Innovations in Retirement Financing

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Chapter 8
Mortality Risk, Inflation Risk, and Annuity Products

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> "Buy an annuity cheap, and make your life interesting to yourself and everybody else that watches the speculation." (Jonas Chuzzlewit to his father, in *Martin Chuzzlewit* by Charles Dickens)

Future retirees are likely to shoulder an increasing share of the burden of managing their wealth after they leave the labor force. This is primarily the result of the rapid growth of self-directed retirement accounts. Poterba, Venti, and Wise (1999) project that the average retiree balance in 401(k) accounts will rise tenfold between 2000 and 2030. The popularity of self-managed retirement resources is further supported by U.S. corporate pension plans permitting, and in some cases even encouraging, lump sum distributions when participants retire. Interest in retiree responsibility for asset decumulation has also emerged in policy discussions of "individual account" programs that could supplement or replace government-provided social security. As the leading edge of the baby boom approaches retirement, more attention is likely to be directed toward the development of financial products such as annuities that provide households with a structure way to draw down the assets that they have accumulated during their working lives.

Annuities feature prominently in theoretical discussions of asset decumulation in life cycle models, so it has been disappointing to economists that, in practice, the market for privately purchased annuities in the United States is very small. Most elderly households in the U.S. receive government-provided social security benefits that provide an inflation-indexed lifetime annuity. Many also receive a nominal annuity from a defined benefit company pension plan. But few elderly households in the U.S. convert their

financial assets accumulated outside a defined benefit pension plan into an annuity providing a lifetime retirement income. The Life Insurance Marketing Research Association (LIMRA, 1999) reported that in 1998 there were only 1.56 million individual annuity policies in "payout" phase, meaning that the policy owners were currently receiving benefits. These policies covered a total of 2.35 million lives, since many of the policies were joint and survivor annuities paying benefits to both members of a married couple.

A number of previous studies have investigated the demand for annuity products and evaluated various aspects of annuity pricing (cf. Friedman and Warshawsky 1990, and Mitchell, Poterba, Warshawsky, and Brown 1999; hereafter MPWB). In the current study, we present new evidence on the pricing of annuity products in the United States and several other countries. We focus on three issues. First, we offer new computations on the "money's worth" of nominal annuities, the present value of annuity payouts relative to their purchase price, in the United States during the late 1990s. Our findings broadly confirm previous results that suggest money's worth values between 80 and 90 cents per premium dollar for randomly selected individuals in the population, but values between 90 cents and one dollar for the average annuitant. Second, we assess the U.S. market for real annuities, annuities that offer a payout stream indexed to the price level. There is effectively no market for inflation-protected annuities in the United States, but there are active markets in other nations, notably the United Kingdom. Third, we summarize available evidence on annuity pricing in other nations. We describe some of the shortcomings of studies that have analyzed prices in annuity markets outside the United States and the United Kingdom, and we note the difficulties associated with obtaining key data inputs for these studies.

The Market for Annuities in the United States

Annuities may be purchased either by members of a group or by individuals. In this analysis we focus on individual policies. These are most directly relevant for older people who might wish to use the annuity market to spread their accumulated assets over a remaining lifetime of uncertain length. By contrast, a group annuity contract is typically obtained via an employer-provided defined benefit pension plan. In some cases, group annuities may also be obtained via a defined contribution pension plan. The key distinction between an annuity purchased as an individual and one obtained through a group is that individuals purchasing annuities on their own are more likely to be self-selected to live longer than average. As in other insurance contexts, group purchases of annuities reduce the risk of adverse selection. In the present paper, we focus on individual annuities as a means to manager retirement assets outside pension plans.

The U.S. individual annuity market is one component of the broader

market for life insurance products. The American Council on Life Insurance (ACLI 1999) reports that premiums paid for *immediate individual* annuities, which are our main focus, totaled $7.9 billion in 1998. By comparison, premiums for *immediate group* annuities totaled $16.3 billion, and premiums for *group deferred* annuities, typically representing contributions to defined benefit pension accounts, were $117.7 billion. Further, the $7.9 billion figure for individual annuity premiums overstates the importance of annuity products in retirement, since about half of all newly purchased individual annuities represent "structured settlements" (typically resulting from legal cases) and hence do not represent income flows to retirees. Moreover, of the remaining "annuities," half are "period certain" policies. These policies promise a fixed nominal payout stream for a specified time period without a mortality contingency; they are effectively bonds issued by insurance companies. Thus, premium flows for annuity products providing lifetime income from an initial asset stock are currently only about $2 billion per year.

Premium volume for individual *immediate* annuities is dwarfed by that for individual *deferred* annuities. Deferred products attracted $87.5 billion in premiums in 1998, mostly for purchases of variable annuities during the preretirement period. It is not clear whether the assets that accumulate in these financial instruments will ultimately be used to finance the purchase of traditional immediate annuities. Survey results presented by the Gallup Organization (1999) suggest that many purchasers of variable annuities regard the accumulating principal in these products as a source of emergency resources for health care or other needs, not as a source of stable retirement income.

Although the U.S. individual annuity market is currently small, it is likely to grow substantially in the future. Many current retirement saving vehicles permit individuals to exert substantial discretion over how they draw down their accumulated assets. These vehicles include 401(k) plans, 403(b) plans, and Individual Retirement Accounts (IRAs). Potential draw-down options from these include lump-sum distributions, periodic partial distributions, and annuitization. Brown (1999) reports that data for individuals aged 51–61 from the Health and Retirement Survey suggest that 48 percent of households with a defined contribution pension plan permitting a phased withdraw or annuity option intend to annuitize at least a portion of their account. When coupled with the rapid prospective growth in the number of retirees who will have participated in a defined contribution plan during their working lifetime, this should yield significant future growth in the annuity market.

