

THE POLITICAL ECONOMY OF GOVERNMENT-ISSUED LONGEVITY BONDS

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ABSTRACT

This article explores the trade-offs associated with government issuance of longevity bonds as a way of stimulating private annuity supply in the presence of aggregate mortality risk. We provide new calculations suggesting a 5 percent chance that aggregate mortality risk could *ex post* raise annuity costs for private insurers by as much as 5–10 percentage points, with the most likely effect based on historical patterns toward the lower end of that range. While we suspect that aggregate mortality risk does exert some upward pressure on annuity prices, evidence from private market pricing suggests that, to the extent that private insurers are accurately pricing this risk, the effect is less than 5 percentage points. We discuss ways that the private market can spread this risk, while emphasizing that the government has the unique ability to spread aggregate risk across generations. We note factors that might hamper such an efficient allocation of risk, including potential political incentives for the government to shift more than the optimal amount of risk onto future generations, and the possibility that government fiscal policy might allocate risk less efficiently within each generation than would private markets. We also discuss how large-scale longevity bond issuance might affect government borrowing costs, as well as political economy aspects of how the proceeds from such a bond issuance might be used.

INTRODUCTION

The provision of longevity insurance is a central function of governments around the world, as evidenced by the large share of public expenditures dedicated to public defined benefit pension systems. In most developed nations, the national government provides pension benefits in the form of annuities, which provide individuals with insurance against outliving their resources. At least since Yaari's (1965) seminal article,

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it has been known that the theoretical welfare gains to providing individuals with access to annuities are substantial. These gains arise because annuities provide risk averse individuals with a guaranteed lifelong income stream that lasts for as long as the annuitant survives, thus enhancing consumption smoothing by eliminating the individual's mortality risk as a significant source of financial uncertainty.

Despite the potential welfare gains from annuitization, the private annuity markets in many countries, including the United States, are not well developed, and a large literature has developed to explore the reasons why this is so.¹ Indeed, the potential "failure" of private annuity markets is often listed as one of several leading rationales for why government intervention in the retirement income market is potentially welfare enhancing.

While there are many possible reasons that the annuity market is small, including both rational and behavioral explanations, the private annuity market failure that is most commonly discussed in the literature is adverse selection. There is ample evidence that individuals who purchase private annuity contracts live longer, on average, than individuals who do not, and that this longevity differential leads private insurers to charge higher prices for annuities than they would in the absence of this selection effect (Mitchell et al., 1999). Adverse selection is a form of market failure that can, in principle, be addressed through government intervention. That is, if the government required that individuals annuitize part of their savings, individuals with lower-than-average life expectancies would be forced into the market, thus eliminating the information-based selection effects. Importantly, the government need not be the annuity provider in this scenario; instead, the government must simply use its power of compulsion to force individuals into annuity arrangements.

Even if adverse selection were adequately addressed through government intervention, however, another potential market failure is not solved simply by mandating that individuals annuitize. This market failure reflects aggregate mortality risk, i.e., the fact that there is uncertainty about overall rates of population mortality improvement. While insurers are extremely adept at using the law of large numbers to essentially eliminate the relevance of idiosyncratic risk facing any one individual that they insure, it is more difficult to hedge aggregate shocks to the entire distribution of mortality risk because, by definition, aggregate shocks cannot be diversified away simply by insuring more individuals (Milevsky, Promislow, and Young, 2006). Put differently, insurers face parameter risk with regard to the underlying mortality risk distribution. For annuity providers, the costliest risks are those of unexpected reductions in mortality that increase life expectancy for the population, such as would accompany new medical breakthroughs for treating leading causes of mortality, such as heart disease or cancer (e.g., see Stallard (2006) for discussion of recent declines in heart disease and stroke over the latter part of the twentieth century). To be sure, the uncertainty cuts both ways, as the outbreak of major pandemics could substantially increase mortality rates, as could some major environmental risks; events such as these would represent a positive financial shock to annuity providers.

¹ See, for example, Davidoff, Brown, and Diamond (2005); James and Vittas (2000); Mitchell et al. (1999); and Murthi, Orszag, and Orszag (1999).

To the extent that such innovations in mortality risk affect the entire population, and are thus systematic rather than idiosyncratic, they are more costly to insure. While annuity providers do have some tools available for minimizing exposure to this risk, such as diversifying across the age distribution, diversifying internationally (either on their own or through reinsurance contracts), partially sharing this risk with the annuitants, or hedging the risk by selling life insurance policies as well as annuities, such efforts generally cannot eliminate this risk entirely. Rational annuity providers are therefore likely to charge higher prices per unit of annuity payout than they would in the absence of such a risk.

To the extent that aggregate mortality risk is important for pricing annuities, and to the extent that consumer demand for annuities is responsive to pricing, addressing aggregate risk could be important for promoting annuitization through the private sector. Blake and Burrows (2001) have suggested that one potentially effective and appropriate way of addressing this risk would be for the government to issue “survivor bonds” or “longevity bonds.” These are financial products whose coupon payments are linked to the aggregate mortality experience of a specified cohort of individuals. By making such bonds available to the private sector, annuity providers would be able to hedge their exposure to aggregate mortality risk, which in turn would presumably allow insurers to increase annuity payouts per dollar of premium paid, or conversely, lower the premium per dollar of annuity income provided. The issuance of such bonds does not eliminate the aggregate mortality risk from the economy. Rather, it transfers the risk from annuity purchasers or providers onto the government, and thus implicitly on to current and/or future taxpayers.

The transference of risk through the government has the potential advantage of allowing for more efficient intergenerational risk sharing, because the government can, in theory, use fiscal policy to spread risk to future generations, a tool which is largely unavailable to private insurers. Whether optimal risk sharing will occur in practice, however, is unclear, both because governments may not optimally spread risk within a generation (perhaps due to competing policy priorities, such as redistribution policy) and because elected officials may have the incentive to excessively protect the current generation of voters at the expense of future generations. Government issuance of longevity bonds may also have other unintended consequences, depending on whether and how the government’s fiscal policy responds to the availability of additional debt instruments.

