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LONGEVITY-INSURED RETIREMENT DISTRIBUTIONS FROM PENSION PLANS: MARKET AND REGULATORY ISSUES

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ABSTRACT

This paper explores the extent to which retirees can and do insure themselves against longevity risk in private pension plans. We first review the theoretical and empirical results on the value of annuities, and discuss reasons why households may choose not to further insure themselves against longevity risk. We then analyze current trends in the private pension market, and find that the shift from defined benefit plans to defined contribution plans is likely to reduce annuitization rates among future retirees. This is driven primarily by the fact that the majority of DC plans, such as 401(k) plans, do not even offer participants a life annuity option at retirement. Thus, individuals who wish to annuitize generally must do so in the individual market where payouts are lower due to a healthier mortality pool. Hence, we can forecast that in the coming decades, absent institutional and regulatory changes, overall annuitization rates may fall and households may be increasingly exposed to the risk of outliving their financial resources, while the currently small private individual annuity market may witness significant growth. Finally, we discuss several policy options designed to increase annuitization of retirement resources.

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The method of funding retirement in the United States is in the midst of a major transition, one that is placing greater responsibility on individuals for managing their own retirement assets. The past two decades has witnessed a large shift away from defined benefit to defined contribution pension plans, a trend that appears likely to continue for the foreseeable future. According to some estimates, the average retiree's balance in 401(k) plans alone will rise tenfold over the next 30 years, and will rival Social Security as the major source of retirement wealth (Poterba, Venti, and Wise 2000).

While defined benefit (DB) and defined contribution (DC) plans differ along many margins, one of the most important differences is the method of distributing retirement income. Traditional DB plans typically paid benefits in the form of a life annuity and thus provided retirees with a form of insurance against outliving their resources. According to standard economic life-cycle theory, this longevity insurance is quite valuable to consumers, as it provides a higher sustainable level of consumption than is available in the absence of this insurance. Defined contribution plans, on the other hand, are much less likely to offer life annuities to retirees. Instead, most DC plans offer some form of lump-sum payment and/or "phased withdrawal" options upon retirement. While these alternative distribution methods offer retirees a high degree of flexibility and liquidity, they fail to provide a formal mechanism by which individuals can insure against the risk of outliving their resources, an issue that is central to this paper.

Individual responsibility for retirement asset decumulation has also emerged as a policy issue in the debate about supplementing or partially replacing the current social security system with an individual accounts program. The existing OASI system is currently the primary source of annuitized income for the majority of U.S. households, and

is the only meaningful provider of inflation-indexed annuities. As such, any plans to alter the existing social security benefit structure could impact the desirability of alternative distribution methods from private pension plans.

This paper examines the extent to which individuals can and do insure themselves against longevity risk in defined contribution plans. This issue is of policy concern for several reasons. The distribution method chosen can directly affect the extent to which retirees are able to finance consumption in old age, particularly for those individuals that live significantly longer than they anticipated at retirement. Also, increasing average longevity and the trend towards earlier retirement presumably makes the problem of ensuring adequate resources throughout individuals' old age more widespread among the population. The adequacy of old age income directly affects the extent of poverty rates among the elderly, a problem that is especially acute for elderly widows (Hurd and Wise, 1987). In addition, if individuals fail to adequately provide for old-age consumption needs, this could increase the financial pressure on means-tested social assistance programs such as SSI and Medicaid. Finally, the distribution method chosen can significantly impact the size of intergenerational transfers taking place in the economy, and thus impact the wealth distribution of the next generation and even the amount of estate tax revenue collected.

This paper focuses on five issues. First, we review the welfare gains from annuitization that result from a standard life-cycle model (Section 1). We then discuss several reasons that households may choose not to annuitize in spite of these theoretical welfare gains, including the presence of Social Security, pricing of annuities in the market, bequest motives, inflation risk, health uncertainty, ignorance, and regulatory impediments

(Section 2). Third, we demonstrate that one result of the shift from DB to DC plans is a reduction in opportunities for annuitization of retirement wealth, due to the fact that the majority of DC plans do not offer an annuity payout option (Section 3). Fourth, we indicate that even though the fraction of retiree wealth that is annuitized will likely decline, the individual annuity market will likely experience substantial growth in the coming decades as households who desire longevity insurance are forced into the individual market with their retirement assets (Section 4). One likely implication of this shift towards individual markets is a reduction in the annuity income available per dollar of retirement wealth, because annuity payouts in the individual market are probably lower than those in the group market. Finally, we discuss the pros and cons of a number of regulatory options available, including annuity mandates, tax incentives, and government provision, for increasing annuitization of DC account balances (Section 5).

1. The Welfare Benefits of Annuitization

Annuities play a central role in the economic theory of wealth decumulation. By trading a stock of wealth for a life-contingent income stream, a healthy individual is able to sustain a higher level of consumption than in the absence of annuities, and is assured that this income cannot be outlived.

If an individual does not have access to annuitization, then she must allocate her retirement wealth in a manner that trades off two competing risks. The first is the risk that if she consumes too aggressively, she increases the likelihood of facing a future period in which she is alive with little or no income. The second is the risk that if she self-insures by setting aside enough wealth to be certain it cannot be outlived, then she risks dying with assets that could have been used to increase consumption while alive.

Yaari (1965) was the first to demonstrate the economic value of annuitization in a life cycle model with uncertain lifetimes, and this framework has been used extensively to value the insurance benefits of annuities. The basic result is that a life-cycle consumer will always choose to purchase actuarially fair annuities to finance retirement consumption, and absent a bequest motive, will annuitize 100% of his resources.[1] The intuition for this result is straightforward -- annuities pay a rate of return that is equal to the riskless rate plus a mortality premium. The mortality premium arises from the fact that the there is some positive probability that the insured individual will not be alive to receive future payments. Because this mortality premium is always positive, it means that the annuity rate of return strictly dominates the riskless return. In addition, because the annuity income cannot be outlived, the individual is completely insured against an outcome in which they are alive in some future state without sufficient resources to fund ordinary levels of consumption.

The welfare gains from annuitization can be put into dollar terms using an expected utility framework (interested readers will find a more formal treatment of this model in Appendix A). Consider a 65-year old consumer facing an uncertain date of death, who maximizes a lifetime utility function given a fixed amount of retirement wealth. We first allow this individual to fully annuitize in an actuarially fair market, and we calculate the utility level that this individual achieves. We then take away access to the annuity market, and ask the question "how much additional wealth must we give this individual to make him as well off (i.e., put him on the same expected utility curve) in the absence of annuities as he would be if he were permitted to fully annuitize his wealth?"

[1] In a simple life-cycle model with no other savings motives besides retirement consumption and bequests, and individual with bequest motives will invest the bequest portion of wealth in riskless bonds, and will annuitize the rest.

In previous work (Brown and Poterba 2000, Brown, Mitchell, and Poterba 1999, Brown 1999b), the ratio of non-annuitized to annuitized wealth that puts one on the same expected utility curve has been labeled as the "Annuity Equivalent Wealth," or AEW. For example, if the AEW equals 1.20, it means that an individual would be indifferent between $120,000 of non-annuitized wealth and $100,000 of fully annuitized wealth.

The middle column of Table 1 reports the AEW for an individual, inflation-indexed annuity purchased by a 65-year old male with mortality expectations consistent with that of the 1933 birth cohort (that turned 65 in 1998). Because the value of annuitization rises with risk aversion[2], we report values of the AEW for several different levels of the risk aversion parameter in the utility function. For the case of log utility (CRRA=1), the AEW is 1.502, indicating that this consumer would be indifferent between obtaining access to a real annuity or having a 50.2% increase in non-annuitized wealth. For higher levels of risk aversion, the increase is even more substantial. With risk aversion of 10, having access to an actuarially fair annuity is equivalent in utility terms to a doubling of wealth.

Within this life-cycle model, the gains from annuitization are substantial. Given this, economists have been somewhat puzzled by the limited extent of annuitization outside of DB plans and Social Security. A substantial literature has examined a number of possible explanations, which we review in the next section.

[2] With CRRA utility, the reciprocal of the risk aversion parameter is the elasticity of substitution in consumption across periods. A low risk aversion coefficient corresponds to a high willingness to substitute consumption intertemporally.

2. Why Don't Individuals Fully Annuitize?

2.1 *Individuals are Annuitized by Social Security*

Social Security, itself a real annuity, is the major asset in the portfolio of most retired individuals (Mitchell and Moore, 1999). Because Social Security provides a minimum level of income that will last for life, recipients are already protected against completely outliving their resources. Therefore, the benefits from additional annuitization will be reduced. However, the benefits from additional annuitization do not fall to zero, because in the simple life-cycle framework, 100% annuitization of retirement assets is still optimal in the absence of bequest motives.

The life-cycle model can be adapted to account for the presence of pre-existing annuities, such as Social Security. As reported in the last column of Table 1, the gains from additional annuitization are smaller, but still substantial. For example, consider the case of an individual with log utility who has $100,000 of non-annuitized wealth and is also entitled to a flow of Social Security benefits with an expected present value of $100,000. In other words, 50% of this individual's net worth is already annuitized. In this case, the person is indifferent between annuitizing the $100,000 of financial wealth or having $133,000 of non-annuitized wealth, or has an AEW of 1.33. While this is lower than the 1.502 AEW in the absence of pre-existing annuity wealth, it is nonetheless substantial. Thus, while the presence of Social Security and defined benefit pension plans may lessen the value of additional annuitization, it cannot, by itself, explain why individuals do not choose to annuitize all of their retirement resources.

2.2 Individual Annuity Markets Do Not Offer Actuarially Fair Prices

One important explanation for the lack of annuitization is that annuity prices are unattractive for the average person in the population. Price deviations from their actuarially fair level can be expected to arise for two basic reasons. First, insurance companies selling annuities need to cover administrative and marketing expenses and earn a competitive accounting profit. Second, to the extent that individuals who choose to annuitize have longer life expectancies than the general population, insurance companies need to adjust their prices to reflect this fact.