While the *number* of future retirees who will have resources that could be annuitized is likely to increase in the future, it is possible that the *percentage* of retirees with such accounts who choose to annuitize will decline, at least if current stock market valuation levels persist. Individuals reaching retirement age with large accumulations in retirement accounts may feel less

need for annuity-type products to product them against outliving their resources than would less wealthy retirees. The increase in share values in recent years, and the associated rise in the value of retirement account assets, has apparently affected the demand for annuity products. At one major retirement annuity provider, TIAA-CREF, King (1996) reports that retirees who control their assets have been gradually shifting away from annuity distributions and toward lump sum options. A different study at the same firm by Ameriks (1999) reports that participants with larger account balances tend to choose the lump sum route for distributing plan assets. Even if the *fraction* of defined contribution plan participants selecting annuities declines somewhat in the future, the fact that the retiree population with self-directed accounts is growing rapidly still suggests prospective growth in the annuity market.

Valuing U.S. Annuity Products

We now consider the set of nominal annuity products currently available to annuity buyers in the United States. We also develop a framework for evaluating the payouts from annuity products by calculating the ratio of the expected present discounted value of such payouts to the purchase cost (initial premium) of these products. In the next section we report empirical results based on this framework.

Currently Available Annuity Products in the United States

Virtually all the annuity products marketed to individual annuity buyers in the United States are nominal annuities. They pay benefits that are not inflation-indexed. Two forms are common: (a) level-payout annuities that provide a fixed payment, typically monthly, for as long as the annuitant is alive; and (b) graded annuities paying benefits that increase over time at a prespecified rate (e.g. at 3 or 5 percent per year). The payout streams associated with these two types of policies differ, with the real value of payouts from a level-payout nominal policy declining faster than that from a graded annuity. A graded annuity does not offer inflation protection, however, since the stream of benefits provided is not affected by the inflation rate over the contract's lifetime.

An annuity may be purchased as either an individual policy or a joint and survivor policy. In the former case, in the absence of a period-certain clause, benefit payments continue as long as the insured person is alive. In the latter case, benefits are paid for as long as either of *two* individuals is alive. Brown and Poterba (2001) explain that joint and survivor products vary in the ratio of the payout that second to die annuitant receives relative to the payout when both annuitants are alive. There are three common types of joint and survivor products, and several variants. One, a "100 percent survivor policy,"

provides the same benefit when both members of a couple are alive as when only one survives. A related policy, a "50 percent survivor policy," provides the survivor with half of the benefit that was paid when both annuitants were alive. The third common policy is a "50 percent contingent beneficiary policy." In this case, one of the annuitants is defined as the primary and the other as the contingent beneficiary. The full amount of the annuity payout continues for as long as the primary beneficiary is alive. If the primary beneficiary predeceases the contingent beneficiary, the contingent beneficiary receives a payout equal to half of the primary beneficiary's payout.

A final factor affecting annuity products is their tax status, which has to do with the source of the funds used to purchase the annuity. In the U.S., contributions to employer-provided pension programs are not included in taxable income provided that the plan meets regulatory standards. In this paper, we focus on annuities purchased using nonqualified funds.[1]

Table 1 reports the average annuity payouts available to 65-year-old annuity buyers in the United States over the period 1995–99. For comparability purposes, the table reports only on annuities with a premium of $100,000; the data represent single premium, nonparticipating, annuities. Premiums are reported gross of state premium taxes. By restricting the sample to nonparticipating annuities, we exclude annuity products for which the payout to the annuitant depends on either the investment returns or the mortality experience of the insurance company writing the policy. TIAA-CREF is an example of a firm that sells participating annuities, and that is therefore excluded from our sample.

Data for the period 1995–98 are drawn from the Life/Health edition of *Best's Review.* For many years this major publisher of insurance market information conducted an annual survey of single premium immediate annuity policies, but it ceased doing so in 1998. The Best's survey generally included around 100 firms with consistent representation from the larger national insurers, along with many small companies with a strong regional presence. Table 1 also reports information from 1998 and 1999 from the *Annuity Shopper,* which is a print and electronic publication providing annuity price quotes to prospective buyers. The *Annuity Shopper* has collected information on annuity prices since the early 1980s. This publication does not offer a representative sample of insurers; rather, listing with the *Annuity Shopper* is at the discretion of the insurer. In 1998 there were 99 firms in the *Best's* database, compared with 35 firms in the *Annuity Shopper* database. It is interesting that for the overlap year of 1998, average monthly annuity payouts agree quite closely across the two sources.

The evidence in Table 1 suggests that annuity payouts have declined in the United States between 1995 and 1999. For instance, a 65-year-old man purchasing a $100,000 single premium annuity in 1995 would expect to receive a monthly payment of $794 on average ($9,528 per year). By 1998, the nominal payout would have dropped by 8 percent to $733 ($8,796 per year).

TABLE 1. Average Monthly Payouts from Single Premium Immediate Annuities Offered to 65-Year-Olds, United States, 1995–99

	Best's Survey				*Annuity Shopper*	
	1995	*1996*	*1997*	*1998*	*1998*	*1999*
Male Annuitant	$794.12	761.79	772.22	732.74	731.94	734.77
Female Annuitant	716.98	685.62	699.67	661.62	659.29	667.36

Source: Authors' tabulations from *Best's Review* (various issues) and *Annuity Shopper* of payouts for nonqualified individual annuity purchases. Monthly payouts are based on a $100,000 initial premium.

Women live longer than men on average, so the 65-year-old female paying the same $100,000 premium in 1995 would have anticipated receiving about 10 percent less than her male counterpart, $717 per month ($8,604 per year). By 1998, her nominal benefit would also have fallen by 8 percent or to $662 per month ($7,944).