This article explores some of these public finance and political economy aspects of government provision of longevity bonds. While we stop short of providing a formal theoretical model, we nonetheless hope that this “thought piece” will highlight some of the key trade-offs in the analysis of whether it is desirable for the government to enter into the business of issuing such bonds.

This article proceeds as follows: In the section “Why Should Governments Care About Annuitization Policy?” we begin by reviewing the basic case for why policymakers ought to be concerned about annuitization levels, including the theoretical foundations for why annuities have the potential to increase individual consumer welfare. In the section “Information Problems and the Supply of Annuities,” we discuss two sources of information problems that have the potential to plague annuity markets: asymmetric information and aggregate risk. We also provide suggestive evidence

about the potential magnitude of aggregate mortality risk. In the section "Using Longevity Bonds to Hedge Aggregate Risk," we review the basics of longevity bonds and discuss how they could be used by insurers to hedge aggregate mortality risk. In the section "The Pros and Cons of Government Issuance of Survivor Bonds," we then outline the major arguments for and against government provision of longevity bonds. We discuss how the government's unique ability to spread risk across generations through its fiscal policy (i.e., tax and debt policy) must be weighed against the fact that governments may not always allocate risk efficiently within a generation and that elected officials may have an incentive to inefficiently pass more than the optimal amount of risk onto future generations. In the section "Other Political Economy Aspects of Longevity Bond Issuance," we discuss some additional political economy issues, such as the how proceeds from bond issuance would be invested in periods of budget surplus. The section "Summary and Conclusions" concludes.

WHY SHOULD GOVERNMENTS CARE ABOUT ANNUITIZATION POLICY?

The Individual Welfare Gains from Annuitization

At least since the seminal contribution of Yaari (1965), economists have understood that the ability to convert financial wealth into life annuities is potentially welfare enhancing for individuals. For example, Brown, Mitchell, and Poterba (2001) show that a 65-year-old risk-averse male, facing average US population mortality rates, would find access to actuarially fair real annuity markets roughly equivalent to a 50 percent increase in wealth.

Recent theoretical work by Davidoff, Brown, and Diamond (2005) shows that, if markets are complete, individuals without bequest motives should annuitize 100 percent of their wealth, so long as the return on annuities to surviving annuitants exceeds the return on an unannuitized version of the same asset. This dominance of annuities can be shown through a basic arbitrage argument, and does not require most of the Yaari (1965) assumptions, such as exponential discounting, time separability, or even that the utility function meets the von Neumann Morgenstern expected utility axioms. In other words, so long as the "mortality premium," which arises from the insurer's ability to pay a higher return in exchange for the annuitant giving up the right to annuitized wealth upon death, exceeds administrative costs and the costs of adverse selection, individuals without bequest motives will find it advantageous to annuitize all their wealth.

Does this mean that public policy should seek to encourage, or even require, full annuitization of resources? In general the answer is no, for two reasons. First, some individuals may have bequest motives that render complete annuitization suboptimal. While the academic literature has not been successful at convincingly demonstrating that bequest motives are an important determinant of marginal annuitization decisions (e.g., Hurd, 1987, 1989; Brown, 2001a, 2001b), this evidence should not necessarily be interpreted as evidence that individuals have no bequest motives at all. Second, even in the absence of bequest motives, many individuals may not be able to perfectly match their desired consumption stream with the income stream available from existing annuity products if annuity and other financial markets are not complete. For example, an individual who is highly risk tolerant and who has a high discount rate would not wish to convert all of her wealth into an inflation-indexed

annuity stream, because such a portfolio would place too much consumption in later years of life than is optimal. For example, Davidoff, Brown, and Diamond (2005) show that a 65-year-old male with log utility, facing a real interest rate of 3 percent and a rate of time preference of 9 percent, would wish to annuitize only about three-quarters of his wealth in a fixed real annuity. Similarly, individuals who face uninsurable risks other than mortality, such as end-of-life medical expenditures, may find full real annuitization suboptimal, as demonstrated by Turra and Mitchell (2004) and Sinclair and Smetters (2004).

Nonetheless, even under rather extreme mismatches between desired consumption paths and available annuity income streams, the optimal fraction of annuitized wealth is quite high. For example, Davidoff, Brown, and Diamond (2005) simulate a 65-year-old individual whose utility function exhibits internal habit formation and who faces a severe consumption drop at retirement. Even in this case where the income–consumption mismatch is quite severe, the individual would still wish to place approximately two-thirds of wealth in a real annuity.

Because of the robustness of the result that annuities increase individual welfare in rational consumer models, it is not surprising that many view increased levels of annuitization as a reasonable public policy goal. As will be discussed in the section “Information Problems and the Supply of Annuities,” if the private market is unable to provide an adequate supply of annuities due to market imperfections, and if these market failures are ones that the government has a comparative advantage in overcoming, then government intervention in the market for annuities may indeed enhance individual welfare.

The “Social” Gains from Annuitization

In addition to the potential individual gains from annuitization, potential positive externalities exist in the form of reducing moral hazard in the presence of means-tested antipoverty programs. Numerous studies have shown that means-tested programs can distort individual behavior in contexts such as savings (e.g., Hubbard, Skinner, and Zeldes, 1995), labor supply (e.g., Moffit and Wolfe, 1992), and insurance demand (e.g., Brown and Finkelstein, 2004). It is reasonable to suspect, therefore, that such programs may lead individuals to alter their postretirement spending behavior as well.

The basic concern is that, in the absence of annuitization, individuals may have the incentive to spend their financial wealth too quickly, knowing that if they live longer than anticipated and run out of money, they can simply rely on the government to provide benefits. Although such behavior may be individually optimal, it is socially costly because it increases the burden on means-tested programs, which are typically financed through distortionary taxes. Thus, public policies that help to encourage individual annuitization—such as a policy that requires that individuals annuitize at least enough wealth to remain out of poverty—will help to reduce this form of moral hazard.

