as the intuitive approach presented earlier: if the future is highly uncertain, it may make sense to build in the flexibility to adjust the level of funding as the economy evolves. Several points about the model and its implications are worth highlighting.

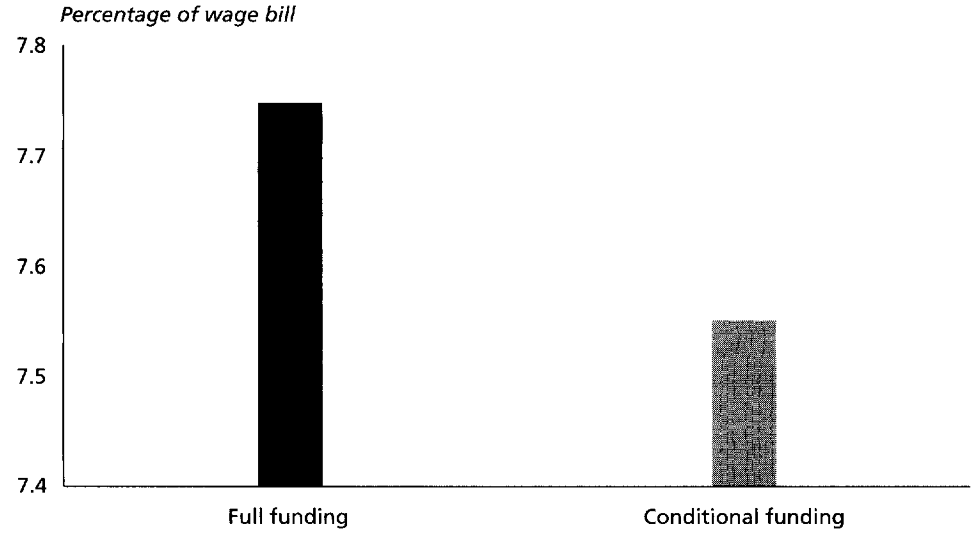
First, the main point—the desirability of flexibility in funding—shares certain similarities with the broader discussion of intergenerational risk sharing. That discussion implicitly involves a change in the level of funding, at least temporarily, when one generation is able to "share risk" with another (by reducing its funding share when a negative financial market shock hits the economy, for example). But the approach delineated here makes a somewhat different point. The discussion on intergenera-

Figure 5. Contribution Rates under Full and Conditional Funding



Source: Authors' calculations.

Figure 6. Present Value of Deadweight Losses under Full and Conditional Funding, Given a Shock



Source: Authors' calculations.

tional risk sharing focuses primarily on financial market risk (Bohn 1998 is an exception) and is concerned mostly with high-frequency fluctuations. Our approach reflects both demographic and financial market shocks, focusing primarily on low-frequency fluctuations.

Second, our model assumes that the shock hitting the economy after the reform is undertaken is permanent and large enough to reverse the relative social welfare benefits of a pay-as-you-go and funded system.[4] On the permanency of the shock, there is some evidence that mortality rates contain a unit root (so that any given movement in mortality rates should be expected to persist until another shock hits), as assumed by Lee and Carter (1992a) and Lee and Tuljapurkar (1998). With less persistent shocks, the benefits of flexibility would be attenuated. On the size of the potential shocks, the variance in future pay-as-you-go contribution rates highlighted by Lee and Skinner (1999) and by others suggests that the uncertainty is substantial enough to warrant concern about the ability of policymakers to respond. The resolution of all uncertainty is a more restrictive assumption than is necessary to generate some benefit from flexibility—all that is required is that some of the uncertainty dissipate over time.

Third, our model examines a situation in which there is only one major reform, one permanent shock that hits the economy thereafter, and one opportunity to undo the reform. These restrictions capture some elements of reality: many countries are considering substantial pension reform over the next decade or so (and some have already undertaken reform), and significant uncertainty remains about the demographics associated with a single event—the life expectancy of the relatively large baby boom generation in many countries. But the restrictions also abstract from a more realistic setting in which several shocks hit the economy and reforms are partial rather than absolute. The restrictions are helpful in identifying the underlying issues relating to funding flexibility, but the model should not be taken too literally. The model could clearly be extended to incorporate partial funding and multiple shocks.

Fourth, we have abstracted from political concerns about different approaches to funding. Examples of the concerns often cited include corporate governance problems, political malfeasance, and dynamic consistency. Such potential concerns may be significant enough to undermine the potential benefits of a more flexible approach. If the flexibility is more likely to be abused than used sensibly, its benefits are clearly undermined.

Political Economy of Public and Private Funding

The models above suggest that funding through a flexible system may be preferable to funding through an inflexible system. If further research supports the empirical relevance of this argument, a key policy issue will be which types of pension reform are the most flexible. This section briefly explores the flexibility embedded in a public approach to prefunding relative to that in a private one.