Table 1 does not present information on joint and survivor annuities, but we have also examined data on those products to place them in perspective. In 1999, for instance, a couple consisting of a 65-year-old male and a 62-year-old female buying a joint and full survivor annuity would receive $587 monthly, about 20 percent less than a single male.

The *Annuity Shopper* and *Best's* data appear to compare reasonably well in 1998, the year for which we present summary measures from both data sets. If we extend the time series of annuity payouts for 65-year-old men to 1999 using the *Annuity Shopper* data, the average monthly payout for the 65-year-old annuity purchaser falls by around 8 percent over the 1995–99 period. It is likely that this fall in monthly payouts is partly attributable to the decline in nominal long-term interest rates of over 100 basis points that occurred between 1995 and 1999.

The information on mean monthly annuity payouts shown in Table 1 does not reflect the substantial variation across insurance companies in the montly payouts offered. MPWB (1999) report that different insurance companies can vary widely in their annuity payouts, and that these payout differences do not appear to be systematically related to factors such as insurance company ratings. This implies that some annuity purchasers may receive payouts substantially different from the average values shown in Table 1.

Valuing Annuity Payouts: The "Money's Worth" Calculation

Annuity products provide a stream of payouts lasting many years. The exact value of this payout stream is uncertain because it is conditional on an individual annuity buyer's longevity. In order to evaluate how the future annuity stream compares with the current price of an annuity product, we

must therefore undertake an expected present discounted value calculation to account for the future payment stream and annuity buyer's mortality risk. The "money's worth" valuation approach we undertake here builds on prior research including Warshawsky (1988), Friedman and Warshawsky (1990), Mitchell, Poterba, Warshawsky, and Brown (1999), and Brown, Mitchell, and Poterba (2001). Specifically, the formula used to calculate the expected present discounted valued (EPDV) of a nominal annuity with an annual payout A_n, purchased by an individual of age b is:

$$V_b(A_n) = \sum_{j=1}^{115-b} \frac{A_n * P_j}{\Pi_{k=1}^{j} (1 + i_k)} . \tag{1}$$

We assume that no annuity buyer lives beyond age 115. P_j denotes the probability that an individual of age b years at the time of the annuity purchase survives for at least j years after buying the annuity. The variable i_k denotes the one-year nominal interest rate k years after the annuity purchase. We value annuities without regard to the tax consequences of receiving annuity income, in part for comparability with previous literature, and in part because calculations in MPWB (1999) suggest that there is little difference in the money's worth ratio calculated before and after taxes.

In the U.S. market, virtually all annuities sold offer only nominal payout streams, but in other countries, real annuities that provide inflation-indexed payout streams are also available. To compute the EPDV for such products, equation (1) must be modified to recognize that the amount of the payout is time-varying in nominal terms but fixed in real terms. The easiest way to handle this is to allow A_r to denote the real annual payout, and to replace the nominal interest rates in the denominator of (1) with corresponding real interest rates. We use r_k to denote the annual real interest rate k years after the annuity purchase. While historically it was difficult to measure real interest rates without some assumptions about the future course of inflation rates, it may be possible to use data on the interest rates on inflation-indexed bonds in the United States and the United Kingdom to obtain direct estimates of these rates. The expression that we evaluate to compute the EPDV of a real annuity is

$$V_b(A_r) = \sum_{j=1}^{115-b} \frac{A_r * P_j}{\Pi_{k=1}^{j} (1 + r_k)} . \tag{2}$$

The "money's worth" of an annuity is defined as the ratio of the expected present value of the annuity's payouts and its purchase price. For a nominal annuity that costs \$100,000, for example, the money's worth is $V_b(A_n)/100{,}000$. Our discussion focuses on money's worth ratios because they provide a scale-free metric for comparing annuities over time or across countries.

Money's Worth Calculations for Nominal Annuities

The framework developed above can be used to calculate the money's worth for a variety of different nominal annuity products. To calculate expected present discounted values based on equations (1) and (2), we require three types of data input. The first is the payout rate on the annuities being valued, which was reported in Table 1. The second is a set of mortality rates that can be used to calculate the probability that an annuitant will be alive in future years. The third is a set of discount rates. We describe our choices for these assumptions and then present our empirical EPDV calculations.

Mortality Assumptions for Annuity Valuation

Equations (1) and (2) are evaluated using mortality tables drawn either for the population as a whole, or for a subset of annuitants. The first set of results uses survival probabilities for the population at large, and for this we rely on birth cohort mortality rates taken from the Social Security Administration's 1999 Trustees' Report (1999). It is not sufficient to use current period mortality tables, since over time populations generally experience mortality improvements. Annuity valuation requires mortality projections that model the *prospective* survival experience of today's retirees. When estimating the money's worth of an annuity for a 65-year-old in 1995, we therefore use the projected mortality experience of the 1930 birth cohort, since this is the group that would have been 65 years old in 1995. Similarly, we use the 1931 through 1934 birth cohort mortality rates for the 1996 through 1999 money's worth calculations.

The second set of results acknowledges that annuity purchasers tend to have a mortality experience that differs from that of the general population. Whether this is the result of those who have information that they are likely to be long-lived purchasing annuities, or simply a function of different (and potentially observable) characteristics of annuitants and nonannuitants, is not clear. In any case, because annuitants have longer life expectancies than the broader population, insurance companies have developed a second set of mortality rates. This *annuitant* mortality table describes the mortality experience of those who actually purchase annuities. MPWB (1999) develop an algorithm that combines information from the Annuity 2000 mortality table described in Johansen (1996), the 1983 Individual Annuitant Mortality table, and the projected rate of mortality improvement implicit in the difference between the Social Security Administration's cohort and period mortality tables for the population. Our algorithm generates projected mortality rates for the set of annuitants purchasing annuity contracts in a given year. Our calculations use an updated version of that algorithm that incorporates the most recent social security data.