INFORMATION PROBLEMS AND THE SUPPLY OF ANNUITIES

As discussed in the last section, standard economic models indicate that well-functioning annuity markets are socially valuable, both because they improve

individual welfare and because they reduce excessive reliance on means-tested programs. Given the potentially large individual welfare gains from annuitization, however, it is natural to ask why the government must be involved in this market at all. In other words, are there any market failures in the private annuity market that justify a role for government intervention?

This section examines two potentially important sources of market failure: adverse selection and aggregate mortality risk. We discuss why the first of these, adverse selection, is “easily” addressable through a program of compulsory annuitization. We then turn to a more in-depth discussion of aggregate risk, which sets the stage for the discussion of longevity bonds. We provide some evidence suggesting aggregate mortality risk may have an effect, albeit a potentially small one, on prices in the private annuity market.

Adverse Selection

Adverse selection in annuity markets arises when individuals with longer life expectancies are more likely to enter the market than individuals with shorter life expectancies. Insurers must account for lower mortality rates in the annuitant population by lowering annuity payouts or else the insurer will not be profitable. Normally, we consider these selection problems to be attributable to asymmetric information—in this case, the problem that individuals may know more about their future mortality rates than the insurer. In addition to this form of “active selection,” Finkelstein and Poterba (2002) make the point that annuity markets also suffer from a form of “passive selection,” which arises because, even in the absence of private information, annuitants in voluntary markets tend to have higher lifetime income than the general population. Since income is inversely correlated with mortality, even if annuity demand were driven entirely by income effects, we would expect to see the annuitant population living longer, on average, than nonannuitants.

There is ample evidence of both active and passive selection in voluntary annuity markets around the world. Mitchell et al. (1999) illustrate the degree of selection in the United States by computing “money’s worth ratios”—the ratio of the expected discounted value of annuity payouts to the upfront annuity premium—using both annuitant and population mortality tables. These calculations show that mortality differences between annuitants and the general population reduces annuity payouts by approximately 10 percent, in addition to the 5–10 percent “load” arising due to other factors. Murthi, Orszag, and Orszag (1999) find similar results for the United Kingdom. A survey of several other nations confirms that such differences exist in many nations (James and Vitas, 2000).

By themselves, these deviations from actuarially fair pricing are not sufficiently large to explain the low levels of annuitization observed in the United States and elsewhere. In conjunction with other market limitations, however, high prices may very well limit annuity demand. If so, lowering annuity prices by overcoming adverse selection might be considered a worthwhile goal of public policy. Compulsory annuitization represents the most straightforward solution to adverse selection.² By forcing

² As noted by Summers (1989), the government can accomplish compulsory annuitization either by directly providing the annuities (such as through the Social Security system) or by simply mandating that private employers provide them.

all individuals, regardless of demographic characteristics, to enter into an annuity pool, the average mortality rate of the pool will be higher than in a market subject to selection, and thus insurers will be able to provide higher monthly payouts per dollar of premium paid.³

To be sure, compulsory annuitization has other implications that policymakers may wish to consider. First, while it overcomes the selection problems of a voluntary market, annuity prices are still unlikely to reflect the equally weighted population mortality rates. Because of the correlation between economic resources and mortality, the dollar-weighted mortality rates in the annuity pool are likely to be lower than the people-weighted mortality rates, suggesting that pricing will still be higher than actuarially fair for the median individual (as opposed to the mean dollar) even in the absence of other mark-ups.

Second, as documented by Finkelstein and Poterba (2004), if individuals in a compulsory market have choice over the form of annuitization (e.g., whether to choose inflation indexed or nominal annuities), active selection can occur across annuity products. For example, individuals who expect that they will live longer than average are more apt to choose annuities with longer durations, i.e., inflation indexed or escalating nominal annuities, while individuals with shorter life expectancies will opt for annuities in which the payments are front loaded. Thus, selection across product type can also influence annuity prices.

Third, as discussed by Brown (2003), in a world with heterogeneity in expected mortality rates, mandatory annuitization amounts to a form of *ex ante* redistribution from high mortality rate individuals (who are more likely to be poor, male, black, and with low education) to low mortality rate individuals (who are more likely to be high income, highly educated, white or Asian women.) In a compulsory annuity market with uniform prices (i.e., prices that are “blind” to demographic and socioeconomic characteristics), the direction of the redistribution runs counter to the redistributive goals that are often part of public pension policy. Of course, as also noted by Brown (2003), the degree of “reverse distribution” is not as severe on a utility-adjusted basis as it is on a financial basis, because many of the low-income individuals place a high value on the insurance aspects of annuitization.

Aggregate Mortality Risk

From an insurer’s perspective, the mortality risk faced by individuals can be decomposed into two parts. The first part is the idiosyncratic risk that is unique to each individual. The second part is the systematic or aggregate risk that is correlated across individuals.

Idiosyncratic risk exhibits tremendous heterogeneity, and this risk varies with both observable and unobservable characteristics, including genetic make-up, socioeconomic status, life-style, and so forth. Idiosyncratic risk is easily insurable, though, because by pooling together a large number of individuals into a mortality “portfolio,” the idiosyncratic risks are diversified away, much the same way that a market

³ If the government mandates annuitization such as through Social Security, the problems of selection in the voluntary market may actually be exacerbated. For example, Abel (1986) shows that the introduction of actuarially fair Social Security reduces the steady-state rate of return on annuities.

portfolio of stocks diversifies away the idiosyncratic stock price risk of any individual firm. To be sure, individuals can often take actions to alter their idiosyncratic mortality risk. For example, if an individual decides to start smoking, the individual's mortality risk (and possibly the mortality risk of a few other individuals if they are exposed to second-hand smoke) will increase. However, any one individual's decision to start smoking will not significantly affect population average mortality risk.

In contrast, *aggregate* mortality risk is that risk which cannot be diversified away by combining a large number of individuals into a portfolio, and thus is analogous to market risk in a Capital Asset Pricing Model (CAPM) framework for financial securities. Because this risk is correlated across individuals, insurers cannot diversify it away no matter how large their insurance pool becomes. In the mortality context, examples of systematic or aggregate risk might be a medical breakthrough that reduces average mortality in the entire population, such as a cure for a leading cause of death, or a pandemic that is responsible for a major spike in mortality rates.