Friedman and Warshawsky (1988, 1990) were the first to document the extent to which private market annuity prices deviate from an actuarially fair level by calculating a money's worth ratio using both population and annuitant mortality tables. The money's worth ratio is a measure of the expected discounted present value of future annuity payments per dollar of premium that an individual can expect to receive if she were to participate in the individual annuity market. Mitchell, Poterba, Warshawsky and Brown (1999) and Brown, Mitchell and Poterba (2000) have extended this pricing analysis on more recent data. In 1999, a 65-year old male (female) with mortality rates like that of actual annuitants could expect to receive approximately 97 cents (95 cents) on the dollar, when discounted using the Treasury yield curve. This suggests that administrative costs account for a 3-5% reduction in annuity payouts. However, when valued using population-average mortality rates, a 65-year old male (female) could expect to receive only 85 cents (87 cents) on the dollar. This suggests that adverse selection is responsible for an 8-12% reduction in annuity payouts. Therefore, to the extent that annuities are priced unattractively, it is due to selection effects more so than administrative costs. It should be

noted, however, that the observed load factors are not large enough by themselves to explain the almost complete lack of annuity demand by U.S. households.

2.3 Bequest Motives and Risk Sharing within Families

The original life-cycle model of annuity valuation (Yaari 1965) recognized that if retirees wish to leave bequests to their children, full annuitization is no longer optimal. Walliser (1999) shows that if bequests enter the utility function in a CRRA form and are weighted such that optimal bequests are about four times annual consumption, then with actuarially fair annuity markets and a risk aversion coefficient of 2, it would be optimal to annuitize only 60% of one's wealth at age 65. Furthermore, the optimal allocation to annuities would fall with age. Sufficiently strong bequest motives, combined with the existence of Social Security and the fact that private annuity markets are not actuarially fair, could explain the limited amount of annuitization.

There is an extremely large economics literature on the subject of bequest and transfer behavior that has failed to come to a consensus on whether bequest motives have an important effect on household asset allocation and consumption decisions.[3] For example, Hurd (1987) shows that couples with children do not decumulate their retirement assets any faster than couples without children, and interprets this as evidence against bequest motives. In related work, Hurd (1989) estimates a bequest parameter from the consumption patterns of individuals and finds that it is not significantly different from zero. On the other hand, Laitner and Juster (1996) report data on TIAA-CREF participants that is suggestive of some limited bequest behavior. Bernheim (1991) suggested that individual bequest motives were strong enough that 25% of elderly households were over-

[3] A much more complete survey of the bequest and transfer literature is provided by Gale and Slemrod (2000).

annuitized by Social Security and were purchasing life insurance to undo the effects of mandated annuitization. A recent reexamination of this approach, however, suggests that this is unlikely to be the case (Brown, 1999a). Specific to the context of defined contribution plans, Brown (1999b) reports on empirical findings from the Health and Retirement Survey (HRS) that bequest motives do not appear to affect household decisions about whether or not to annuitize DC plan balances.

Even if bequests to one's children are not important determinants of annuitization behavior, it may be the case that married couples engage in a form of mortality risk-sharing between themselves. Kotlikoff and Spivak (1981) show that two individuals sharing a common budget constraint can capture nearly half of the utility gains achievable through actuarially fair individual annuities. Hurd (1999) also discusses a life-cycle model for couples and the interaction between bequests and family self-insurance. Brown and Poterba (2000) demonstrate that, as a result of this risk-sharing, the utility gains associated with the purchase of joint-and-survivor annuities are substantially lower than the utility gains outlined for a single individual above.

Table 2 reports some representative results from Brown and Poterba (2000) for a married couple consisting of a 65-year old husband and a 62-year old wife. As for the case of a single individual, the Annuity Equivalent Wealth is calculated assuming access to actuarially fair annuities for individuals facing general population mortality tables. The main feature of these results is that the AEW for couples are significantly below that of individuals. For example, a married couple with log utility has an AEW of only 1.175, significantly below the AEW for a 65 year-old single man. Given that most individuals

entering retirement are married, within-couple-risk-sharing may partially explain the lack of annuity demand.

2.4 Lack of Inflation Protection in Commercially Available Annuities

The results presented so far have assumed that individuals are able to obtain annuities that are not subject to inflation risk. While the current U.S. Social Security system essentially provides real annuities by indexing benefits to the CPI, outside of this system there are very few opportunities to purchase annuities that are protected from inflation uncertainty.

As discussed in Brown, Mitchell, and Poterba (1999), inflation has two undesirable effects on fixed nominal annuity streams. First, even modest rates of inflation will erode the real value of the income stream over time. For instance, at a 3.2% annual rate (which is average US inflation rate over the 1926-97 period), the real value of a constant nominal annuity will be cut in half in 22 years. The erosion from a constant and expected rate of inflation, however, is easily remedied through the use of graded or escalating annuity products that increase the nominal payout by a fixed percentage each year. The second effect, however, arises from the uncertainty about inflation. If inflation varies from year to year, then this will induce variance in the real income available to retirees, even in escalating products. When Brown, Mitchell, and Poterba (1999) extend the annuity valuation model to account for persistent inflation, they find large differences between the valuation of real versus fixed nominal annuities.

Table 3 presents results from Brown, Mitchell and Poterba for single individuals facing inflation uncertainty. They considered two alternative inflation processes, one with independent draws each year (independent and identically distributed) and one in which

inflation follows a stylized simple autoregressive [AR(1)] process and thus exhibits some persistence. Not surprisingly, the results indicate that inflation uncertainty reduces the value of a nominal annuity, more so when inflation is persistent. Notice that for more risk averse individuals, the impact of inflation uncertainty is an even greater consideration.

A caveat should be added to explanations for the lack of annuity purchases invoking market imperfections (as opposed to preferences). Market imperfections can be absolute (that is, costs of a product are so high as effectively to eliminate its consideration for most households) as well as relative (that is, other products that do the same or almost the same things as the product being examined and are less expensive). Administrative costs and incomplete inflation protection are features of most investment and insurance products and not just annuities. Hence, market imperfection explanations invoking these considerations have to claim that the problems arising from these features are more severe or important for annuities than for other somewhat similar products.

Table 4 demonstrates the cumulative impact of the factors mentioned so far. It reports the Annuity Equivalent Wealth for a couple consisting of a 65-year old man and a 62-year old wife who have 50% of their total wealth annuitized through Social Security. They are assumed to purchase a joint and 50% survivor annuity that is fixed in nominal terms in an environment of 3.2% annual inflation. In addition, due to a combination of administrative costs and selection effects, the nominal annuity is assumed to have a money's worth of 0.88, that is, the couple faces a 12% load factor on their annuity purchase.

The results indicate that couples with low levels of risk aversion now have an annuity equivalent wealth that is close to one. In fact, for a risk aversion coefficient of one,

complete annuitization would actually lower utility.[4] For higher levels of risk aversion, the gains from annuitization are still positive, but much smaller than the gains found in a simple life-cycle model of a single individual purchasing actuarially fair real annuities. These results show that, while there may be no single explanation for the lack of annuity demand that can explain the lack of annuity demand, several factors working in combination can substantially lessen or even eliminate the value of annuitization.

2.5 Health Uncertainty and the Irreversibility of Annuitization

The annuitization decision is largely irreversible. Insurance companies do not allow individuals to cancel an annuity agreement once it is in place; otherwise, adverse selection would obviously occur as individuals acquire additional information about their expected longevity. Furthermore, annuitization imposes a liquidity constraint on individuals, meaning that in each period they have access only that that period's annuity income (and any unconsumed previous payments). Thus, if individuals face significant uncertainty about future expenditure needs, they may be reluctant to fully annuitize.

Uninsured long-term care expenditures are arguably the most important source of financial uncertainty facing most elderly retired individuals. While Medicare, supplemented by Medigap and retiree health insurance, adequately insures a large proportion of medical expenses for most elderly Americans, it covers only 100 days of long-term care, in certain limited circumstances, leaving this important source of financial risk uninsured for most elderly. Similarly, Medicaid imposes strict income- and asset-

[4] This does not necessarily mean that some additional annuitization on the margin would not be valued, only that complete annuitization is clearly not optimal in this case.

based eligibility tests that generally require that individuals exhaust their personal assets and apply all but a trivial amount of their income to cover nursing home expenses.

Among those age 65 and over, it is estimated that 60 percent will need some long-term care (LTC) in their remaining lifetime (Warshawsky, et.al, 2000). LTC needs include a need for critical care that must be supplied in a nursing home, as well as a less critical need for simple assistance with daily activities. According to Murtaugh, et.al. (1997), current projections indicate that more than 40 percent of the 65+ populations will spend some time in a nursing home. The likelihood of spending some time in a nursing home at some point during the remainder of life increases with age (from 39 percent at age 65 to 56 percent at age 85). Murtaugh, et.al (1997) estimate that the average expected stay in a nursing home among users of all ages is 2.4 years. The expected stay for most is less than a year; but for almost 20 percent of users, it is more than five years. The mean number of years of nursing home use declines with age, from 2.8 years in the 65 to 74 age group to 1.9 years in the 85+ age groups.

According to the Lewin-VHI, Brookings-ICF Long-Term Care Financing Model, as quoted in Health Insurance Association of America (HIAA) (1997, Table 1.3), the average lifetime home health care use is just over 200 visits. About half of those expected to use home health care will use fewer than 90 visits during their lifetime, while 12 percent can expect to use more than 730 visits.

The escalating cost of typical long-term care services presents a substantial financial risk to individuals and their families. Cohen (1998) reports that the average annual cost for a stay in a nursing home was $38,000 in 1995, and this increased to $44,500 by 1998. Assisted living facilities currently charge, on average, $26,000 a year. It is clear that older

Americans recognize health care costs as an important source of financial risk. Venti and Wise (1997) report results from the Health and Retirement Survey on the question "In thinking about your financial future, how concerned are you with health care costs?" 52% of respondents indicated a high level of concern. This is a significantly larger proportion than are concerned with other sources of uncertainty such as job loss or financial market collapse.

Despite the fact that nursing home care represents the greatest source of financial uncertainty for most elderly households, very few are insured against this risk. According to Murtaugh, et. al., 1995, about 30 percent of the elderly population are unhealthy enough that current underwriting criterion would prevent the purchase of LTC insurance. Warshawsky, et. al., forthcoming, estimate that less than 8 percent of the elderly population owns an individual LTC insurance policy, and group employer-sponsored coverage is still quite uncommon. Therefore, retired individuals may be reluctant to fully annuitize their retirement resources because they wish to retain a buffer stock of wealth that they can use to pay for possible future long-term care expenses.[5]

2.6 Lack of Consumer Understanding of Annuitization

Thus far, we have been working primarily within the framework of a rational life-cycle consumer who chooses an optimal consumption path with full knowledge of his or her own survival probabilities. In 1999, however, the "Task Force on Annuity Messages" of the American Council of Life Insurance concluded that "consumers have very little knowledge about annuities or understanding of how the product works" (ACLI, 1999, p.16).