The population and annuitant mortality tables differ substantially. Fig-

ure 1 shows the projected mortality rates in 1999 for 65-year old male annuity buyers and 65-year-old men in the population at large. Between the ages of 65 and 75, the mortality rate for annuitants is roughly half of that for the general population. The mortality differential is somewhat smaller at older ages. Because cash flows in the first few years after annuity purchase contribute importantly to determining the expected present discounted value (EPDV) of the annuity payout, the large mortality differential between 65 and 75 generates significant differences in EPDVs when we switch from one mortality table to another.

Discount Rate Assumptions for Annuity Valuation

In equation (1) above, the term i_k denotes the one-year interest rate k years after the annuity purchase. In our baseline calculations, we measure these interest rates using the term structure of yields for zero-coupon U.S. Treasury "strips." We estimate the pattern of interest rates that are implied by these yields. The data on the U.S. Treasury strips yield curve were collected from *Bloomberg Financial Markets* for the same dates on which the *Best's Review* and *Annuity Shopper* data were collected. These are riskless interest rates, and using them to discount future annuity payouts implicitly assumes that there is no default risk associated with these payouts. The argument for using such discount rates is that insurance regulation makes the default risk for annuity providers very low. In most states, annuity buyers are protected against insurance company defaults through state insolvency funds. While these funds do not make all annuity purchases riskless, they do further reduce the chance that an annuity buyer will not receive the promised payouts.

One can argue, however, that riskless interest rates generate discount rates that are too low, particularly from the standpoint of the insurance companies that offer annuities. Life insurance firms generally invest their portfolios in risky bonds, so the return at which the insurers may discount their liabilities may exceed the riskless rate. To explore the sensitivity of our findings with respect to alternative interest rate assumptions, we also calculate discount rates from the term structure for BAA corporate bonds. These rates were also taken from *Bloomberg* on the same dates as the annuity price quotes, and correspond to a Bloomberg bond rating of BBB-2. The risk premium associated with these bonds varies with maturity, and over the five years of our sample period. However, the typical yields of these corporate securities at a 30-year horizon are approximately 90–140 basis points higher than comparable yields on riskless Treasury bonds of the same maturity. The yield spread at shorter maturities is in the 70–100 basis point range.

Using a market-based term structure for interest rates on risky bonds represents a methodological advance relative to previous work on annuity valuation. Early studies of the value of annuity payouts used a single dis-

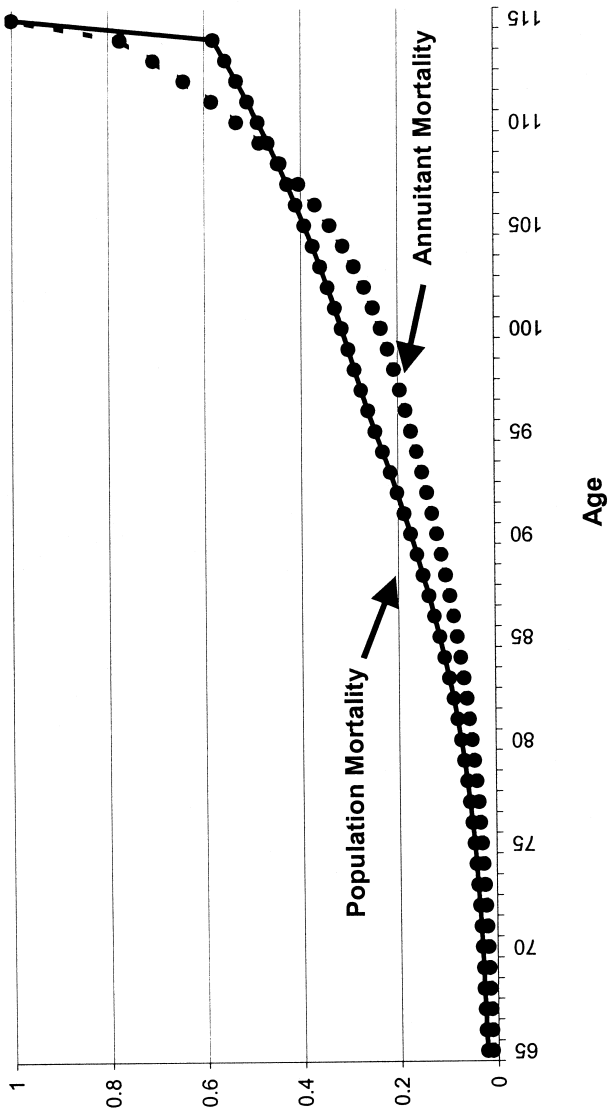

Figure 1. U.S. annuitant and population mortality. Source: Mitchell, Poterba, Warshawsky and Brown (1999), with updates as described in the text.

TABLE 2. Money's Worth of Single Premium Immediate Annuities Offered to 65-Year-Olds, United States, 1995–99

Mortality Table	*Term Structure*	*Best's Survey*				*Annuity Shopper*	
		1995	*1996*	*1997*	*1998*	*1998*	*1999*
Men							
Population	Treasury	0.830	0.821	0.837	0.855	0.844	0.852
Population	Corporate	0.790	0.783	0.800	0.808	0.798	0.783
Annuitant	Treasury	0.937	0.929	0.938	0.974	0.960	0.970
Annuitant	Corporate	0.885	0.879	0.891	0.913	0.900	0.881
Women							
Population	Treasury	0.840	0.829	0.849	0.872	0.857	0.872
Population	Corporate	0.793	0.784	0.806	0.818	0.804	0.792
Annuitant	Treasury	0.909	0.899	0.921	0.953	0.936	0.952
Annuitant	Corporate	0.854	0.846	0.870	0.888	0.872	0.858

Source: Authors' tabulations as described in the text.

count rate, typically the interest rate on a ten-year government or corporate bond, to discount annuity payouts. MPWB (1999) used a market-based term structure for riskless bonds, but constructed a synthetic term structure for risky bonds by adding a constant risk premium to the riskless interest rates. There is currently some variation in the yield spread between corporate and government bonds at different maturities, so the most accurate approach is one that exploits the actual term structure of corporate and government interest rates.