For annuity providers, the risk of a major reduction in average mortality rates may impose substantial financial risk. For example, if an insurer sold life annuities to the 1940 birth cohort when they turned 65 in 2005, under most annuity arrangements the insurer is legally bound to provide annuity payments for life to these individuals. If, in the year 2010, scientists find a way to slow down the aging process so that the remaining life expectancy of this cohort is extended by five years, the insurer would clearly end up losing money.

How might annuity providers react in the face of this risk? There are at least five possibilities:

First, the insurer may be able to hedge some of this risk using other insurance contracts. The insurer's problem is that it is adversely affected if mortality rates improve. Therefore, a natural solution is to also invest in products that payoff positively to the insurer if mortality rates improve. One natural product is life insurance, which essentially puts the insurer in the position of buying, rather than selling, annuities (Dowd, 2003; Milevsky and Promislow, 2003). If an insurer had a large portfolio of both life insurance and annuities, then the adverse financial effects of an aggregate positive mortality shock on their annuity business would be naturally hedged by the positive financial impact in their life insurance business. This strategy, however, is imperfect, because the dollar-weighted age profile of annuity contracts is much older than the dollar-weighted age profile of life insurance contracts. Therefore, in the likely case that shocks to mortality had a differential impact at different points in the age distribution, the ability to hedge this risk is inherently limited.

A second approach is to try to diversify the aggregate mortality risk internationally. This could easily be done, for example, through the use of reinsurance markets. Some have argued (Dowd, 2003) that because mortality shocks are not perfectly correlated across countries, insurers can diversify their holdings internationally and thus reduce risk exposure. This is analogous to a diversified US stock market investor adding international stocks to his portfolio. This approach, however, is also inherently limited by the fact that there will always be some mortality risk that is globally correlated, albeit perhaps with complicated lag structures.

A third approach would be for insurers (or reinsurers) to try to securitize this risk without the assistance of the government. The idea here is quite similar to the securitization of property-casualty risk due to hurricanes or earthquakes, a risk that has the property of being highly correlated across a large number of households. The logic of catastrophe securities is that, to the extent that the shocks are not perfectly correlated with the market, investors might find these securities an attractive way to diversify their financial portfolio (Froot, 1999). The problem with this idea in the context of longevity is that the potential shareholders—who are members of the currently alive generation—are themselves potentially subject to the aggregate mortality shocks. If a medical advance improves life expectancy for the entire population, the financial cost this imposes on annuity providers would have to be borne by individuals who just saw their own life expectancy increase. For a fixed set of resources, an increase in life expectancy likely increases the marginal utility of income within each period of life (because per-period resources are now lower), and thus these securities would have a poor payoff in states of the world where the marginal utility of income to investors is high. As such, it is not clear that securitization of this risk by insurers helps improve the market in any way, as those investors who are willing to bear this risk can now do so by investing in the insurers' stock directly.⁴

A fourth approach is for the insurers to pass some of this aggregate mortality risk onto the annuitants themselves, by offering "participating" annuities. Indeed, most of the annuities offered by TIAA-CREF, the leading annuity provider to academic and research institutions in the United States, are of this type. Under TIAA-CREF participating annuities, future annuity payouts rise and fall with unexpected mortality shocks to the population of individuals in a particular subaccount. This approach does not eliminate aggregate risk at all, but rather it merely transfers the risk to the individual. With well-informed consumers, equilibrium pricing would require that providers of participating annuities offer annuitants a higher expected payout to compensate the annuitants for bearing this risk.

Fifth, given the limitations on the ability of annuity providers to hedge this aggregate risk, the remaining strategy for insurers is simply to charge a risk premium for bearing this nondiversifiable risk.⁵ Indeed, the idea that annuity providers are charging a price that is higher than the expected value of the annuity payments due in part to nondiversifiable aggregate risk appears to be the primary rationale for why some have called for the government to issue longevity bonds (Blake and Burrows, 2001; Blake, Burrows, and Orszag, 2002).

Is Aggregate Mortality Risk Quantitatively Important?

Two previous studies have suggested that aggregate mortality risk is noticeable but not overwhelming. Friedberg and Webb (2006) use the Lee-Carter mortality model to calibrate aggregate mortality risk. They find that for an annuity provider to

⁴ Of course, investing in the insurer's stock is not a pure mortality play because the insurance company's value is also a function of its other lines of business, managerial skill, etc.

⁵ In the extreme, the price required to make the annuity business attractive to capital constrained insurers could be high enough that a company may choose not to enter the annuity market at all.

TABLE 1

Present Value of \$1 Per Year Annuity for a 65-Year-Old Male in 2006

	3 Percent Discount Rate	1 Percent Discount Rate	5 Percent Discount Rate
Mean	\$12.59	\$14.89	\$11.04
Median	\$12.58	\$14.86	\$11.04
95th percentile	\$13.53	\$16.17	\$11.76
99th percentile	\$13.96	\$16.74	\$12.08
99th/mean	1.108	1.124	1.094
95th/mean	1.075	1.086	1.065

reduce the probability of insolvency due to aggregate mortality risk to 1 percent, a 5 percent mark-up in annuity prices would be required. Reducing the probability of insolvency to 5 percent would require a 3.7 percent mark-up in annuity prices. These figures assume a 3 percent interest rate. At higher interest rates, the markups are smaller, since the impact of future risk on the net present value of annuity payments is smaller. In a somewhat similar spirit, Blake, Cairns, and Dowd (2006) estimate a 90 percent value-at-risk for mortality bonds with coupons at 4–5 percent of the premium.

To provide some additional estimates of the potential magnitude of aggregate mortality risk, we use the model developed by the Congressional Budget Office (CBO) to project mortality rates as part of their Social Security actuarial analyses. In particular, CBO provides projections of mortality rates by age category, along with estimates of the stochastic process governing the evolution of such mortality rates. More specifically, CBO has estimated an AR(1) regression of historical mortality rate changes for 65–69 year olds; 70–74 year olds; 75–79 year olds; 80–84 year olds; 85–89 year olds; 90–94 year olds; and 95 years and above. We used the results from that regression and the matrix of error terms that account for the covariance between mortality shocks across different age groups to undertake a Monte Carlo simulation of actuarially fair annuity prices for 65-year-old males in 2006. The results, based on 5,000 simulations, are presented in Table 1.