[5] Warshawsky, et.al., forthcoming, analyze an idea to combine long-term care insurance with the life annuity in order to reduce adverse selection and underwriting, and make both LTC insurance and annuities more attractive and available to middle-class elderly households.

The ACLI task force conducted a number of qualitative focus groups among consumers. These groups indicated that "the term annuity is somewhat familiar to people, but many cannot define it." Furthermore, the focus group findings suggested that:

> "virtually no consumer fully understands how a lump-sum distribution can be converted to an annuity. While older Americans are generally aware that annuities involve some type of payment stream, few really grasp how it works. Most Americans don't know that annuity payments are a combination of principal and investment return, or how the insurance feature can promise these benefits for a lifetime." (ACLI 1999 p. 16).

The report goes on to suggest that the least understood aspect of annuities is how risk sharing can allow insurers to offer lifelong income. Consumers tended to focus on the risk of dying early and therefore receiving less in return from the annuity than they paid in, while overlooking the fact that they may live longer than expected and receive much more than they paid. In fact, some consumer focus group participants equated lifetime annuity payments with gambling on their lives and believed that the odds in the gamble favored the insurance company. Viewing insurance as a source of increased risk is not consistent with the standard economic model of consumers using annuities to reduce risk by equating the marginal utility of consumption across different states of nature.

This qualitative research by ACLI suggests that consumers simply do not understand the longevity insurance benefits provided by a life annuity. Clearly, for any consumer that equates the purchase of longevity insurance with gambling, it is unlikely that the life-cycle model well represents their preferences. Moreover, the strong desire felt by some individuals to control, manage, and invest wealth for its own sake, and perhaps even for some entertainment value, is not well explained by traditional economic models. While previous work has shown that the predictions of the simple life-cycle model are correlated

with intended annuitization decisions on the margin (Brown, 1999b), much of the variation in this decision has been left unexplained. One potentially fruitful area for future research is to consider whether any behavioral models of decision-making have the potential to improve our understanding of household decisions about annuitization.

2.7 Institutional Barriers and Legal Issues

Federal law categorizes employer-sponsored tax-qualified retirement plans into three categories: pension, profit-sharing, and stock bonus plans. Defined benefit plans and money purchase defined contribution plans are considered by law to be pension plans, while most 401(k) plans and other thrift-type plans are considered profit-sharing plans.[6] This distinction is important because pension plans are required to "provide systematically for the payment of definitely determinable benefits to his employees over a period of years, usually for life, after retirement" (Treasury Regulation Section 1.401-1(b)(1)(i)). Defined benefit and money purchase plans typically meet this requirement by providing a life annuity as the normal form of payment (McGill, et al 1996).

By contrast, 401(k) plans and other profit sharing or stock bonus plans are not required to offer an annuity as a payout option. Hence, plans which we generally refer to as defined contribution plans, with the minor exception of money purchase plans, are not required by federal law to offer life annuities to participants. Indeed, as we will show in the next section, most DC plans do not offer such an option to their employees.

[6] Money purchase plans are funded by employer contributions based on a fixed formula. Profit-sharing and stock bonus plans (which includes employee stock ownership plans) have discretionary employer contributions and are therefore not considered to be pension plans (i.e., plans meeting a definitely determinable benefit requirement). All of these plans, however, are defined contribution plans in that the ultimate benefits are based upon the accumulated employer contributions and earnings and losses thereon.

Even though most DC plans are not required to offer annuities, there are no explicit legal constraints against doing so. There are several possible reasons arising from the legal and regulatory environment, however, that may cause sponsors of DC plans to not offer annuities. The first reason is the increase in administrative complexity that offering an annuity brings. Since 1984, federal law has required all retirement plans that provide life annuities to automatically pay these benefits to married employees in the form of qualified joint and survivor annuities (QJSA).[7] The law also requires that pension plans must provide a qualified pre-retirement survivor annuity (QPSA) to the spouse of any participant if the participant dies after becoming entitled to a vested benefit but before the normal annuity starting date. These requirements were put into place in response to concerns that husbands were selecting single life annuities; single life annuities pay higher benefits than joint-and-survivor annuities. The selection of single life annuities meant that wives, who typically survive their husbands, were not adequately protected against the loss of pension benefits upon the death of their husbands. The joint and survivor requirement can be waived with the consent of the spouse, but the consent must be in writing and witnessed by a plan representative or a notary public and sufficient time before the annuity starting date must be given for this consent to occur.

The law permits the plan sponsor to make actuarially fair adjustments in benefit levels to recoup the cost of survivor annuities, i.e., by reducing the benefits for the participant and his or her spouse compared to a single life annuity. According to McGill, et. al., (1996), many plans do reduce benefits to reflect approximately the cost of joint and survivor annuities, although most do not do so for pre-retirement survivor annuities.

[7] The qualified annuity must provide income to the surviving spouse that is not less than one-half of the amount of the annuity payable during the joint lives of the participant and his spouse.

Although actuarial adjustments are allowed, the legal requirements for survivor annuities have added to the costs and potential liabilities of pension plan sponsors by increasing administrative burdens. Overall, there is a sense among professionals who advise plan sponsors, i.e., plan practitioners, that the requirements have discouraged sponsors of plans that are not currently required to offer life annuities as a payment form from doing so.

A second institutional barrier that may limit the offering of annuitization opportunities by plan sponsors is the uncertainty among plan practitioners about the attitude of the IRS toward the payment of life annuity benefits from a trust held for participants in a profit-sharing plan. Defined benefit pension plans can be either insured or trusteed; money purchase plans are insured plans and profit-sharing plans are trusteed plans. If a pension plan is insured, it is funded through contracts with a life insurance company; life annuities made available to participants will be underwritten by the insurance company, either through individual contracts or through a group contract. If the defined benefit pension plan is funded through a trust, the plan sponsor's contributions to the plan are invested and reinvested in a variety of assets. In a trusteed defined benefit pension plan, retirement income benefits can be provided either through (individual or group) annuities purchased from an insurance company or they may be paid directly from the trust fund.

The regulatory uncertainty arises about the ability of plan sponsors to offer annuities directly from profit-sharing plan trusts, a possibly desirable arrangement. If an employer sponsors both a pension and profit-sharing plan, the plan participant can transfer assets accumulated in the profit-sharing plan to purchase additional retirement benefits (that is, a life annuity) through the pension plan, if the plan sponsor allows such transfers.

If the employer does not offer a pension plan, it is nevertheless possible, because of the number and characteristics of plan participants or particular efficiencies and skills possessed by the benefits staff, that a profit-sharing plan itself could offer annuities paying higher rates than available through an insurance company. Because the assets in a trust for a profit-sharing plan are matched to market-value accounts owned, and often controlled, by plan participants, however, it is unclear what security could be offered for the interest and mortality rate guarantees implicit in the payment of determinable annuity benefits. Either the annuities would have to be completely participating (as opposed to non-participating) or the plan sponsor or the plan itself would have to guarantee rates, perhaps backed up by a reinsurance contract or through a captive insurance company. The view of the IRS concerning these arrangements is unknown.

A third consideration for plan sponsors relates to the regulatory burden imposing a liability for the evaluation of the claims-paying ability of the insurance company providing annuities. The Department of Labor, in Interpretive Bulletin 95-1 has stated that a plan fiduciary must evaluate a potential annuity provider's claims-paying ability and generally must select the safest annuity available, although the cost of the annuity may also be considered in the final selection. Some plan practitioners have claimed that this requirement has led to a decline in the level of benefits payable, as competition in the market may have been impaired.

2.8 Summary of Barriers to Annuitization

The gains to annuitization suggested by the simplest version of the Yaari life cycle model are substantial. When one jointly considers the role of Social Security, risk sharing within families, and health uncertainty, all of which ought to reduce the value of annuities,

it is possible to explain why many households do not annuitize. However, it appears that the gains from annuitization should still be large enough to stimulate more demand for annuities than we observe in the private market. To explain the limited market for annuities, one must turn to other factors, including market imperfections, limited consumer understanding of the benefits of annuitization, and institutional and regulatory barriers to the provision of annuities. Importantly, if consumers would benefit from annuitization but are unable to do so due to market imperfections or regulatory constraints, or if consumers fail to understand the risk of not annuitizing, then public policies that encourage annuitization may be welfare improving.

3. The Current State of Retirement Plan Distributions

3.1 The Changing Composition of Pension Plans

Over the past 25 years, there has been explosive growth in the number and importance of defined contribution plans. As indicated in Table 5, the number of private-sector DC plans has more than doubled from 1977 through 1996. During this same period, the number of DB plans rose from 1977 through the mid-1980s, but then fell dramatically by 1996. As a result, by 1996, defined contribution plans represented 92% of all private sector employer-sponsored pension plans. The growth in the number of participants in DC plans is even more striking, rising from approximately 15 million to over 51 million over this same nineteen year period. The number of participants in DB plans also grew during this period, from 35 to 41 million, but by the early 1990s, DC plans accounted for over half of all pension plan participants.

Table 6 further illustrates these trends by examining the fraction of the U.S. workforce covered by DB and DC pension plans. In 1978, 38% of wage and salary workers were covered by DB plans, while only 7% had primary pension coverage in form of a DC plan. By 1996, the fraction covered by DB plans had fallen to only 22% of the workforce, while primary DC coverage had increased to 23% of workers. In addition, the number of workers covered by a supplemental DC plan rose from 11% to 16% of workers. Thus, by virtually every measure, it is clear that DB plans are declining in importance as a source of retirement income, while DC plans are becoming ever more important.