New Results on the Money's Worth of Nominal Annuities in the United States

Table 2 presents our central findings regarding the money's worth of nominal annuities in the U.S. market. The table presents results for both men and women purchasing annuities at age 65, and the table shows money's worth calculations using (a) both the Treasury yield curve and the corporate bond yield curve, and (b) both population and annuitant mortality tables. To illustrate how to interpret the finings, consider the 1999 *Annuity Shopper* results. For a 65-year-old man purchasing a $100,000 annuity using funds accumulated outside a qualified retirement account, our results suggest that annuity payouts have an expected value of $85,200 using the Treasury yield curve for discounting, and $78,300 with the BAA corporate yield curve. These values translate into money's worth ratios of 0.852 and 0.783 respectively; these are the values shown in the table. These calculations are

based on the population mortality table. If the annuity purchaser faced mortality rates corresponding to the typical annuity buyer, then the EPDV of payouts rises to $97,000 (with the Treasury yield curve) or $88,100 (with the corporate yield curve). Corresponding money's worth ratios for women are 0.872 or 0.792 with the population mortality rates, and 0.952 and 0.858, respectively, with annuitant tables.

Table 2 shows that there has been a small rise in money's worth of individual annuities over the 1995–99 period when we compute EPDV using the Treasury yield curve. There is virtually no change in the money's worth ratio, however, when we use the corporate yield curve for valuation. This reflects a slight widening of the yield spread between Tresury and corporate bonds over the period in question, particularly from 1998 to 1999. These findings are consistent with insurance companies pricing annuity products using risky interest rates.

Real Annuity Offerings in the United States: What Are the Options?

Our discussion of annuity products thus far has focused on nominal annuities. One disadvantage of this type of annuity is that it exposes buyers to the risk of unexpected inflation, which can cut the real value of their benefits and leave them late in retirement with a substantially lower than expected standard of living. In other nations, notably the United Kingdom, there is a well developed market for annuities that offer inflation-indexed payout. In the United States, even though inflation-indexed Treasury bonds have been available since 1997, there is still virtually no market for inflation-indexed annuities. We now summarize the types of inflation-indexed annuity products that are available in the United States, drawing on Brown, Mitchell, and Poterba (2000).

To date we have identified only two annuity products in the U.S. that offer substantial inflation protection to retirees. The first is the "Freedom CPI Indexed Income Annuity," offered by the Irish Life Company of North America (ILONA), and the second is the "Inflation Linked Bond Account" annuity, offered by TIAA-CREF. It is possible that other inflation-indexed products will become available in the future, as insurers adapt to the availability of inflation-indexed Treasury bonds. If inflation should become a more substantial concern with consumers, that could also stimulate the development of inflation-indexed products.

The ILONA Real Annuity

Index-linked annuities in the United States are offered by Irish Life PLC, an international insurance firm headquartered in Dublin, Ireland, through the Interstate Assurance Company. Interstate Assurance is a division of Irish

TABLE 3. Monthly Payout and Money's Worth of Nominal and Inflation Indexed Annuities Offered by Irish Life of North America to 65-Year-Olds

	Monthly Annuity Payment	*Money's Worth*	
		Population Mortality	*Annuitant Mortality*
Men			
Nominal	$781.79	0.892	1.013
Inflation Indexed	548.42	0.749	0.871
Women			
Nominal	708.57	0.904	0.989
Inflation Indexed	475.21	0.741	0.824

Source: Authors' tabulations as described in the text. Payouts are for a $100,000 initial premium.

Life of North America ((ILONA), a well-rated insurance company. ILONA's real annuity product is the "Freedom CPI Indexed Income Annuity." The annuity payout for this product rises annually in step with the increase in the prior year's CPI. Annuity benefits from the Freedom CPI Indexed Income Annuity cannot decline in nominal terms, even if the CPI were to fall from year to year. The minimum (maximum) purchase requirement for the ILONA annuity product is $10,000 ($1 million). The ILONA real annuity can be purchased as a simple life annuity, as well as with a "years certain" provision, and it can be purchased by an individual or as a joint and survivor product. Though the "Freedom CPI Indexed Income Annuity" has been offered by ILONA for two years, as of this writing there have been no buyers for this product. We are not sure what accounts for the lack of market interest in this product, or more generally for the apparent lack of interest on the part of retired households in purchasing assets that offer inflation protection.

In Table 3 we report the monthly payout and the money's worth values for both nominal annuities and inflation-indexed annuities offered by ILONA in April 2000. The payouts on the ILONA inflation-linked annuity are 30 (33) percent below those on nominal annuities for men (women). In valuing inflation-indexed annuities, we used data on the term structure of yields on Treasury Inflation Protection Securities to discount future cash flows. As in the calculations reported above, we focus on pretax EPDV calculations.

For the *nominal* annuities offered by ILONA, we found money's worth values of approximately 0.89 for men, and 0.90 for women. These calculations use the population mortality table for individuals turning 65 in 2000. Using the annuitant mortality table for nominal ILONA annuities yields a larger value, approximately 1.01 for men and 0.99 for women. For inflation-

linked ILONA annuities, however, we found much smaller values. For example, with population mortality tables, the value was 0.75 for men and 0.74 for women. One way to interpret these results is to say that purchasing inflation protection adds more than 15 percent to the cost of an annuity policy. The low demand for the ILONA real annuity may reflect the substantial charge that the insurer levies for providing inflation protection.