The results suggest that the expected present value of an annuity paying \$1 per year has a mean of \$12.59 at a 3 percent discount rate. The 95th percentile is \$13.53, and the 99th percentile is \$13.96. The present value cost of the annuity at the 95th percentile, in other words, is 7.5 percent higher than the mean cost, results somewhat higher but not dissimilar to those reported above. At a lower discount rate, the 95th percentile is somewhat higher compared to the mean, and vice versa for a higher discount rate.⁶ Given the limitations of this analysis (including the aggregation of different

⁶ These results assume death at age 100 with probability 1. Alternative scenarios in which death was not assured until 110 generated similar results. Under the alternative scenario, for example, the ratio of the 95th percentile to the mean was 8.4 percent assuming a 3 percent discount rate.

ages into age categories, the assumption of a smooth stochastic process, the failure to take uncertainty about the coefficients themselves into account, the assumption of real versus nominal annuities despite the much higher prevalence of the latter in the private market, and the use of males alone), we take these results as suggestive rather than definitive, especially since they are modestly higher than previous studies.

Our conclusion is that based on historical patterns, there is a 5 percent probability that aggregate mortality risk could raise real annuity costs *ex post* by 5–10 percentage points, with the most likely outcome toward the lower end of that range. The effect on annuity pricing is likely to be more modest than even the lower end of this range, however, because of intermediating factors at both the firm and shareholder levels. First, to the extent that insurance firms irrationally discount or even ignore aggregate mortality risk, the impact on pricing is muted.⁷ Second, to the extent that insurers can use some of the techniques discussed above to hedge this aggregate risk at least partially, the impact on annuity pricing should be more modest than suggested by the simulation results above. Third, to the extent that the firm cannot perfectly hedge the risk, the impact on pricing will reflect the compensation that the firm's shareholders demand in return for assuming this risk. On the other hand, the historical stochastic process may not capture the potential for discontinuous improvements in mortality in the future, so that the risk calculations could potentially understate the risks that insurance firms face.

Especially since the historical patterns may not be a reliable guide to the future (as perceived by insurance firms), we find calculations by Brown, Mitchell, and Poterba (2001) helpful in providing an upper bound effect on market pricing of aggregate mortality risk. Those calculations show that when the annuitant (rather than population) mortality table and the Treasury term structure of interest rates is applied, the money's worth ratio of life annuities is roughly 0.95. This estimate suggests that the *maximum* effect of aggregate mortality risk on annuity prices is 5 percentage points. Given administrative cost loadings and other market imperfections, furthermore, it is likely that the effect of aggregate mortality risk is even more modest than 5 percentage points. Admittedly, an implicit assumption in using current market prices to bound the influence of aggregate risk is that insurance companies are appropriately pricing it. Unlike many other forms of risk, if companies fail to price aggregate mortality risk appropriately, the market may not correct the problem in the short-run. In this sense, the problem is somewhat analogous to behavioral models of bounded rationality in individual retirement planning, where individuals may make poor decisions because they only retire once, and have no opportunity to learn from experience, or when they do experience the consequences, it is too late (Bernheim, 1999).

⁷ In the unlikely event that firms were ignoring aggregate risk while consumers were aware of it, and if these consumers were therefore concerned about the long-term financial viability of the insurance company from which they were purchasing the annuity contract, it is possible that providing insurers a way to hedge aggregate risk could increase consumer confidence that their claims would ultimately be paid. We believe this is an unlikely path for longevity bonds to increase annuitization, however, because rational consumers would tend to flock to those insurance companies that did the best job of hedging this aggregate risk, thus providing an incentive for otherwise short-sighted firms to consider this risk.

On net, we suspect that this risk does exert some upward pressure on annuity pricing, possibly in the range of a few percentage points. Government issuance of longevity bonds would allow insurers to hedge aggregative mortality risk and thus at least conceptually eliminate this effect on pricing. In the next section, we examine how longevity bonds would work.

USING LONGEVITY BONDS TO HEDGE AGGREGATE RISK

Blake and Burrows (2001) discuss in detail how a survivor bond issued by the government might work. Essentially, the government issues bonds whose future coupon payments depend on the survival rate of a specified cohort of individuals. For example, a bond could offer a coupon that pays \$1 times the fraction of a specified cohort that is still alive on the first day of each following year.

The key to these bonds is that at the time of issuance, the expected path of coupons is determined by the expected mortality rates of the cohort on which the bond is based. If there are no aggregate mortality surprises, the bond will therefore pay off exactly as expected. If, however, there is a positive longevity shock (i.e., mortality rates fall and life expectancies increase), then a larger fraction of this cohort will survive to the next period, thus increasing the coupon payment over its expected level. As a result, these bonds will increase in value precisely when there is a positive shock to longevity, making them a good hedge for insurers who are writing annuity contracts.

From the government's perspective, of course, this means that positive longevity shocks will increase the government's survivor bond liability. This increase in survivor bond liability occurs at the same time that the government's other annuitized liabilities—namely Social Security—are also increasing, thus adding additional variability to the government's fiscal stance. Under efficient intergenerational risk sharing, the optimal response would be for the government to pass at least some portion of this additional cost to future generations in the form of higher implicit or explicit debt (as opposed to immediately financing the entire fiscal shock by altering current tax and spending levels). We will further discuss the government's ability to engage in this optimal risk sharing in the next section.

In practice, issuing longevity bonds would require decisions on a series of difficult technical issues. For example, survivor bonds could be issued as nominal bonds or as inflation indexed bonds; the latter would simply adjust the coupon by survivorship and the inflation rate. The government would also have to decide how the cohort mortality rates would be calculated. For example, would rates be set on a unisex or gender differentiated basis? Would the basis be a single birth year or multiple cohorts? Would the rates need to be set with a lag to account for the fact that the reporting of deaths is not instantaneous? These, and other, technical issues, including several raised by Stallard (2006), are beyond the scope of this article, but would clearly need to be addressed were the government to actually issue longevity bonds.