3.2 The Availability of Alternative Payout Options

While most DB participants still receive benefits as an annuity, the fraction of DB plans permitting lump-sum withdrawals at retirement has grown during the 1990s. As shown in table 7, the Department of Labor reports the fraction of DB participants with access to any type of lump-sum option grew from 14% to 23% in just six years from 1991 to 1997. Even more striking, the fraction of participants with access to a 100% lump-sum payment rose from 9% to 22% over this period. Other sources giving estimates of lump-sum availability within DB plans vary widely; some suggest that up to half of all DB participants have a lump-sum option, although nearly all sources report an increasing trend over the past decade.[8]

A lump-sum distribution option is nearly universal in defined contribution plans, covering over 90% of all participants. As reported in Table 8, 91% of full-time

[8] A 1992 study by Hewitt Associates reported that 34 percent of surveyed companies with a DB plan for salaried employees provide a lump sum option. EBRI (1996) reports that as many as 64 percent of DB plans made lump-sum distributions available to employees in 1993, although this includes plans offering only *de minimis* lump sum payments. KMPG-Peat Marwick reported that 53 percent of defined benefit pension plans, covering 50 percent of participants, offered a lump sum distribution option for payments in excess of the de minimis level, up from 46 percent in their 1997 study. We thank Mike Packard for pointing out these alternative estimates.

participants in savings and thrift plans in 1997 had access to a lump-sum withdrawal option at retirement, and 41% of participants had access to an installment payment plan. Strikingly, only 25% of participants in these plans had access to an annuitization option within the plan.

Table 9 reports nearly identical results for 401(k) plans. While 91% and 41% of 401(k) participants had access to lump-sum and installment options, respectively, only 27% of participants had the option to purchase a life annuity in 1997. It should be noted that in both tables 8 and 9, the estimates of the fraction of employees with access to each distribution option exhibit a high degree of variance from year to year. It is quite likely that this variability is due to sampling error rather than high-frequency changes in employee payout options.[9]

The overall trend regarding options for annuitization is clear. DB plans are on the decline, and those that still exist are making it easier to take a lump-sum distribution. DC plans are growing, but 70% or more of them do not offer participants a life annuity option. Therefore, opportunities for insuring against longevity risk through employer-provided pensions appear to be on the decline. Now we turn to a review and an assessment of other information about the fall in annuitization rates in recent years.

3.3 Annuitization of Current Retirement Assets

Available evidence suggests that a declining fraction of retirement income is being paid in the form of a life annuity. We rely on two primary sources of information to make this determination: the Current Population Survey, including supplemental surveys,

[9] This is one of several "data deficiencies" that will be mentioned in this paper. Clearly, better data on the distribution phase of employer provided plans is needed.

sponsored by the Department of Labor (DOL), and Form 5500 filings by qualifed plan sponsors.

The Department of Labor (DOL) periodically sponsors supplemental surveys connected to the Current Population Survey to determine the extent of pension and health benefits of workers ages 40 and over, and retirees. One particular aspect that the DOL has examined through its surveys is the shift in the form in which pension benefits are being received. According to tabulations of the 1994 survey (DOL, 1995), among persons 40 and over who have been employed in the private sector and received a pension benefit resulting from this employment, 48% report receiving an annuity (10% report receiving both an annuity and a lump sum distribution and 38% an annuity only) and 51% received only a lump sum distribution. This distribution in the form of benefits is substantially different than what was reported just five years earlier in a DOL-sponsored supplemental survey. In 1989, 60% of recipients reported the receipt of an annuity (52% annuity only and 8% annuity and lump sum).

The aggregate numbers associated with this trend away from pension annuities further highlight its significance. According to survey information, in 1989, 7.5 million private sector retirees and workers were receiving annuity benefits and 6 million had received lump sum payments from pension plans at some earlier point. In 1994, the number of annuity recipients had decreased by 4 percent to 7.2 million, while the number of lump sum recipients had increased to 9.1 million. These statistics imply that the annuitization *rates* through private pension plans have declined at an even greater rate than the decline in the number of annuitants.

Other information, aggregate and over a longer time period, about the shift in benefit form is available from the Form 5500 reports filed with the IRS by private plan sponsors. The Form 5500 information, however, is more indirect than the survey information, because only plan type and not benefit form is reported, and, as explained above, the once nearly one-to-one correspondence between DB plan type and annuity benefit form has eroded. According to DOL (1999-2000), $15.2 billion in benefits were disbursed by private DB plans in 1977, presumably almost entirely in annuity form. That year, $7.7 billion in benefits were disbursed by private DC plans, presumably mostly in lump sum form. Hence, in 1977, the estimated ratio of annuity (DB) to lump sum (DC) benefit form payments was approximately 2 to 1. By 1996, the ratio had become 4 to 5: $96.9 billion in benefits from DB plans and $116.5 billion from DC plans. In 1996, there were 8.9 million retired or separated participants receiving benefits from private DB plans, according to DOL, 1999-2000; this had increased only from 7.7 million participants in 1989.[10]

3.4 Utilization of the Annuity Option with DC Plans

Given the rapid growth in DC plans, it is of interest to know to what extent employees with access to an annuity option choose to use it. Unfortunately, after an extensive review of available data sources, we have found that very limited information exists to permit reliable estimates of the fraction of retirees that choose to annuitize when the option

[10] Although the Form 5500 and Current Population Survey give nearly identical number of participants receiving annuity/DB benefits in 1989, the two sources of information give different numbers for 1996 and 1994, respectively. Leaving aside the obvious explanation of different reporting periods for the discrepancy, there is also the explanation that by 1996, many DB plans were allowing participants to receive their benefits in lump sum form. Also the Survey only reports on workers above age 40, whereas the Form 5500 reports on workers of all ages.

exists.[11] As we will show, those estimates that are available vary widely across data sources. Whether these disparities are due to real differences in the annuitization propensities of individuals in different plans, or due to errors or misreporting in the data is not always possible to ascertain. The sources of data that we examine include the Health and Retirement Survey, TIAA-CREF administrative records, and the federal Thrift Savings Plan. In addition, we discuss the growing market for variable annuity products, as well as evidence on annuitization decisions within the Social Security system.

We first turn to the 1992 wave of the Health and Retirement Survey (HRS). Brown (1999) reports that of those households with at least one worker covered by a DC plan who had the option to withdraw the funds as an annuity or installments, 48% *intended* to annuitize at least a portion of their account balances. It is still too early to know whether or not *intended* annuitization will translate into *actual* annuitization within the DC plan, because respondents were on average seven years away from their expected retirement date. This calculation is further complicated by the fact that even individuals who ultimately annuitize may not do so immediately at retirement. In addition, even individuals who choose to take their account balances as a lump-sum could use the proceeds to purchase an immediate life annuity in the individual market.[12]

More detailed information is known about annuity options available to and choices made by participants in the Thrift Savings Plan (TSP), a relatively new supplemental DC plan for federal government employees. According to Poterba and Warshawsky (1999), as

[11] An effort is currently underway to collect information on the availability of life annuity payout options from employer Summary Plan Descriptions as part of the Health and Retirement Survey.

[12] The limited size of the individual annuity market makes it clear that this is not done very often. According to ACLI, only 112,000 immediate annuity contracts were issued in 1998 outside of pension plans, accounting for roughly $8 billion in premiums. Even this overstates the market, however, since it includes non-life contingent products as well as annuities for structured settlements.

of October 1998, the TSP had 2.4 million individual accounts, and $71.5 billion in investment assets; during 1997, it received $7 billion in contributions and disbursed almost $1.4 billion in benefits. In dollar terms, most benefit payments are disbursed as transfers to IRAs and other qualified plans; the second and third largest disbursement categories are lump sums and death benefits. Federal law requires that several different types of life annuities be made available, including level and increasing payment, single and joint life (50 and 100 percent to survivor), and cash refund and ten-year certain options; no variable payout options, however, are available. The annuities are sold by an insurance company selected according to the criteria set forward in a Request for Proposal issued by the TSP. As Poterba and Warshawsky (1999) demonstrate, the TSP annuity payout rates are quite competitive compared to individual life annuities sold by commercial companies through agents. Nevertheless, annuitization rates in the TSP are extremely low, with approximately 1.2% of retiring and separating federal workers choosing to annuitize (Linder 2000). Most currently retiring federal workers are still in an old retirement system, however, and therefore the TSP represents a relatively unimportant component of their retirement resources. As the TSP system matures, it will become clearer whether life annuities will become a more popular disbursement method.

In contrast to the TSP, TIAA-CREF, the principal and longstanding DC retirement system for the nation's education and research sectors, represents a mature defined contribution pension plan system, where the plans are the primary source of retirement security for their participants. As of October 1998, there were 1.8 million TIAA-CREF participants in the accumulation phase and almost 300 thousand participants receiving annuity income; investment assets totaled almost $230 billion. As noted by Poterba and

Warshawsky (1999), TIAA-CREF life annuities are available with a wide variety of features and at attractive rates. Furthermore, the system has a long history of educating its participants on the advantages of life annuities, and, in fact, prior to 1988, all TIAA-CREF basic pension plans allowed for distributions only through a life annuity or death benefit. Since then, a variety of distribution methods have been made available. Most TIAA-CREF participants, however, still choose a life annuity; of the 16,300 participants converting their accumulations into streams of periodic income in 1997, 11,700 chose a life annuity.

Ameriks (1999) confirms the high rate of annuitization among TIAA-CREF participants. Nearly 60 percent of individuals age 65 retiring over the period 1994 through 1996 started their first life annuity income within one year of retiring. Nevertheless, as noted by Ameriks (1999), the frequency at which participants are choosing to begin a life annuity immediately following retirement has declined steadily as the number of alternative options available to TIAA-CREF participants has expanded. Many participants retiring at ages 62 to 68 are postponing distribution of their retirement assets until later ages. According to Ameriks, unexpected increases in retirement wealth and other assets may have played an important role in the drop in annuitization rates. Indeed, the data indicate that the decline in annuitization rates has been slightly larger among individuals with greater equity allocations.

Yet another source of information about the likelihood of annuitizing retirement assets is the market for individual deferred variable annuities. This market has seen phenomenal growth over the last decade, with investors pursuing high stock market returns and favorable tax treatment. According to successive issues of the American Council of Life Insurance *Fact Book*, over the 1989 to 1998 period, the number of persons covered by

these annuities grew from 2.7 million to 14.6 million. Annual premium volume increased from $6.3 billion to $49.2 billion and reserves increased from $42 billion to $354 billion. Table 10 shows statistics on the number of persons covered by individual variable annuity plans, premium considerations, and annuities in course of payment for the period 1971 through 1996.