Annuities Linked to the CREF Index-Linked Bond Account

In May of 1997, the College Equities Retirement Fund (CREF) launched a new investment account, the CREF Inflation-Linked Bond Account (ILBA). This new fund was intended to appeal to those saving for retirement as well as to retirees in the retirement decumulation phase. The fund holds a portfolio that consists primarily of inflation-indexed bonds, although it may also hold other inflation-indexed securities. Foreign inflation-indexed bonds cannot account for more than 25 percent of the portfolio. Expenses total 31 basis points annually, lower than many mutual and pension fund expense levels but comparable to other, more actively managed CREF accounts. The ILBA has no sales, surrender, or premium charges. The ILBA has grown slowly since its inception, and it is currently the smallest of the retirement funds offered by TIAA-CREF. Active participants, rather than retirees, apparently account for most of the funds in the ILBA. This means that the fund is not used primarily to provide inflation-protected retirement annuities, at least at present.

Annuitants intending to use the ILBA to provide an inflation-indexed annuity would purchase a variable annuity, with the payout variation linked to the performance of the ILBA. Although this financial product offers some inflation protection, its protection is incomplete. This is because the ILBA is marked to market daily, meaning that asset values fluctuate and the account could lose money. This might occur if real interest rates rose, or if there were changes in the definition of the Consumer Price Index. The mark-to-market feature means that the payouts on a variable annuity that is linked to the ILBA *do not* offer a guaranteed real payout stream to prospective annuitants. Another factor that may result in incomplete inflation protection arises from the way mortality experience of the annuitant pool affects subsequent payouts. TIAA-CREF annuities place mortality risk for the annuity pool on the set of participants in the pool, so if there were a substantial and unforecast change in the mortality experience of the annuitant pool, this would affect payouts.

Fundamental design features of CREF variable annuities backed by the ILBA raise the possibility that purchasers of such annuities might fail to keep pace with inflation. Any variable annuity is defined by an initial payout amount, which we shall denote A(O), and an "updating rule" that relates

the annuity payout in future periods to the previous payout and the intervening returns on the portfolio that backs the variable annuity. To determine A(O), the initial nominal payout per dollar of annuity purchase on a single-life variable annuity without any guarantee period, the insurance company solves an equation like

$$1 = \sum_{j=1}^{T} \frac{A(0) * P_j}{(1 + R)^j} , \tag{3}$$

where R is the variable annuity's assumed interest rate (AIR) and T is the maximum potential lifespan of the annuitant. To determine annuity payouts in subsequent periods, the insurer applies an updating rule related to the return on the return on the assets that back the annuity (z_t). This updating rule is

$$A(t + 1) = A(t) * \frac{1 + z_t}{1 + R} . \tag{4}$$

The AIR is a key design parameter for a variable annuity. Assuming a high value enables an insurance company to offer a large initial premium, but, for any underlying portfolio, the stream of future payouts will be more likely to decline as the assumed value rises. Equation (4) clearly indicates that an individual who purchases a variable annuity will receive payouts that fluctuate with the nominal value of the underlying portfolio.

All CREF variable annuities use an AIR of 4 percent. Thus when the unit value of the investment account underlying the variable annuity rises by less than 4 percent, the nominal payout on the variable annuity declines. When the nominal return on the underlying assets exceeds this rate, the variable annuity payout rises. The assumption of a 4 percent AIR makes it possible for the *nominal* payout on the CREF ILBA variable annuity to decline over time. Consider the experience of 1998, when the total return (after expenses) on the ILBA account was 3.48 percent. Given the AIR of 4 percent, annuities backed by this portfolio had to reduce their nominal payout by 0.52 percent. This reduction in nominal payout took place at a time when the price level was rising, so the CREF ILBA variable annuity did not deliver a constant real payout stream.

In order to avoid the situation that occurred in 1998, it would be necessary for the returns on Treasury Inflation Protection Securities to exceed 4 percent. The CREF variable payout annuity linked to the ILBA would be more likely to deliver a future real payout stream if the Air on this annuity were set equal to the real interest rate on long-term TIPS at the time when the annuity is purchased. In this case, the return on the bond portfolio would typically equal the AIR plus the annual inflation rate, leaving aside some of the other risks of holding indexed bonds.

Equity-Linked Annuity Products

One recent development in the U.S. annuity market is the rise of products known as "equity linked annuities." These products make use of stock-index options to expand the menu of risk/return choices open to investors. As explained by Bodie (1999), index options make it possible to combine downside protection with some upside gain potential tied to the performance of an underlying index portfolio, essentially providing a guaranteed income "floor." In practice, U.S. equity-linked annuities typically invest most of the annuity premium in a traditional fixed nominal annuity and the remainder in a portfolio of options on stock market indices. A common division is to place 90 percent of the assets in a fixed annuity, and to invest 10 percent in call options on the S&P 500 index. By splitting the investment this way, an annuity buyer will never receive less than the payouts from a fixed annuity that he could have purchased with 90 percent of the initial premium. If the equity market rises enough that the index exceeds the exercise price on the option, then the call option is "in the money," and thus provides additional resources to increase future annuity payments.

Bodie (1999) offers a useful illustration of this approach for an individual with $1 million who is assumed to live another 20 years. With a risk-free interest rate of 3.5 percent, the individual could purchase a real annuity that pays $67,216 per year. If, instead, the individual invested only 90 percent in a real annuity and the other 10 percent in a series of 20 index options of increasing maturity, the minimum amount received would be $60,494. Assuming that the exercise price on the options are set equal to the value of the index at the time the annuity is purchased, and assuming an annualized volatility of the stock index of 0.2, this individual would receive an additional $13,188 for every percentage increase in the index. By increasing the fraction of wealth invested in the call options, one reduces the guaranteed income floor but increases the rate at which the individual participates in the upside potential of the index.