THE PROS AND CONS OF GOVERNMENT ISSUANCE OF SURVIVOR BONDS

In this section, we operate under the assumption, which as noted may or may not be the case, that aggregate risk is significant enough that it adversely influences annuity pricing and is therefore an appropriate topic for policy concern. The natural question arises as to whether the public sector, e.g., the US federal government, should issue

longevity bonds as a way of stimulating the private annuity market.⁸ We begin by summarizing the major argument in favor of this form of government intervention, and then turn to a discussion of reasons that government issuance of survivor bonds may, in practice, not achieve a socially optimal outcome.

Government Issued Survivor Bonds and Intergenerational Risk Sharing

In analyzing the government's role in the market for longevity-based insurance products, we begin with the underlying assumption that there exists a market failure that inhibits the private market's ability to insure against aggregate longevity risk. In this context, the major source of market failure appears to be the fact that, as noted by Bohn (2005), "future generations are naturally excluded from insurance markets . . . (and thus) welfare-improvements are made possible because a government's power of taxation gives it the unique ability to make commitments on behalf of future generations."

In the presence of a market failure, government intervention *may* improve social welfare if the government has a comparative advantage in overcoming the source of the failure. Indeed, the government already serves as the conduit for a large amount of mortality risk through the Social Security and Medicare programs. For purposes of this discussion, we will make the assumption that the government will take the level of aggregate risk as given, and thus seek to efficiently allocate aggregate longevity risk to those individuals who are most willing and able to bear it.

Implicit in this assumption is that the government is not taking steps to alter the level of aggregate risk. This is clearly not a fully tenable assumption, as the government influences the evolution of aggregate mortality rates in numerous ways. For example, the federal government intervenes in health-care markets through funding medical research, encouraging or discouraging certain health-related investments through the tax code, and influencing the demand for new medical technology by the large role that it plays as a third-party payer (e.g., via Medicare), among other ways. Many government policies, such as a decision to heavily invest in cancer research, may increase insurer exposure to aggregate risk. The assumption we are making is not that the government will or will not undertake these investments, but rather that the government's decision to invest in better health care is not affected by the degree of government exposure to aggregate risk, or vice versa. Thus, the question at hand is whether the government can indeed allocate a given amount of risk more efficiently than the private market.

The government's ability to transfer risk across generations gives it a potentially important advantage over private insurance markets and financial markets. As noted by Bohn (2005), the government's comparative advantage is that if each generation is differentially exposed to aggregate risk, the government can use fiscal policy (social insurance programs, taxes, transfers, and public debt) as a way to spread risk across generations. In short, the government has the ability to make markets more complete

⁸ Michael Orszag has pointed out that issuing longevity bonds may help to facilitate a transfer of legacy defined benefit obligations from individual firms to the government. We do not explore this motivation for longevity bonds in this article, although we note that the desirability of this type of transfer is debatable.

by allowing contracts between generations that the private market cannot provide. However, as Bohn (2003a) points out, one must also consider the general equilibrium effects of a realization of aggregate risk. If a shock to longevity alters the capital–labor ratio, wages of future generations would be expected to adjust. Thus, if a positive longevity shock increases not just life spans, but also increases the length of working lives, it is possible that the future supply of labor will increase, reducing the capital–labor ratio, and thus decreasing wages. In this sense, future generations may already be partially sharing in the risk through these general equilibrium effects, and a failure to account for these effects could lead to suboptimal policies.⁹

It is also worth noting here that the form of risk involved here—longevity risk—has a characteristic that makes it somewhat different from the types of risk that most individuals are used to insuring. For most although not all types of insurance that an individual buys (e.g., insurance against property–casualty losses, insurance against adverse health events, insurance against death, etc.), the states in which the marginal utility of income is high corresponds to a state in which the level of utility is low. For example, when someone experiences a large financial loss due to a house burning down, this loss reduces utility and raises the marginal utility of income. With longevity risk, however, reductions in mortality are usually considered welfare enhancing. For example, Nordhaus (2002) has suggested “to a first approximation, the economic value of increases in longevity in the last 100 years is about as large as the value of measured growth in nonhealth goods and services.” An unexpected mortality reduction for the current generation presumably increases its lifetime utility. However, because the current generation is not fully annuitized, the increase in longevity means that its existing financial wealth must be stretched over more periods (especially for retirees, who cannot easily reenter the labor force in order to increase the size of their financial wealth). As a result, consumption per period of remaining life is reduced, thus increasing the marginal utility of income in each period of life. The standard role of insurance is to transfer wealth away from states of low marginal utility of income and toward states of high marginal utility of income, and thus a reduction in mortality is precisely an outcome that individuals should wish to insure against (even though it does correspond to a positive, i.e., utility increasing, event).¹⁰

Who, then, can help to provide this insurance? As noted earlier, insurance and financial markets are inherently limited in their ability to insure against aggregate shocks that affect an entire generation, because at any given point in time those companies and

⁹ In general, what matters is the correlation between human and physical capital returns across generations. It is theoretically possible that future generations could already be overexposed to some types of macroeconomic risk. For example, Bohn (2003a) shows that with regard to productivity risk, laissez-faire allocations are inefficient because they impose too little productivity risk on retirees and too much risk on future generations. From this perspective, the government’s reliance on issuing safe debt and promising safe public pensions is inefficient (unless risk aversion increases with age). Similarly, Smetters (2003) shows conditions under which the government should actually spread productivity shocks across generations by shorting the stock market rather than taking a long position.

¹⁰ For a more formal treatment in a life-cycle model with and without bequest motives of how increased longevity will influence the marginal utility of income, and thus consumption and saving decisions, see Skinner (1985).

securities are owned by the same generation. What about future generations? With improvements in longevity, future generations are, in most cases, also subject to the same longevity shock. If scientists today discover a cure for cancer, not only will the life expectancy of today's generation increase, but the life expectancy of future generations will almost surely increase as well. Indeed, it seems entirely plausible that the innovation will have an even larger impact on the life expectancy of future generations, because the technology will exist from the moment of birth.