There is no requirement that these products ever be converted into a life annuity income stream, and indeed, annuitization rates have remained relatively low over the entire period for which we have data: 1971 through 1996. As shown in Figure 1, the ratio of the number of persons receiving payments to the total numbers of persons covered by individual variable annuities has ranged from .6% to 1.9%, with the most recent rate at 1.1%. As seen in Figure 2, the ratio of total annualized income to total premiums contributed has ranged from .8% to 3.2%, with the most recent rate at 1.0%. Of course, these numbers definitely understate the probability that any one contract will be converted to a life annuity. At any given point in time, the vast majority of these contracts are held by individuals who are still working and accumulating assets. This is especially true given the rapid growth of this market. Consistent with this fact, annuitization rates rose in the late 70s and again in the late 80s when growth in the variable annuity market slowed somewhat. Nevertheless, it is clear that regular payments from variable annuities, which either can be fixed or can vary with current value of investments on which the annuity is based, are relatively small.

A final source of information on the likelihood of annuitization comes from the Social Security program. While individuals do not have the opportunity to take Social Security benefits in a non-annuity form, they do have the ability to choose when to claim

benefits. By delaying this claim, an individual can trade a lower immediate payout annuity for a deferred annuity with larger payouts in the future. Analysis of claiming decisions suggests that of men who retire before age 62, only 10% delay claiming benefits for at least one year after eligibility (Coile, et al 1999). While the patterns of who delays is generally consistent with the theory, the fraction of men delaying is much lower than what the theory would suggest. This suggests that most individuals are not taking advantage of the opportunity to purchase additional annuitization, even when the annuities are inflation-indexed and close to actuarially fair for the average person in the population.

In summary, it is difficult to determine a single reliable estimate of annuitization probabilities. At the high end, the majority of retirees in the TIAA-CREF system purchase a life annuity with their accumulations. At the low end, the federal Thrift Savings Plan has seen miniscule annuitization rates. In between these extremes, a large fraction of HRS respondents intend to annuitize, but there is very little research on the determinants of actual annuitization behavior. This is clearly an area that is ripe for future research.

3.5 Relative Payouts of Annuities in DB versus DC plans

In addition to lessening opportunities for annuitization, one of the implications of the shift from DB to DC plans is that annuity payouts per dollar of premium may be lower in a voluntary DC framework. This is possible for two reasons. First, in traditional DB plans without a lump-sum option, participants are unable to self-select out of the annuity pool and will thus, on average, have higher mortality rates than DC participants who self-select into the annuity pool. Second, administrative costs are likely to be lower in a group plan.

To see the difference in mortality rates between these two mortality pools, table 11 reports mortality rates for several representative ages. Three sets of rates are reported. First, mortality rates for the general population are taken from the 1935 birth cohort table from the Social Security Administration's 2000 Trustee's Report, which is appropriate for individuals turning age 65 in the year 2000. Next we report mortality rates for group annuitants, as reported in the Society of Actuaries 1994 Group Annuitant Mortality Table, updated to the year 2000. Finally, we report mortality rates for individual annuity market participants, as reported in Johansen (1996). For both of the annuitant tables, mortality tables are converted into cohort tables for the 1935 birth cohort by applying the mortality improvement rates implicit in the difference between Social Security's year 2000 period table and the 1935 birth cohort table. Readers interested in more detail on this process should consult Mitchell, et.al. (1999).

As the table indicates, mortality rates for the group annuitant table lie between the population and the individual annuitant tables. Whereas in the general U.S. population, we expect 21.5 deaths per 1000 65-year old males in the year 2000, we expect that only 14.4 out of a thousand group annuitants will die at this age, and only 11 out of a thousand individual annuitants.

To measure the importance of these mortality differences for the pricing of annuities, we have computed the actuarially fair monthly payout that would be provided in a joint and full survivor annuity for two 65 year olds, assuming an initial annuity premium of $100,000. That is, we calculate the monthly payment A, according to the following equation:

$$\$100{,}000 = \sum_{j=1}^{12*(115-age)} \frac{A \cdot \left(P_j^m + P_j^f - P_j^m \cdot P_j^f\right)}{\prod_{k=1}^{j}(1+i_k)} \qquad (1)$$

where P_j^m and P_j^f are the cumulative probability of surviving j months beyond age 65 for males and females respectively, and i_j is the interest rate for month j. When determining the payout of a fixed nominal annuity, i_j is the nominal interest rate, and when determining the initial payout of a fixed real annuity, i_j is the real interest rate.

Table 12 reports the initial value of the payout for an actuarially fair real and nominal annuity, assuming a real interest rate of 3% and a nominal interest rate of 6%. Of most relevance here is the comparison of the group and individual annuitant payout rates. For nominal annuities, using the group annuitant table as would be the norm in a DB plan, the 65-year old couple could expect to receive $651.65 per month. Using the individual annuitant table, as would be the norm if the individual were required to annuitize on their own, this same couple would expect to receive only $632.78 per month, or approximately 3% less. For an inflation-indexed annuity, the difference in payouts is approximately 4%.

Comparing these actuarially fair payouts probably understates the difference between the payouts available in-group versus individual annuity markets due to the role of administrative costs. Administrative costs would reduce the payout of both group and individual annuities. If, however, there are economies of scale in the cost of servicing group annuity contracts relative to individual contracts, then one would expect the individual annuitant prices to be reduced by more.

Thus, it appears that the shift from DB to DC plans means that individuals have fewer opportunities to annuitize their resources. It also probably means that those who do annuitize through their DC plan are likely to receive somewhat less monthly income under the DC plan per dollar invested than they could have under a group DB plan.

4. Future Trends in Pension Distributions

Given the trends away from DB and towards DC pension plans, the possibility exists that future retirees will have a smaller fraction of their retirement assets annuitized than current retirees. To assess the extent of these changes, we have undertaken several illustrative calculations. First, using data provided by the Pension Benefit Guaranty Corporation (PBGC), based on runs of its simulation model of single-employer defined benefit plans, we calculate the expected number of participants, benefit payment amounts and plan liabilities for these DB plans for 1999 and the next twenty years. Second, we have constructed some estimates of future annuitization levels from 401(k) plans.

4.1 Future DB Annuitization Trends

The PBGC uses a stochastic simulation model—the Pension Insurance Modeling System (PIMS) -- to evaluate its exposure and expected claims. The model produces, for the universe of private single-employer defined benefit plans, among other variables, the number of participants (total, active, terminated vested, and retired), benefit payment amounts, and plan liabilities. Values of the variables can be averaged over thousands of runs of the model to represent the most likely outcomes in the future. Under the assumptions that the long-term Treasury bond yield will tend to 6.35%, the inflation rate will tend to 4.26%, and the wage growth rate will tend to 5.31%, we calculated the likely number of participants, benefit payment amounts, and plan liabilities for 1999 and the next twenty years.[13] These calculations were based on data runs provided to us by PBGC staff.

[13] Readers should be cautioned that the simulation sample weights provided to us by the PBGC are more appropriate to the liability statistics than the participant and benefit amount statistics. In order to give some indication of the extent of the universe of private single-employer DB plans, however, we have used the weights for all variables being studied. It should also be noted that active participant counts are not the result of a stochastic simulation but rather represent the assumption of PBGC staff on the likely or median future path of the system.

The benefit payment amounts were calculated under two diametrically opposed assumptions: all benefits are paid as life annuities versus all new and future benefits are paid as lump-sums while payments to current retired annuitants continue for their lives. The results are shown in Table 13, in inflation-adjusted terms where appropriate.[14]

According to the calculations, the number of participants in private single-employer defined benefit plans is forecast to increase minimally over the next twenty years, from 24 million to 29 million, and even that increase occurs only in the terminated vested and retired segments of the participant population, as the entire private defined benefit plan sector ages. Annual benefits paid as life annuities grow from $94 billion in 1999 to $160 billion (inflation-adjusted) in 2019. Given the increasing tendency of defined benefit plans to pay benefits as lump-sums, this forecast is probably on the high side. If current and future benefits are paid entirely as lump-sums, that amount grows from $84 billion to $132 billion (inflation-adjusted) over the period, while benefits paid to current annuitants (not shown in Table) decline from $77 billion to $22 billion.

To provide some context for these figures, consider forecasts done in 1999 by the Office of the Actuary for the Social Security OASI program. In 1999, $341 billion was paid out in life annuity benefits from Social Security; private DB plan annuity benefits therefore would currently represent 27.5 percent of Social Security benefits. In 2019, under the intermediate assumptions of the Actuary, $602.2 billion (inflation-adjusted) in Social Security annuity benefits will be paid out. According to the calculations cited above, defined benefit plan annuity benefits will represent no more than 26.5 percent of

[14] We do not have access to similar forecasts for multi-employer and government worker retirement plans; the trend in these sectors, however, like the private sector, is toward defined contribution plans.

Social Security benefits in 2019, and probably less given current trends in plan distribution options and choices.

4.2 Future DC Annuitization Trends

According to Poterba, Venti and Wise (2000, hereafter PVW), 401(k) plans are now the most important form of retirement saving, accounting for 55 percent of all contributions to employer sponsored plans in 1998. PVW constructed synthetic cohorts of households using earnings history information from the CPS and constructed an algorithm to forecast future 401(k) balances for cohorts attaining age 65 in 2025. Their results suggest that 401(k) wealth will be an extremely important component of household portfolios in the coming decades. For example, among those reaching retirement in 2025, assuming that plan assets are invested in a 50-50 stock/bond portfolio, PVW report that average 401(k) plan assets would be $133,400 (in 1992 dollars), or roughly 1.10 times Social Security wealth.