Equity-linked annuities were introduced in 1995. The marketing materials for these products suggest that they provide purchasers with some degree of inflation protection, because their payouts are partly related to stock market returns. (A similar argument could be made for investing in traditional variable annuities with the underlying assets invested in a broad-based portfolio of common stocks.) Whether an equity portfolio really offers an inflation hedge depends on investor's planning horizon. Brown, Mitchell, and Poterba (2001) present evidence showing that the U.S. stock market has historically not provided a good inflation hedge at short horizons. In the long run, however, Boudoukh and Richardson (1993) and others have argued that equities may offer some degree of inflation protection. This debate notwithstanding, it is clear that equity-linked annuity

products do not offer potential annuitants a payout stream guaranteed to retain a constant purchasing power in all future years.

International Evidence on Annuity Products

Our analysis so far has focused on annuity products available in the United States. But there are also annuity markets in other countries, and in some cases these markets are substantially larger than those in the United States. This is particularly true with regard to markets for inflation-protected annuities. In this section we offer a brief overview of recent cross-national evidence on the money's worth of both nominal and inflation-indexed single premium immediate annuities.

Comparisons of annuity market operations across countries pose several challenges. One is that annuity pricing data are often difficult to obtain, though an important effort in this direction was recently undertaken for a World Bank project summarized by James and Vittas (1999). Another problem is that insurers in other countries often lack country-specific mortality tables, and hence they must rely on some adaptation of the U.S. or UK mortality tables. Which they choose will matter, as a glance at Figure 2 confirms. When mortality patterns are not well known, insurers may build in additional reserves to cover eventualities. McCarthy and Mitchell (2001) argue that these additional reserves have the effect of making the annuity streams less valuable to purchasers, because they reduce the money's worth of annuity products.

Finally, computing the money's worth of annuities requires obtaining either a government Treasury yield curve or the relevant corporate yield curve, either of which can be difficult to obtain, particularly in developing economies. It is also not clear whether insurance companies selling annuity products in emerging nations are actually investing a substantial fraction of the assets that back these annuities in the domestic bond market. These operational difficulties in annuity valuation underscore the need for further data collection and refinement in the annuity valuation process.

International Comparisons of the Money's Worth of Nominal Annuities

James and Vittas (1999) present evidence on the money's worth of nominal annuities in five countries. Table 4 reproduces their central results. The table refers to single premium immediate nominal annuities for 65-year old men or women; James and Vittas (1999) provide information for other potential annuitants as well.[2]

The results in Table 4 suggest that money's worth ratios for nominal annuities in the countries surveyed are rather high. All the money's worth values are at least 0.85. Nevertheless, the values frequently exceed 0.90 and

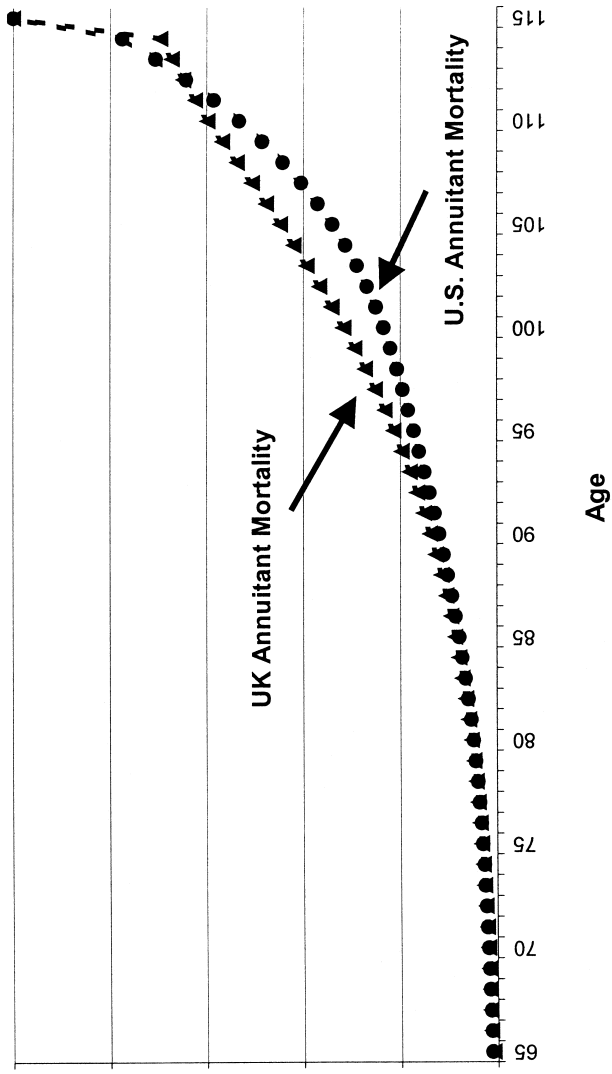

Figure 2. U.S. and UK annuitant mortality. Source: Authors' calculations following MPWB (1999) for U.S. and Finkelstein and Poterba (1999) for UK.