The key difference is that the current generation has fewer opportunities to adjust their lifetime labor supply, consumption and savings decisions to adapt to this new realization of mortality. For example, if scientists suddenly discovered a way to cut mortality rates in half above age 80, thus extending life expectancy for everyone, most of today's 80-year-olds would be unable to reenter the labor force, and thus any unannuitized wealth would have to be stretched over a longer period. Today's 60-year-old would at least have some opportunity to adjust their date of retirement and/or savings behavior, but even their ability to respond would be more limited than today's 40-year-old, and so forth. By the time the next generation is born, behavior could be adjusted throughout the lifecycle to incorporate this information. Thus, social welfare gains would arise from the ability to spread some of the financial risk of a sudden aggregate mortality shock from today's 80-year-olds to future generations. Given that the government is the only body with the ability to enforce intergenerational contracts, the government has a potential comparative advantage in efficient risk spreading.

Would Government Spread This Risk Efficiently across Generations?

The standard efficiency rationale, outlined in the last section, for allowing the government to intervene in markets with aggregate risk that is undiversifiable within a generation is the potential welfare gain achievable from spreading this risk across generations. In practice, however, an important question is whether the government will actually spread this risk efficiently. After all, to maximize social welfare, it is not sufficient that the government move *any* amount risk from the current generation to some other generation. Rather, the government needs to move the *optimal* amount of risk onto the right generations. One political economy concern about government issuance of survivor bonds is that it is far from certain that the government will transfer the optimal amount of risk.

The US government is, to a very large degree, already in the business of intergenerational risk sharing through the pay-as-you-go Social Security and Medicare systems. If the government were to issue survivor bonds, the amount of aggregate risk that is processed through the government would increase even further (unless the issuance of these bonds was accompanied by policy changes that reduced the government's exposure through these other programs).¹¹ It is difficult to state with any degree of

¹¹ For example, in the United Kingdom context, Turner (2006) argues that there is a case for government issuance of survivor bonds, but only if it first exits from its exposure to mortality risk in other areas. In essence, this amounts to a shift in the composition of its longevity risk exposure (e.g., bearing more of the risk at older ages and less at younger ages) rather than a net increase in overall exposure.

confidence whether the US government today is engaged in an optimal amount of intergenerational risk sharing. Indeed, political economy considerations suggest that government policies may systematically tilt toward current generations and away from future generations. As Heller (2003) notes, "Taking the long term into account requires that political decision makers be willing to ask generations living today, whether working or retired, to sacrifice a portion of their own interests for those of later generations, including those yet unborn. . . . Even if the merits of such action appear sensible in strict economic benefit-cost terms, the political costs may seem to today's politicians to be better spent addressing current needs."

Several models based on the median voter theory have similarly suggested a political economy motivation for politicians to redistribute resources toward current voters. For example, Bohn (2003b) argues that the necessary condition for Social Security to continue is that the median-aged voter in each election has to expect positive returns from the program. That is, Social Security must maintain majority support in each round of a sequential game, and it will do so if the median voter—because of his age and for other reasons—stands to gain from Social Security, regardless of the impact on future generations.

Regardless of whether future generations are already facing an excessive *level* of cost or risk because of such political economy considerations, it is conceptually possible that mechanisms could be put in place to allow more efficient sharing of unexpected *changes* to longevity. It is not obvious that an efficient risk sharing policy will be the natural outcome of the political process, however. For example, there could be a tendency for "good" news to be shared with the current generation of retirees, whereas "bad" news is shifted entirely onto future generations. Although policymakers could try to minimize the likelihood of an asymmetric response by legislating automatic adjustments, this would not entirely eliminate the risk because future Congresses would always have the right to alter the adjustment process. As such, it is quite possible that government issuance of survivor bonds will not lead to a more efficient allocation of risk across generations than would be the case in the absence of these bonds.

Would Government Spread This Risk Efficiently within Generations?

Within a generation, prices in an efficient financial market will ensure that, in equilibrium, risk is borne by those individuals most willing to bear it. When the government takes on financial risk, this risk is spread within the generation not through market prices, but rather through the government's tax and expenditure policies.

In theory, the government could choose to allocate risk efficiently through the tax system. In practice, tax bases and tax rates are set based on a very large number of considerations, including economic factors (e.g., can we tax inelastic factors more?), distributional factors (e.g., how convex should the structure of marginal rates be?), administrative factors (e.g., how costly is it to administer alternative tax regimes?), and political factors (e.g., is the tax system fair?). In general, there is little reason to think that elected officials will make tax and spending decisions within a generation based solely on whether the risk is being borne in an economically efficient manner. As discussed in detail by Bohn (2005), risk bearing is "often determined by subtle features of economic institutions that are ill defined or not well understood."

Toward a Trade-Off Theory of Intergenerational Risk Sharing?

While we are not offering a formal theoretical model of optimal risk sharing in this article, we are implicitly suggesting that there is an underlying “trade-off theory” of intergenerational risk sharing. In such a model, the benefits of being able to spread aggregate longevity risk intergenerationally would need to be weighed against two political economy constraints. The first is that elected officials may inefficiently push too much risk onto future generations, and that the resulting risk allocation could potentially turn out to be less efficient than a world in which there is no intergenerational risk sharing. The second is that even if policymakers succeed at efficiently transferring resources from low marginal utility generations to high marginal utility generations, it does not follow that the government will succeed at allocating these resources efficiently within a generation.

While a formal model of these trade-offs is beyond the scope of this current article, the nature of the trade-offs is such that it is quite difficult to clearly conclude that government provision of survivor bonds would enhance social welfare even if aggregate risk were having a first-order effect on annuity prices. Indeed, given that the effect of aggregate risk on annuity prices is not likely to be greater than a few percentage points, combined with political economy concerns about the implementation of intergenerational risk sharing, the likelihood of significant welfare gains from government issuance of survivor bonds is small.