Not surprisingly, these 401(k) wealth levels vary by earnings decile, varying from virtually nothing among low earners to substantially more than double Social Security wealth at the higher end of the earnings distribution. Using these estimates and information on the size of the cohort reaching age 65 in 2025, one can estimate an aggregate amount of wealth held in 401(k) accounts by this cohort. Using data household projections for the year 2020 from the Joint Center on Housing Studies (Masnick 2000), combined with mortality rate information from the Social Security Administrations 2000 Trustee's Report, we estimate that there will be approximately 2.35 million households turning age 65 in the year 2025.[15] If we again use the 50/50 stock/bond portfolio estimate

[15] This is quite likely an overstatement of the relevant population, because it includes individuals who were never in the labor force due to disabilities, and so on.

of $133,400 (in 1992 dollars), and update this to January 2000 using the CPI-U (which rose approximately 20% from end of 1992 to end of 1999), we produce an estimate of aggregate 401(k) wealth holdings by the cohort age 65 in year 2025 of $376 billion (year 2000 dollars). Recall that in 1997, an estimated 27% of 401(k) participants had access to an annuity option. This was higher than that reported for 1995, but lower than that for 1993, and thus it is difficult to ascertain whether there is any trend in the data. Furthermore, we do not know whether newly created 401(k) plans will be more or less likely to offer a life annuity option. If we assume that 27% of all 401(k) plans will offer a life annuity option to participants, and if the probability of having this option is the same across all income deciles, then approximately $101 billion of 401(k) assets in 2025 will be in plans that have an annuity option.

As previously discussed, it is quite difficult to determine a precise measure of a households propensity to annuitize its assets. Brown's tabulations from the HRS suggest that 48% of households with a 401(k) plan intend to annuitize at least *a portion* of their accounts. If we were to assume that those households that do annuitize do so with half of their account balances, then this would result in approximately $24 billion of wealth going into the purchase of immediate life annuities each year. For perspective, this is roughly 10 times larger than the approximately $2 billion flowing into the individual immediate annuity market in 1998.[16]

While these estimates are quite speculative, they nonetheless suggest two broad conclusions. First, the private individual annuity market will likely undergo substantial

[16] As discussed in Brown, Mitchell & Poterba 2000, the $7.9 billion individual annuity market reported by the ACLI significantly overstates the extent of annuitization because it includes structured settlements as well as non-life contingent annuities. We estimate the actual size of the retirement life annuity market to be on the order of two to three billion dollars in premiums per year.

growth over the coming decades. Second, the size of the individual annuity market will remain small relative to Social Security as a source of annuitized income. Combined with the declining importance of defined benefit plan payouts relative to Social Security, it seems clear that, absent institutional and regulatory changes, overall rates of annuitization will fall in the future, potentially exposing retirees to substantial longevity risk.

5. Evaluation of Options to Encourage Annuitization

In this section, we evaluate a range of policy options related to the annuitization of account balances in defined contribution plans. These options extend from mandating minimum levels of annuitization, to the grant of tax incentives, to the establishment of a government-sponsored program/organization where plan participants can purchase annuities. It will be assumed that the laws and regulations currently applying to annuities from pension plans, such as joint-and-survivor requirements, will be extended to DC plan annuities. We do not discuss other policy proposals that have been made to improve the functioning of pension annuities, such as inflation-indexing or the enhancement of joint-and-survivor rules.

The evaluation of policy options will clearly differ depending on what one believes is the underlying reason for why individuals do not choose to annuitize more of their wealth. As discussed in section 2, there are many possible reasons that individuals may not annuitize, and it is highly unlikely that any one reason is sufficient to explain the lack of annuitization. It could be that rational actors are making an optimal decision based on their expectations about future health expenditure needs and preferences towards risk and bequests. If so, then the lack of annuitization may not be viewed as a major problem for policy makers, and it should be left to the private market to design products accomodating

individuals' needs and preferences. Alternatively, it may be that rational actors would like to annuitize, but simply do not have access to fairly priced annuities because their DC plan does not offer them and the private market for individual annuities suffers from adverse selection. In this case, government policy may wish to require that DC plan sponsors offer an annuity option, or even considering mandating annuities to overcome the adverse selection problem; otherwise, many individuals would be at risk of relying on government assistance if they live longer than expected and exhaust their resources. If, on the other hand, individuals are not behaving rationally at all, but rather are failing to purchase welfare-enhancing annuities due to myopia or a lack of understanding of the benefits of annuitization, then paternalistic policy makers might wish to simply mandate annuitization. Unfortunately, existing evidence does not allow us to specify what fraction of the population falls under each category. Therefore, we will explore a range of policy alternatives, and discuss under what assumptions each policy does or does not make economic sense.

5.1 *Mandate minimum level of annuitization*

An obvious and highly controversial way to increase annuitization levels would be to mandate that every tax-qualified employer-sponsored retirement plan provide that any benefits payable to a participant below a certain dollar level be paid entirely in life annuity form. Such a mandate could apply to all types of plans, including pension, profit-sharing, and stock bonus plans. For example, one might select the dollar level so that the (joint-and-survivor) lifelong annuity income produced at the normal retirement age would be sufficient, when combined with Social Security benefits, to keep retirees above some minimum income level. If the account balance/plan benefit were below this (age-adjusted)

level, the entire account would have to be annuitized; if it were above this level, discretion for the disposition of the remaining account balance would be left to the plan participant.[17]

An annuity mandate would greatly increase annuitization rates in tax-qualified, especially defined contribution, plans. Therefore the mandate would improve the retirement income security of many plan participants and reduce the adverse selection problem affecting the life annuity market (thereby enhancing annuity payout rates).

However, an annuity mandate has several important negative effects as well. Annuitization may be inappropriate and even harmful for many plan participants, such as those in poor health, or those who wish to leave a large estate. In addition, a mandate has the potential to be administratively burdensome. It is also likely to be politically very unpopular in the U.S. because it severely restricts individual choice.

Some recent policy discussions in the United Kingdom are relevant to these proposals. Current pension law in the U.K. requires that those with personal or occupational pension plan assets must buy a life annuity by the age of 75.[18] The main aim of the law is to cure the moral hazard problem, that is, the possibility that pensioners will spend their assets quickly and fall back on state welfare provision. Recent declines in annuity rates owing to falling interest rates, as well as chafing at the (perceived and real) inflexibility and illiquidity inherent in life annuities, have led to demands that these requirements be softened. A semi-official Retirement Income Working Party recently issued a Report (2000) recommending that the obligation for total annuitization should be

[17] Non-discrimination requirements presumably would have to be amended to allow the differential treatment of participants by size of account.

[18] Under present rules, however, 25% of the pension account can be taken as a tax-free lump sum distribution. Prior to age 75, the plan participant can choose to substitute "income drawdown" for the purchase of an annuity. In income drawdown, the capital sum remains invested and individuals are allowed to draw an income from the account, as long as the income drawdown level stays within strict guidelines set forth by the government regulator.

changed to a requirement that when an individual retires, he or she purchase an inflation-indexed annuity to meet a minimum retirement income. The minimum income would be set at a level related to eligibility for State welfare support. The new obligation would be imposed on the individual plan participant when he or she retires; formulas would be established to determine that individuals had pension entitlements, from both state and private sources, sufficient to deliver the minimum retirement income on an inflation-adjusted basis going forward.[19]

5.2 Make Annuitization the Default Option for Defined Contribution Plan Distributions

A less drastic proposal is to mandate that employers make annuitization the default distribution option in defined contribution plans. Plan distributions other than in annuity form would require the active and affirmative choice of the plan participant. This is the recommendation of the Department of Labor Advisory Council Working Group (1998):

> Require that all defined contribution plans offer annuities as the primary form of benefit for all distributions in excess of $5,000 and comply with the joint and survivor rules, unless the participant elects otherwise in conformance with the joint and survivor rules, including spousal consent.

In order to reduce the administrative burden on plan sponsors and providers, defined contribution plans that are not primary plans might also be exempted from the default option mandate.

This proposal has several advantages and disadvantages compared to the proposals for mandatory annuitization and current practice. Clearly, the element of compulsion is missing and therefore freedom of choice and flexibility is preserved. Yet annuitization is encouraged and this presumably would lead to some improvement in the functioning of

[19] The enforcement mechanism for the current and proposed requirements, however, is left unclear in the Report.

annuity markets. Still, an additional administrative burden would be imposed on hundreds of thousands of plans that heretofore have avoided offering the annuity payment form.

There is empirical evidence that creating a default option has a powerful affect on plan participant behavior. Madrian and Shea (2000) examined the impact of a shift in one large 401(k) plan from affirmative election of participation to automatic enrollment with the right to decline. No other economic feature of the plan changed and therefore it might be thought that behavior would not change. They found, however, that participation is significantly higher under automatic enrollment: the overall participation rate increased by 25 percentage points and the variation in participation rates with respect to demographic characteristics was reduced considerably. Similarly, the default contribution rate and fund allocation chosen by the plan sponsor had a significant influence on the behavior of plan participants. Madrian and Shea make reference to psychological factors such as procrastination, framing and anchoring in explaining these results. This evidence implies that mandating an annuitization default option would probably substantially increase the selection of life annuities by plan participants.

5.3 *Mandate or Encourage Primary Defined Contribution Plans to Offer Life Annuities*

A less stringent requirement than mandating plans to provide annuitization as the default option is to require that primary defined contribution plans simply offer annuities as one of many distribution options. Alternatively, tax credit incentives could be given to plan sponsors to offer annuities through their plans. Such tax credits have been proposed for small employers to cover the administrative costs of sponsoring a new retirement plan.

It is unclear whether the mere fact that the retirement plan offers an annuity option will be sufficient to increase annuitization rates. Hence, it is uncertain whether this

proposal will result in substantial public welfare gains. Furthermore, the requirement to offer annuities presumably would result in some increase in administrative burden for plan sponsors, at least initially. Clearly, however, it is the least intrusive on participant choice; indeed, it effectively expands the choice set available to most retirement plan participants.[20]

Although any annuity from a retirement plan is currently subject to the joint-and-survivor rules, unless the annuity is the default distribution option, other distributions from the retirement plan are not subject to the joint-and-survivor requirements. This exemption could be viewed either as an advantage or disadvantage. It is an advantage in that it results in a smaller administrative burden on the plan sponsor or provider; it is a disadvantage in that it exposes spouses to unexpected impoverishment in retirement.

5.4 Encourage Plan Participants to Choose Life Annuities for Asset Distribution

In this proposal, distributions from retirement plans would receive favored tax treatment if they occurred through life annuities. For example, capital gains rates could be applied to the entire annuity payment or to the percentage of the distribution attributable to investment gains. Alternatively, a flat dollar amount or a percentage of annuity payments could be exempted from income taxation, similar to the current treatment of Social Security retirement annuity payments.