TABLE 4. International Comparisons of Money's Worth Values for Single Premium Nominal Life Annuities Offered to 65-Year-Olds

Annuitant Sex	*Mortality Table*	*Term Structure*	*UK*	*Australia*	*Canada*	*Switzerland*	*Singapore*
Male	Population	Treasury	0.897	0.914	0.925	0.965	NA
Male	Population	Corporate	0.854	0.846	0.869	0.922	NA
Male	Annuitant	Treasury	0.966	0.986	1.014	1.117	1.256
Male	Annuitant	Corporate	0.916	0.906	0.947	1.11	1.073
Female	Population	Treasury	0.910	0.914	0.937	1.029	NA
Female	Population	Corporate	0.860	0.846	0.874	0.974	NA
Female	Annuitant	Treasury	0.957	0.970	1.015	1.115	NA
Female	Annuitant	Corporate	0.901	0.906	0.941	1.083	1.058

Source: James and Vittas (1999).

sometimes are greater than 1.0 for computations involving annuitant mortality tables (particularly with the lower Treasury discount rates). This latter finding is surprising since it implies that purchasers receive more, in an expected value sense, than the premium they pay for the product. We are skeptical of results that suggest money's worth values of more than unity, and we suspect that insurers offering these annuities do not price using Treasury rates, or that the annuitant mortality tables that are used to calculate the EPDV of annuity payouts are not the ones used by insurance companies selling these products. While further work is clearly needed, the key findings also indicate that annuity offerings elsewhere are not inferior to offerings in the United States, at least when measured by money's worth ratios.

International Comparisons of Inflation-Indexed Annuity Products

Inflation-indexed annuity products are offered in several countries, including the United Kingdom, Australia, Israel, Mexico, and Chile. Information about these annuities is even more difficult to obtain, however, than data on nominal annuities. Table 5 summarizes the available information for the UK, Chile, and Israel, focusing on inflation-indexed products for 65-year old men and women.

Overall, the money's worth values for the real annuity products appear lower than for the nominal products, a pattern consistent with our findings for the United States and with the results in Finkelstein and Poterba (1999) and Murthi, Orszag, and Orszag (1999) for the United Kingdom. However the gap between real and nominal annuities is smaller in countries other than the United States. This is particularly evident in the U.K., where real annuities have been sold for many years. The difference in money's worth values for real and nominal annuities in this case is only on the order of 5

TABLE 5. International Comparisons of Money's Worth Values for Single Premium Inflation-Indexed Life Annuities Offered to 65-Year-Olds

Annuitant Sex	*Mortality Table*	*Term Structure*	*UK*	*Chile*	*Israel*
Male	Population	Treasury	0.801	0.868	0.799
Male	Population	Corporate	0.756	0.802	0.742
Male	Annuitant	Treasury	0.878	0.939	0.921
Male	Annuitant	Corporate	0.823	0.863	0.847
Female	Population	Treasury	0.798	0.866	0.760
Female	Population	Corporate	0.745	0.788	0.703
Female	Annuitant	Treasury	0.850	0.947	0.911
Female	Annuitant	Corporate	0.791	0.859	0.83

Source: James and Vittas (1999).

percent. Why there is such limited demand for real annuities in the United States, and why the available inflation-linked products are priced so unfavorably relative to nominal products, remains an open issue for further study.

Conclusions and Discussion

Our analysis of annuity markets in the United States and our review of evidence on annuity markets in other nations suggests several broad conclusions. First, the present discounted value of annuity payouts typically falls below the cost of these products by between 10 and 20 percent for a randomly selected person in the population. For typical annuity buyers, however, the expected present value of the payouts is much closer to the purchase price of the annuity. Differences in prospective mortality experience between typical annuity buyers and individuals in the population at large, what we call "adverse selection," therefore may explain a substantial share of the effective cost of an annuity for a randomly selected individual.

Second, the money's worth of nominal annuities exceeds the money's worth of inflation-indexed annuities both in the United States, where only one "inflation-indexed" annuity product has been brought to market thus far, and in other countries, where there are more active markets for real annuities. This is true even though insurance companies may have access to bond markets in which they can purchase inflation-indexed government securities. The gap in money's worth values is smaller in the more established markets.

Third, the operation of annuity markets in the United States does not appear to differ in significant ways from the operation of annuity markets in other nations, at least given current evidence. Money's worth values for nominal annuities offered in a range of different nations are remarkably

similar. This conclusion must be qualified, however, by the recognition that past studies have made strong assumptions to obtain the necessary mortality data and interest rate data for annuity valuation in countries other than the United States and the United Kingdom.

The research presented here raises a number of issues for further study. One is why consumers do not place greater value on inflation-indexed annuity products, and why the demand for these products is not greater than it currently appears to be, particularly in the United States. It is possible that investors do not understand the meaning of, and the substantial value of, inflation protection. Another possibility is that inflation-protected securities, bonds as well as annuities, are still novel products, and it will take time for these products to attract a substantial following among the investing public.

A second issue requiring further study concerns the relationship between planned and actual annuitization on the part of households with significant retirement resources. Surveys of households that are still several years away from retirement suggest that many people plan to annuitize a part of their financial portfolio at retirement. Whether these households' plans are borne out remains to be seen, and this will play a critical role in affecting the future size of the annuity market. If there are fixed costs of operating an annuity market, then it is possible that the effective cost of annuities for prospective buyers will decline as the size of the potential market expands.

A third important issue concerns group annuities. Limits on data availability led us to concentrate on individually purchased annuities for this research, yet little is currently known about the market for group annuities. It may be that in the future, employers will negotiate arrangements with annuity providers that will permit their employees to annuitize their retirement resources in a group setting. This may reduce the evident disparities between the mortality experience of the annuitant pool and of the population at large.

Notes

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1. McGill et al. (1996) summarize the regulations that govern qualified plans. Brown, Mitchell, Poterba, and Warshawsky (1999) analyze the tax treatment of distributions from qualified and nonqualified plans.

2. There are important institutional details that affect the analysis of each country's annuity market. For example, in the United Kingdom, the information in Table

4 refers only to the "voluntary" annuity market. As Finkelstein and Poterba (1999) explain, there is also an active "compulsory" annuity market in the UK, where individuals who have accumulated assets in a set of tax-favored self-directed retirement plans are required to annuitize a share of their assets.

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