OTHER POLITICAL ECONOMY ASPECTS OF LONGEVITY BOND ISSUANCE

The Cost of Government Borrowing

The introduction of a new type of government security has the potential to affect the government’s cost of borrowing. To be clear, we are not suggesting that the interest rate on longevity bonds is itself a source of comparative advantage to government issuance. As with all types of government lending or borrowing, the opportunity cost is the private rate of return on capital. Thus, the fact that the government might itself be able to issue bonds at a lower rate does not provide any intergenerational advantage over the private sector because the private sector ultimately bears the risk.

Nonetheless, conditional on the amount of borrowing that the government wishes to engage in, adding longevity bonds to the mix of available securities may alter the cost of borrowing. However, the direction of any such effect is unclear. On the one hand, longevity bonds represent a financial instrument not currently available on private markets, and to the extent that they provide a useful hedge for insurance firms, such firms should be willing to pay more for such bonds than for conventional bonds. If this were the only effect, it is possible that their issuance could lower net borrowing costs.

On the other hand, the longevity bond market is likely to be relatively thin, and the relative lack of liquidity in the market may somewhat depress the price of longevity bonds. These two effects are similar to those associated with the introduction of inflation-indexed bonds: the inflation protection component of the bonds introduced an asset class that had previously been missing in financial markets, but the market was less “deep” than the traditional Treasury bond market.

Investing the Proceeds

The net supply of government debt is a policy decision that is determined in large part, although not entirely, by the broader fiscal stance of the public sector. Specifically, during times of government deficits, the net proceeds from debt issuance may be used to finance those government expenditures that exceed revenue. During periods of government budget surpluses, the proceeds from any new debt issues can be used to buy back previously issued debt. If the net proceeds from debt issuance exceed the government's need for cash, the government is then faced with a question of how to invest the proceeds.

If the government were to start issuing longevity bonds, a natural question arises of how much the supply of longevity bonds would vary based on overall government financing needs. If the sole reason that the government issues longevity bonds is to stimulate private annuity markets, a plausible case could be made that some minimum amount of such bonds ought to be issued regardless of the government's need for financing deficits or refinancing the outstanding debt.

Budget scoring rules can affect how policymakers think about various types of federal funds when they make taxing and spending decisions. Depending on how the investment of funds is scored, it is possible that large sales of longevity bonds could distort the federal government's taxing and spending decisions. If so, mechanisms might therefore be needed to segregate longevity reserves from other federal funds.

To give a sense for the importance of budget scoring rules, it is useful to discuss how security issuances and purchases are scored today.¹² When the Treasury department issues securities, no budget transaction occurs. Presumably, this would be true for longevity bonds issued by Treasury as well. An issuance of securities is deemed an exchange of assets, as the government receives cash and issues securities of equal value. Therefore, there is no budget outlay and no receipt.

If the proceeds from a bond issuance were invested in corporate stocks or bonds, however, there are conflicting views about how this should be scored. Office of Management and Budget (OMB) Circular A-11, which is a document that explains basic budget rules, says that such a purchase is a government outlay, whereas the sale of such assets is a government receipt. Why does this matter? Suppose that through some combination of budget policy and issuance of longevity bonds, the government needed to invest excess longevity bond proceeds in private securities. Under the OMB rule, the purchase of private securities would be scored as a budget outlay, thus providing the appearance that government spending was higher than it really is. Depending on one's view of the political economy of the budget process, this change in the reported fiscal position of the government might influence other government spending decisions.

¹² The rest of this section draws substantially on (and in some cases directly quotes) material from the 2005 National Academy of Social Insurance report "Uncharted Waters: Paying Benefits from Individual Accounts in Federal Retirement Policy." In particular, we are drawing heavily from material presented in Box 4-8 on page 95 of that report. While both of the authors of this current paper were members of the NASI panel, the material from Box 4-8 was provided by Douglas Elliott (Center on Federal Financial Institutions) and Richard Kogan (Center on Budget and Policy Priorities).

However, many budget experts believe this rule is incorrect, and that it would be more consistent to treat this as an exchange of assets. Consistent with this view, in 2002 Congress allowed the Railroad Retirement Board to invest its assets in stocks and corporate bonds. Both the CBO and the Office of Management and Budget scored these transactions as an exchange of assets (NASI 2005).

SUMMARY AND CONCLUSIONS

This article summarizes the pros and cons of the government issuing longevity bonds as a way of providing private market insurers with an opportunity to hedge aggregate mortality risk. Our calculations and previous estimates suggest that aggregate longevity risk may raise annuity costs by 5–10 percentage points with 5 percent probability, with the most likely effects toward the lower end of that range. The effect on pricing is likely to be more modest than this, but we suspect that aggregate mortality risk may nonetheless exert some upward pressure on annuity prices. Because the large literature on annuities has not produced a price elasticity of demand for these products, it is difficult to assess the degree to which any price reduction associated with transferring this aggregate risk to the government would translate into meaningfully higher levels of annuitization. In particular, while the direction of the effect is clear, we are somewhat skeptical that such a price change would have a significant effect on the overall level of annuitization in the economy.

The potential efficiency gains from having the government issue longevity bonds arise from the government's unique ability to spread aggregate mortality risk across generations. We discuss two reasons, however, why it is unclear whether these potential gains would ever be realized. First, elected officials may have an incentive to transfer more than the optimal amount of risk to future generations. Second, the government likely does a poorer job of allocating risk within any given generation than private markets. As a result, the ultimate welfare effects of government issuance of survivor bonds are ambiguous.

Were the government to decide to issue longevity bonds, careful consideration would have to be given to additional factors as well. First, it is unclear whether the addition of this new financial instrument would increase or decrease government borrowing costs, due to the trade-off between tapping into a new source of demand and potentially limited liquidity. Second, if the decision regarding the amount of longevity bonds to issue is driven by factors other than the need to finance government budget deficits, this raises difficult issues about how excess funds would be invested.

Taken as a whole, the issues raised in this article suggest that the decision to issue longevity bonds should not be made under the assumption that the end result will necessarily improve social welfare. While that desirable outcome is possible, it is by no means guaranteed.

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