Although this alternative approach would presumably encourage annuitization, it would not be a mandate on either plan sponsors or a constraint on participant choice and therefore might be more attractive than some of the proposals mentioned above. The

[20] Of course, a plan participant can currently roll over 401(k) assets to an individual retirement annuity; this economically equivalent action, however, requires significant effort, particularly in search costs. A plan sponsor, who has already conducted a search for the best plan provider and investment manager, presumably is better capable of doing the search and negotiating the best deal possible.

demand from plan participants for annuities, as well as the current legal requirement that retirement plans be run in the interests of their participants, would presumably be sufficient cause for many defined contribution plans to offer life annuities. Of course, there would be a revenue loss of unknown magnitude to the federal government from the change.[21] Furthermore, placing a tax wedge between alternative distribution options could lead to pure efficiency losses if it distorts the decisions of individuals who would otherwise rationally choose not to annuitize.

5.5 Create a Government-Sponsored Agency to Provide Life Annuities to Plan Participants

The last proposal we examine, which either could operate independently or in conjunction with the proposals listed above, would be to create an agency or organization sponsored by the federal government to offer life annuities to retirement plan participants. An analogy might be the TSP or the Federal Employee Group Life Insurance program for federal government workers. Theoretically, this organization could lower transaction and search costs, and could underwrite product research and innovation to encourage annuitization, which in turn would lead to reduced adverse selection. There would be no increased burden on plan sponsors. A federal government-sponsored organization might be viewed as unfair competition to tax-paying and regulated commercial insurance companies, particularly those efficiently run and already providing safe and low-cost annuities to retirement plan participants. Warshawsky (1997), writing in the context of Social Security reform, discussed the possibility of creating a federal board of overseers of

[21] Another approach that would increase government revenues and still encourage annuitization would be to penalize, say by the imposition of an excise tax, retirement plan distributions, both pre- and post-retirement, *not* in the form of life annuities.

annuity providers as well as a national clearinghouse for commercially sold annuities. This mechanism would be analogous to the health plan for federal government workers; annuities from competing insurers could be offered in a clear and rational platform.

6. Conclusions

Annuities play the important economic role of insuring individuals against the financial risks associated with longevity uncertainty. In the absence of opportunities for annuitization, retirees are required to balance the risk of outliving their resources with the desire to increase consumption while alive. Those who choose to consume conservatively forego the extra utility they could have achieved from a higher consumption level. Those who consume too aggressively risk finding themselves with insufficient resources at older ages. As a result of their ability to resolve these risks, annuities play a central role in the life-cycle theory of wealth decumulation.

One important implication of the shift from DB to DC pension plans is a reduction in opportunities for retirees to annuitize their retirement assets. This is due primarily to the fact that a minority of DC plans include a life annuity as one of the payout options. Even in those plans that offer an annuity option, the fact that it is optional means that individuals who do choose to annuitize will likely receive lower monthly income due to the lower mortality characteristics of the individual annuitant pool.

Policy makers interested in increasing annuitization rates, either out of concern for the welfare of individual retirees or to avoid excessive old-age dependence on government assistance programs, have a number of options available to them. Mandating annuitization is the most extreme measure, and runs the risk of forcing annuitization on households that

rationally do not value it. Alternatively, one could simply mandate that firms offering DC plans offer an annuity as a payout option, or possibly even offer it as the default option. This preserves individual choice, and in fact enhances it by expanding the set of distribution options available to individual retirees. Various tax incentives could also be used to encourage firms to offer and retirees to use annuity options. The downsides of this approach are lost government revenues and the potential tax distortions that this would introduce into the distribution decision. Government provision of annuities is also an option, though one that would clearly crowd-out a growing private annuity market.

Appendix A: Calculation of Annuity Equivalent Wealth

The calculation of Annuity Equivalent Wealth begins with a representative individual who is assumed to maximize an expected utility function V, by choosing an optimal consumption path $\{C_t\}$ from time 0 to time T (the maximum possible lifespan), given a rate of time preference ρ and a vector of cumulative survival probabilities $\{P_t\}$.

$$\underset{\{C_t\}}{Max} \sum_{t=0}^{T} \frac{P_t U(C_t)}{(1+\rho)^t} \tag{A-1}$$

The budget constraint facing this individual depends on whether or not he has access to annuities. In the absence of annuities, the constraint is that the present value of future consumption, discounted using the riskless interest rate r, be equal to the individual's initial wealth, W_0:

$$W_0 = \sum_{t=0}^{T} \frac{C_t}{(1+r)^t} \tag{A-2}$$

If this individual is able to purchase actuarially fair annuities, the budget constraint becomes:

$$W_0 = \sum_{t=0}^{T} \frac{P_t C_t}{(1+r)^t} \tag{A-3}$$

The difference between (A-2) and (A-3) is the role of survival probabilities. In equation (A-2), the present value of all future consumption must not exceed the initial wealth level. With annuities in equation (A-3), the budget constraint is that the *expected* present value of the consumption must equal initial wealth. This budget constraint assumes that the insurance company provides an actuarially fair annuity whose payout path exactly equals the consumption path chosen by the individual. In actuality, there may be additional constraints on the structure of the annuity path that make it sub-optimal is some circumstances (Yagi & Nishigaki, 1993).

Even before solving for the optimal consumption path, it is easy to see why annuities will be preferred in this model. One way to view the difference in the two budget constraints is to interpret the survival probabilities in (A-3) as the relative price of future consumption when annuities are available versus when they are not available. Viewed this way, the price of future consumption is always lower when annuities are available, since the value of $P_t<1$ for all $t>0$.

It is common to assume that the one-period utility function, $U(C_t)$, exhibits constant relative risk aversion, and can thus be defined as follows:

$$U(C_t) = \frac{C_t^{1-\beta}}{1-\beta} \tag{A-4}$$

where β is the Arrow-Pratt coefficient of relative risk aversion, and $1/\beta$ is the elasticity of intertemporal substitution in consumption.

By maximizing (A-1) subject to (A-2) or (A-3), one can solve for the individual's optimal consumption path with or without access to annuities annuities. Each optimal C_t^* can be found as a function of W_0, ρ, r, β, and the full set of survival probabilities $\{P_t\}$, as follows:

$$C_t^{\text{no annuities}} = W_0 \left(\frac{1+r}{1+\rho} \right)^{t/\beta} P_t^{1/\beta} \left(\sum_{j=0}^{T} \frac{(1+r)^{j(1-\beta)/\beta}}{(1+\rho)^{1/\beta}} P_j^{1/\beta} \right)^{-1} \tag{A-5}$$

$$C_t^{annuities} = W_0\left(\frac{1+r}{1+\rho}\right)^{t/\beta}\left(\sum_{j=0}^{T}\frac{(1+r)^{j(1-\beta)/\beta}}{(1+\rho)^{j/\beta}}P_j\right)^{-1} \quad \text{(A-6)}$$

To gain some intuition for the difference between these equations, it is useful to consider the special case in which the consumer has log utility (β =1) and in which the interest rate and rate of time preference are equal to one another (r = ρ). In this case, equations (A-5) and (A-6) reduce to:

$$C_t^{no\ annuities} = P_t W_0\left(\sum_{j=0}^{T}\frac{P_j}{(1+r)^j}\right)^{-1} \quad \text{(A-5')}$$

$$C_t^{annuities} = W_0\left(\sum_{j=0}^{T}\frac{P_j}{(1+r)^j}\right)^{-1} \quad \text{(A-6')}$$

In this special case, the difference in the consumption at time t is proportional to the cumulative survival probability to time t. Since P_0=1 by definition, the level of consumption at time 0 is the same whether there are annuities available or not. In the case with no annuities, consumption declines over time due to falling survival probabilities, whereas with annuities, the consumption profile is level for the rest of the individual's life. Thus, consumption with annuities is greater than or equal to consumption without annuities in all periods, and thus utility is higher.

By plugging the optimal consumption rules from (A-5) and (A-6) back into the lifetime utility function (A-1), one can construct the indirect utility functions, V(.), that correspond to each budget constraint. These indirect utility functions express the maximum utility the individual can achieve by following the optimal consumption path as a function of the parameters W_0, r, ρ, β and $\{P_t\}$:

$$V_0(W_0)^{no\ annuities} = \frac{1}{1-\beta}W_0^{1-\beta}\left(\sum_{j=0}^{T}\frac{(1+r)^{j(1-\beta)/\beta}}{(1+\rho)^{j/\beta}}P_j^{1/\beta}\right)^{\beta} \quad \text{(A-7)}$$

$$V_0(W_0)^{annuities} = \frac{1}{1-\beta}W_0^{1-\beta}\left(\sum_{j=0}^{T}\frac{(1+r)^{j(1-\beta)/\beta}}{(1+\rho)^{j/\beta}}P_j\right)^{\beta} \quad \text{(A-8)}$$

As already indicated, for a given level of wealth W_0, an individual achieves a higher level of utility with annuities than without. It is possible to state this utility gain in dollar terms by determining how much additional wealth would need to be given to an individual without annuities to make him as well off as if he had annuities. This is done by finding the α such that:

$$V_0(\alpha W_0)^{no\ annuities} = V_0(W_0)^{annuities} \quad \text{(A-9)}$$

α is what we denote the "Annuity Equivalent Wealth." In the case shown here, it is easy to solve for α analytically. However, once one begins to incorporate additional complexities, such as the presence of pre-existing annuities, liquidity constraints, or other sources of uncertainty, solving for α must be done through dynamic programming solution techniques. Readers interested in the details of the dynamic programming algorithms should see Mitchell, Poterba, Warshawsky and Brown (1999) for the case of a single individual, Brown and Poterba (2000) for the case of couples, and Mitchell, Brown & Poterba (1999) for the case in which returns and/or inflation are uncertain.

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Table 1: Annuity Equivalent Wealth with Pre-Existing Annuity Wealth

Coefficient of Relative Risk Aversion	Annuity Equivalent Wealth	
	No Pre-Existing Annuities	Pre-Existing Annuities
1	1.502	1.330
2	1.650	1.441
5	1.855	1.623
10	2.004	1.815

Source: Brown, Mitchell & Poterba, 1999.