It may be easier to achieve some degree of reversibility in a public approach to prefunding—precisely the point made by many advocates of a private approach. If adopting a mandatory, privately managed second pillar is as dramatic and discrete a step as many descriptions of that approach suggest, the substantial uncertainty surrounding its benefits should give policymakers pause.

In a partially funded system, however, it is important to have the flexibility to both increase and decrease the level of funding. The political economy of an increase in funding, given a partially prefunded system, seems unclear. Concerns about government interference in the economy are likely to increase with the size of prefunding undertaken through a public system, making it increasingly difficult to raise the level of prefunding. But increasing the prefunding in a private system may also be increasingly difficult: increases in mandatory contributions to private accounts may become politically unacceptable.

These political economy issues are important, but they go beyond the scope of this article. We note only that the degree of flexibility may need to be added as a factor—in addition to potential differences in administrative costs, risk sharing given the level of funding, and redistribution differences—in the analysis of the relative costs and benefits of public and private approaches to prefunding. A public approach that provides slightly less prefunding but more reversibility may even be preferable to a private approach that provides more prefunding but less reversibility.

A related question is how flexible prefunding can be achieved in a real-world pension system. Finland provides one example. Its system of mandatory, employer-based private pension schemes covers virtually the entire private sector workforce. These employer-based pension schemes are of several different types, governed by different legislation. The degree of funding changes as different components of the system are adjusted.

The Finnish pension system is partially funded, with some schemes—such as those for the self-employed—unfunded. (About three-quarters of all current benefits are financed on a pay-as-you-go basis.) Interestingly, Finland created a special buffer reserve, amounting to 1.1 percent of the wage bill, when it joined the European Monetary Union in 1999. The size of the buffer changes over time. The buffer is explicitly intended to provide a flexible source of prefunding: it can be adjusted in response to external shocks and can thus offset some of the adjustment costs that would otherwise be associated with membership in the European Monetary Union.

Partially funded notional defined contribution (NDC) schemes may provide another example of flexible funding. In an NDC system wage earners pay contributions based on a fixed contribution rate. The value of these contributions is credited to notional accounts, giving the system a defined contribution feature. The account values are indexed annually to some macroeconomic metric (a nominal per capita wage index in Sweden, GDP in Italy). Upon the employee's retirement, the NDC benefit is calculated by dividing the value of the account by a factor based on life expectancy.

An NDC system need not involve any broad prefunding; it could be undertaken purely on a pay-as-you-go basis. But it could incorporate some prefunding, with the degree of funding similar to a reserve requirement on accounts that can be adjusted in line with economic conditions, much as central banks adjust reserve requirements for banks. Contrary to the conclusions of Disney (1999), the flexibility of a partially funded NDC approach in coping with shocks might be a reason to prefer such an approach to other pension reform strategies.

Conclusion

In exploring the implications of demographic and economic uncertainty for prefunding pension systems, we show that changing circumstances may warrant a change in the degree of funding. Committing to the up-front costs associated with moving from a pay-as-you-go to a prefunded system—without any assurance that the costs can be recaptured if the reform turns out to be less beneficial than had been expected—may therefore be unwise.

The model we present is intentionally limited in order to highlight the benefits of reversibility in funding. Despite its simplicity, it is consistent with sound pension policymaking and common sense.

Key areas for future research include building more detailed models in which flexibility matters, examining the empirical relevance of flexibility by parameterizing the models to real-world data, and evaluating the political economy of public and private approaches to prefunding and the implications for flexibility. This article represents a small step—but a step in a potentially important new direction that has not, to our knowledge, been explored in the pension reform literature.

Discussions of appropriate responses to the old age crisis must focus not just on expected events but also on the uncertainty surrounding those events. In the face of significant uncertainty, policymakers must carefully examine the costs and benefits of setting up inflexible funding systems. And in evaluating the costs and benefits of flexibility, they must assess whether the flexibility will be exercised judiciously.

Notes

1. Feldstein (1998) argues that such distortions already amount to approximately 1 percent of GDP for the U.S. Social Security system. As the payroll tax increases, the distortion would increase more than proportionately. The labor market distortions caused by payroll taxes within a redistributive pension system, however, are not as clear as they may initially appear (see Diamond 1998 and Orszag and others 1999).

2. According to Feldstein and Samwick (1998), "Reduction in the payroll tax rate results in a reduction in the deadweight loss that is itself equal to about 2 percent of payroll. Thus, the long-run gain from shifting to a funded system is almost as large as the entire 12 percent payroll tax. This is equivalent to a permanent increase in real income of about 5 percent of GDP" (p. 216).

3. Bohn (1998) uses "conditional prefunding" in a somewhat related sense.

4. Our example assumes that the changes in the productivity growth rate and the death rate, along with the pension system's response to those changes, do not affect the interest rate. This lack of feedback from the real shocks to the interest rate would be warranted, for example, if the economy were a small open one. The shock hitting the economy in this case would be large enough to make it dynamically inefficient, which may seem extreme to some readers. The shock does not need to be so large to allow the conditional prefunded system to dominate the fully funded one.

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