Table 2: Annuity Equivalent Wealth for Couples

Coefficient of Relative Risk Aversion	Annuity Equivalent Wealth	
	Nominal Annuities	Real Annuities
1	1.175	1.202
2	1.244	1.295
5	1.339	1.446
10	1.407	1.600

Notes: Assumes no pre-existing annuities and that the survivor benefit ratio is 0.5.
Source: Brown & Poterba, 2000

Table 3: Annuity Equivalent Wealth for Nominal Annuities with Uncertain Inflation

Coefficient of Relative Risk Aversion	Individual with No Pre-Existing Annuity Wealth			Individual With Half of Initial Wealth in Pre-Existing Real Annuity		
	Real Annuity	Nominal Annuity: i.i.d. inflation	Nominal Annuity: Persistent Inflation	Real Annuity	Nominal Annuity: i.i.d. inflation	Nominal Annuity: Persistent Inflation
1	1.502	1.451	1.424	1.330	1.304	1.286
2	1.650	1.553	1.501	1.441	1.403	1.366
5	1.855	1.616	1.487	1.623	1.515	1.450
10	2.004	1.592	1.346	1.815	1.577	1.451

Source: Brown, Mitchell, & Poterba 1999.
Notes: The AEW for the nominal annuity is calculated under the assumption that inflation takes one of six possible values, roughly capturing the distribution of inflation outcomes over the 1926-1997 period. Inflation shocks are independent across periods in the i.i.d. case, and follow a stylized AR(1) process in the persistent inflation case.

Table 4: Annuity Equivalent Wealth for Couples with 50% Pre-Existing Annuity Wealth and a 12% Load Factor (Money's Worth = 0.88)

Coefficient of Relative Risk Aversion	Nominal Annuity with Fixed 3.2% Inflation
1	0.972
2	1.011
5	1.069
10	1.157

Source: Authors' calculations.

Table 5
Number of Employer Provided Pension Plans and Plan Participants by Type of Plan

	1977	1982	1987	1992	1996
Total Plans (thousands)	403	594	733	708	696
Defined Benefit	122	175	163	89	64
Defined Contribution	281	419	570	620	633
DC as % Total	70%	71%	78%	88%	92%
Total Participants (millions)	50	63	78	82	92
Defined Benefit	35	39	40	40	41
Defined Contribution	15	25	38	42	51
DC as % Total	30%	40%	49%	51%	55%

Source: Private Pension Plan Bulletin, Abstract of 1996 Form 5500 Annual Reports, Number 9, U.S. Department of Labor, Winter 1999-2000, Tables E1 and E5.

Table 6
Estimated Private Wage and Salary Worker Participation Rates
Under Primary and Supplemental Pension Plans

Year	Number of Wage and Salary Workers (000's)	Fraction of Workers Covered by DB Plan (%)	Fraction of Workers Covered by Primary DC Plan (%)	Fraction of Workers Covered by Supplemental DC Plan (%)
1978	75,939	38%	7%	11%
1980	78,349	38	8	13
1982	82,318	36	10	15
1984	86,732	34	11	18
1986	90,267	32	14	18
1988	93,012	30	15	16
1990	94,772	28	17	17
1992	96,577	26	20	17
1994	101,077	24	21	16
1996	104,313	22	23	16

Note: For workers covered under both a DB and a DC plan, the DB plan is designated as the primary plan unless the plan name indicates it provides supplemental or only past service benefits.

Source: Private Pension Plan Bulletin, Abstract of 1996 Form 5500 Annual Reports, Number 9, Table E4, U.S. Department of Labor. Number of workers taken from Employment and Earnings, Bureau of Labor Statistics, and includes both employed and unemployed wage and salary workers. The number of workers in primary and supplemental plans are estimates derived from annual Form 5500 reports filed with the IRS for plan year.

Table 7
Lump-Sum Availability within Defined Benefit Plans

	Percentage of full-time participants			
	1991	1993	1995	1997
% with Lump Sum	14	10	15	23
Full Amount	9	9	15	22
Amount Limited	5	3	5	1

Source: Employee Benefit in Medium and Large Firms, Bureau of Labor Statistics, U.S. Department of Labor, as reported in Table 17 of Mitchell 2000.

Table 8
Distribution Methods: Savings and Thrift Plans

	Percent of Full-Time Participants with Distribution Option							
	1985	1986	1988	1989	1991	1993	1995	1997
Life Annuity	29	25	25	28	30	30	17	25
Installments	59	52	49	52	52	48	30	41
Lump-Sum	99	98	95	96	99	98	85	91

Source: Employee Benefits in Medium and Large Firms, Bureau of Labor Statistics, U.S. Department of Labor, as reported in Table 29 of Mitchell 2000.

Table 9
Distribution Methods: 401(k) Plans

	Percentage of Full-Time Participants with Distribution Option		
	1993	1995	1997
Life Annuity	34	21	27
Installments	49	34	41
Lump Sum	98	92	91

Source: Employee Benefits in Medium and Large Firms, Bureau of Labor Statistics, U.S. Department of Labor, as reported in Table 30 of Mitchell 2000.

Table 10
Summary Statistics on Individual Variable Annuity Plans in the U.S., 1971–1996

	1971	1976	1981	1986	1991	1996
						In Force Year-End
Number of Persons Covered	171,600	663,170	797,730	1,913,750	2,838,270	8,156,500
Considerations (Thousands $)	$ 128,975	$ 565,600	$ 1,862,150	$ 5,283,190	$ 8,388,040	$39,700,680
Variable Annuities in Course of Payment						
Number of Persons Receiving Payments	1,421	6,130	11,460	29,640	54,400	91,700
Annualized Income (Thousands $)	$ 1,571	$ 7,770	$ 19,300	$ 71,910	$ 184,400	$ 381,580

Source: ACLI *Fact Books* 1972-1997

Table 11
Mortality Rates (Deaths per 1000)

Males	General Population	Group Annuitants	Individual Annuitants
65	21.5	14.4	11.0
70	30.3	22.1	18.0
75	44.0	33.9	29.1
80	70.0	58.0	47.2
85	111.7	93.1	75.6
Females			
65	13.3	9.0	7.0
70	19.7	14.2	11.0
75	29.6	22.5	18.9
80	45.9	37.7	33.1
85	75.0	63.6	57.8

Sources: General population mortality rates from the 2000 Trustee's Report of the Social Security Administration. Group annuitant mortality rates are from the Society of Actuaries (1995). Individual annuitant mortality rates are from Johansen (1996). The annuitant tables have been converted into cohort tables for the 1935 birth cohort as described in text.

Table 12
Monthly annuity payment available from a $100,000 actuarially fair annuity under alternative mortality assumptions

	General Population	Group Annuitant	Individual Annuitant
Real (3%)	$508.41	480.41	459.99
Nominal (6%)	679.33	651.65	632.78

Source: Authors' calculations as described in text.

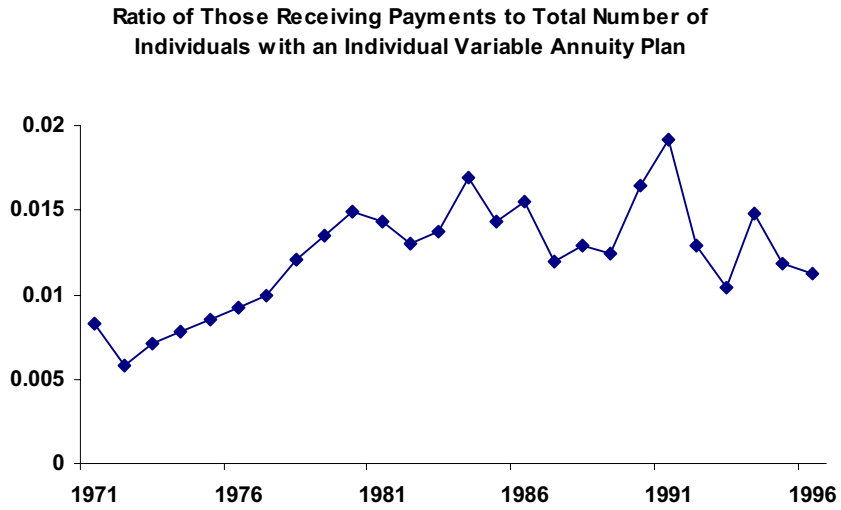
Table 13
Participants, Annual Benefits Paid, and Plan Liabilities for Private Single-Employer Defined Benefit Plans: Most Likely Forecast

	Participants (millions)				Annual Benefits Paid*		Plan Liabilities*
Year	Total	Active	Terminated Vested	Retired	Only Life Annuities	Lump-sums	
1999	23.9	11.0	4.8	8.1	$93.9	$83.7	$1,477,049
2009	26.5	11.0	5.3	10.2	$119.1	$117.2	$1,949,258
2019	28.8	11.0	5.6	12.1	$159.8	$132.3	$2,287,435

* Millions of 1999 dollars

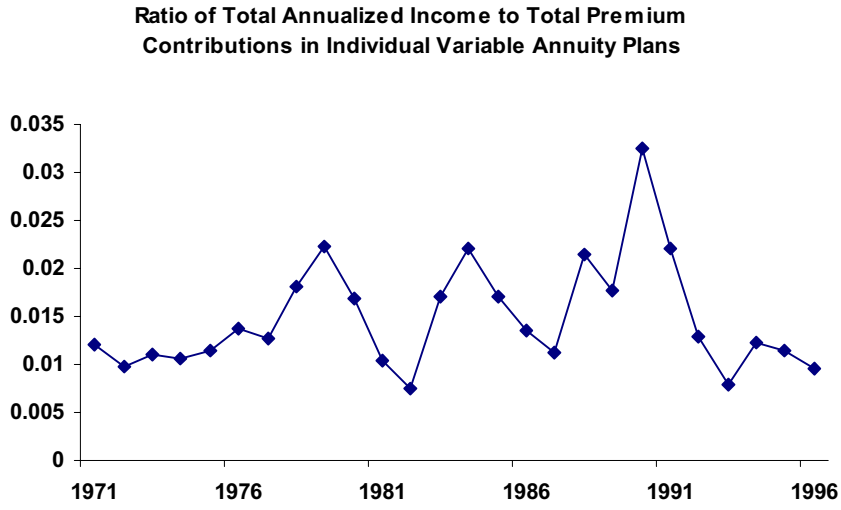
Source: Authors' calculations based on data provided from the PIMS simulation model of the PBGC.

Figure 1



Source: Successive annual issues of the American Council of Life Insurance *Fact Book*.

Figure 2



Source: Successive annual issues of the American Council of Life Insurance *Fact Book*.